Chapter 4

THE CONVENTIONAL EFFICIENCY ANALYSIS

4.1 Overview

The Conventional Efficiency Analysis (expanded by Gittinger 1982) provides a basic framework for the efficiency analysis of projects. It focuses on the maximisation of income through the efficient allocation of resources. To be precise, the Gittinger approach is defined in terms of the total real consumption of goods and services in the economy, rather than of income, since the economic welfare of the people is related to their level of consumption per se. A project investment reduces the goods and services available for current consumption, but increases the levels of consumption possible in the future. Projects also change the relative consumption levels of various individuals in the economy, both at a point of time and over time. In order to judge the worthwhileness of a project from the national point of view, it is necessary to aggregate the various gains and losses accruing to different individuals over different periods into a single gain or loss measure. For this, some rules or conventions need to be choosen to define how the different gains or losses can be compared.

The practice of the method has been to regard all gains and losses accruing at a point in time to be equivalent regardless of whether they affect the rich or poor. The practice does however, treat the gains or losses accruing in different periods differently; future losses and gains being discounted to make them comparable to changes in consumption during the current period. Once aggregate consumption is defined in this way, benefit-cost analysis can proceed to measure the project's net impact on total consumption over time (Ray and Van der Tak 1979).

Apart from the profitability of the project from the viewpoint of society, it is highly important to consider the profitability of the farms associated with the irrigation projects, because even if an irrigation project is found profitable from the viewpoint of the society, there is little chance of farmers participating in the project if they do not derive benefit out of the project. A farm level study is, therefore, inevitably important for two purposes : (a) to ascertain whether farmer's interests coincide with those of the society; and (b) if the answer is negative, to bring about change in agricultural policy at the level of the area to be irrigated which will ensure compatibility between society's aims and those of the probable beneficiaries (Bergmann and Boussars 1976; Gittinger 1982, p.244).

4.2 Application Procedure

For convenience of exposition, the application procedure of the Coventional Efficiency Analysis method (Gittinger 1982) may be divided into sections described briefly as below :

4.2.1 The Numeraire

In financial analysis, the common yardstick of account is the real income change of the entity being analysed and valued in domestic market prices and expressed in domestic currency. In economic analysis, since the market prices do not always reflect the scarcity values, the numeraire is the real net national income change valued in opportunity cost terms and expressed in domestic currency (Gittinger 1982, p.244).

4.2.2 Premium on foreign exchange and standard coversion factor

The official exchange rate (OER) in many countries does not reflect the true value of their currency in relation to other currencies due to Government interference. Thus financial accounts of a project need adjustment to reflect economic values of costs and benefits which involve determining the proper premium on foreign exchange. Gittinger (1982, p.248) suggested two ways of incorporating the premium on foreign exchange into economic analysis. The first is to multiply the official exchange rate by the foreign exchange premium. The shadow exchange rate is than used to convert the foreign exchange price of traded items into domestic currency. The alternative way is to reduce the domestic currency value for non-traded items sufficient to reflect the premium which is some time called 'conversion factor'. Gittinger suggested the use a single conversion factor - the 'standard conversion factor' (Squire and Van der Tak 1975) to capture the foreign exchange premiun problem which can be shown by the following equations :

[4.1] $$OER \times (1 + FXP) = SER$$

[4.2] $$1 / (1 + FXP) = SCF$$

From the equations [4.1] and [4.2],

[4.3] $$SCF = OER / SER$$

Where,

OER = Official Exchange Rate
FXP = Foreign Exchange Premium
SER = Shadow Exchange Rate
SCF = Standard Conversion Factor

4.2.3 Identification of costs and benefits

Costs and benefits of agricultural/ irrigation projects involve both with and without project situations. Capital, labour, land taxes, subsidies etc. comprise costs. Some elements such as taxes and subsidies etc. represent costs or benefits according to the type of anlysis being undertaken. For example, taxes are treated as costs in the financial anlysis ,i.e. they have to be added to the cost stream but they are considered as benefits in economic analysis, because those are paid to the Government and therefore, represent social income, since the Government uses the income for the benefit of the society. Similarly, it is argued that subsidies on farm inputs are a social cost.

Benefits may be direct, secondary or intangible. Direct benefits are those resulting directly from the project and take the form of either an increased value of production or reduced costs. Salvage value of capital items also represent benefits and are taken into account in the profitability analysis.

4.2.4 Determination of proper values

Once the cost and benefit items are identified , the next step is to give each a money value of the inputs and outputs at market prices to undertake the financial analysis. Financial prices are then adjusted to reflect the true social values of the goods and services in which market prices are distorted; otherwise market prices are used in the economic analysis. When the market price of any good or service is adjusted to make it more closely represent the true social cost or benefit, the new value assigned becomes a 'shadow price'. Specific areas in which shadow prices are used are traded goods, labour, capital, and foreign exchange (Gittinger 1982, p.251-2). Three steps have been proposed for adjusting financial prices to economic values for economic appraisal of projects -

Step 1 : Adjustment for direct transfer payments :

The first step of adjustment is to eliminate direct transfer payments. In agricultural projects the most common transfer payments are taxes, subsidy and credit transactions that include loan receipts, repayment of principal and interest repayments.

Step 2 : Adjustment for price distortion in traded items :

For traded items, valuation begins by determining the 'boarder price'. For imports, this will normally be the CIF price and for exports it is the FOB price. The boarder price is then adjusted to allow domestic transport and marketing costs between the port of import or export and the project site to obtain economic import or export parity value which is used in economic appraisal.

Step 3 : Adjustment for price distortion in non-traded items :

In general, non-traded items are produced under relatively competitive conditions. They are produced either by many farmers or by a few industrial producers operating near full capacity level. In a perfectly competitive market, the opportunity cost of an item would be its price. This price would also be equal to the marginal value product of the item. If a non-traded item is brought and sold in a relatively competitive market, the market price is the measure of willingness to pay and is generally the best estimate of opportunity cost. If that is so, the general rule is to accept market prices directly as the estimate of the economic value of non-traded items. When the conversion factor approach is used to allow for foreign exchange premium, all prices of non-traded items are to be reduced by multiplying them by the appropriate conversion factor to obtain economic values. If the standard conversion factor is used, the market price must be adjusted to obtain better estimates of opportunity cost and be multiplied by the standard conversion factor to obtain economic values.

A decision tree for determining economic values from financial prices is presented in Table 4.1 .

4.2.5 The economic value of land

Gittinger (1982 p.256) stated that " the opportunity cost of land is the net value of production forgone when the use of land is changed from its without project use to its with project use". Gittinger discussed a number of ways to value land used in a project. He suggests taking the gross value of land's output at market price and deduct from that all the costs of production including allowances for hired and family labour and the interest on capital engaged to use the land in the project. The residual value represents the opportunity cost of land in financial term. The economic value is derived for each of the input and output entries as described in Section 4.2.4 .

4.2.6 The economic value of labour

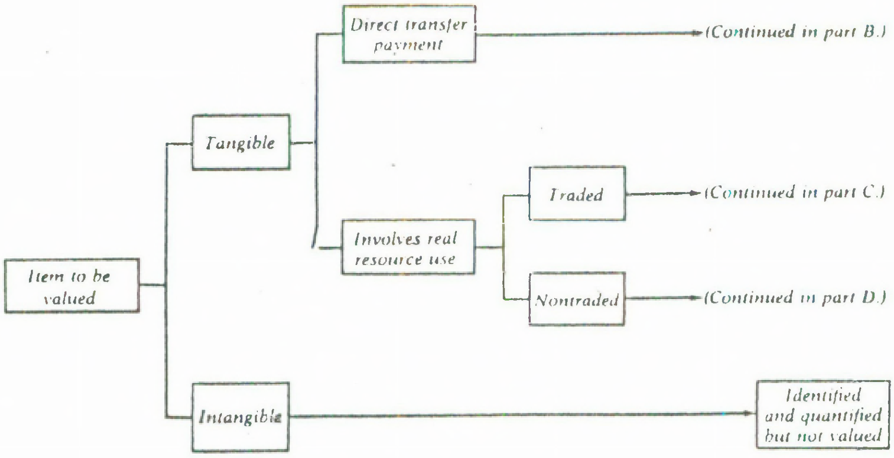
The market for skilled labour, both in developed and developing countries, is considered to be in short supply and fully employed , even if no project is undertaken. Therefore, the wages paid to skilled labour represent the true marginal value product of the workers and hence the market value reflects the opportunity cost of skilled labour, and can be used in the economic appraisal.

In a labour abundant economy, the market wages to rural unskilled labourers during the peak seasons at planting and harvesting is considered to be a good estimate of its oppotunity cost and represents the economic value of such labourers. The marginal value product of

Table 4.1

Decision Tree for Determining Economic Values

Part A: Major Steps



Part B: Direct Transfer Payments

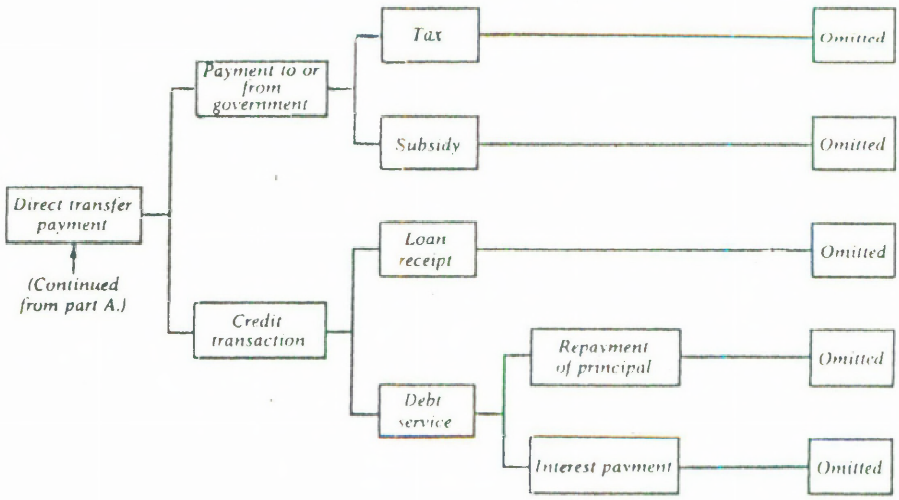
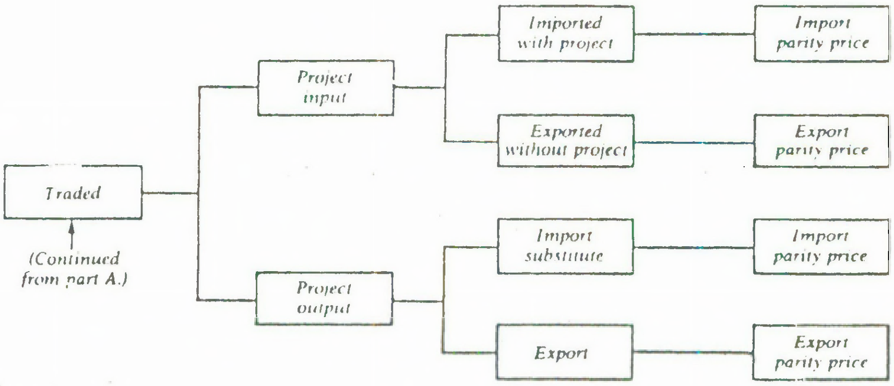
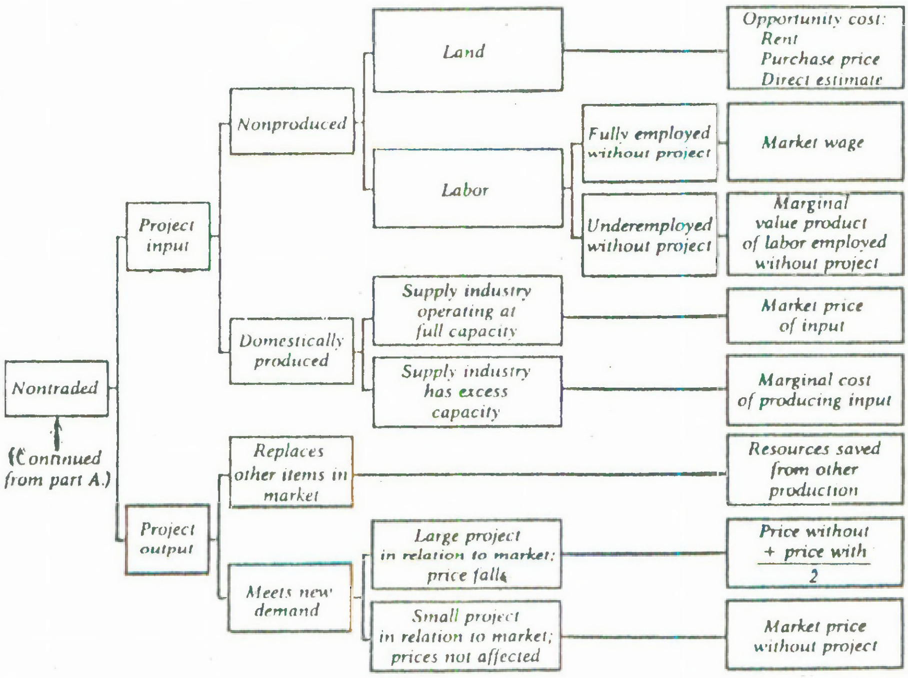


Table 4.1 (Cont'd)

Part C: Traded Items



Part D: Nontraded Items



Source: Gittinger, J.P. (1982), Economic Analysis of Agricultural Projects, Johns Hopkins, Baltimore, p.282-283 .

unskilled labourers in the off-peak season is assumed to be zero or very close to zero. Computationally it is suggested that a zero marginal value product might be used in such cases in the economic analysis.

4.2.7 Discount rate

The social rate of discount is the rate at which society as a whole is willing to trade-off present for future costs and benefits. The idea is that the value of $1 in any future period is not worth the same as the value of $1 to-day; that the future $1 has a lower value than to-day's $1. Therefore, future costs and benefits are to be discounted at a rate which is positive and greater than one. Two reasons are assigned to the proposition that the social time preference rate is positive and greater than one :

(a) society simply prefers present benefit to future benefit i.e., society is 'myopic' ; and

(b) future generations are likely to have higher levels of consumption, because of economic growth. If the principle of diminishing utility operates, then the utility gain in consumption will be less than the utility gain to the present generation from the same gain in consumption. So the future gains are less valuable compared to the same level of present gain and hence, future gain should be discouted.

The choice of an appropriate discount rate is important in view of the fact that the result of benefit-cost analysis is quite sensitive to the discount rate. The lower the discount rate, the more weight is given to future gains in consumption relative to sacrifices in current consumption resulting in greater emphasis to savings and growth. A project which shows a positive net present value at a lower discount rate may estimate a negative net present value at a higher discount rate. Since the capital market is imperfect and private profitability does not reflect social profitability, it is not desirable simply to use the market rate of interest to discount future gains or losses.

Economic theory offers two alternative bases for selecting the social rate of discount :

(a) the social rate of time preference ; and

(b) the social opportunity cost of capital.

The social time preference is the society's subjective valuation of consumption at different points of time. The social time preference rate is the rate at which present consumption is sacrified for future consumption and vice-versa. The concept suggests that the discount rate should reflect society's desire to provide for the future. An appropriate measure of the social time preference rate is the rate of return on risk-free long-term Government bonds. However, only a portion of society buys these bonds. So, the rate of return on those bonds can be treated as the minimum rate of social time preference.

The social opportunity cost is the rate of return that capital, used in a public project, could have otherwise earned in private investment. According to this concept, the social rate of discount should be the rate of return on displaced private investment, since the opportunity cost of capital derives from both public and private investments gives the same weight to future returns.

The two concepts do not lead to the same rate of discount. It is argued that the society has a long time horizon, so its discount rate should be lower. The social time preference rate is normally below that of the social opportunity cost of capital. Therefore, the social time preference rate can be regarded as the lower limit and the social opportunity cost of capital as the upper limit for discounting purpose. However, the two rates may be used for the appraisal of public projects (Gittinger 1982).

4.2.8 Decision criteria

In order to determine the economic profitability and social desirsbility of a development project, the costs and benefits over the entire life of the project are to be discounted at the appropriate discount rate. Many criteria have been suggested in evaluating alternative investment proposals. Among those, net present value (NPV), benefit-cost ratio (B/C) and internal rate of return (IRR) are the most common criteria used in project analysis.

Net present value is the difference between the discounted value of the benefits less discounted costs of a project at a given discount rate. This can be expressed by the following mathematical formula :

[4.4] $$NPV = \sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} .$$

where,

B_t = benefit in year t

C_t = cost in year t

t = 1,2,.......,n year

i = interest (discount) rate.

Benefit-cost ratio represents the ratio of a value of the total discounted benefits divided by the total discounted costs at a given discounted rate. this can be expressed with the following formula :

[4.5] $$B/C \text{ ratio} = \frac{\sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{t=n} \frac{C_t}{(1+i)^t}} .$$

where,

B_t = benefit in year t

C_t= cost in year t

$t = 1,2,\ldots\ldots,n$ year
i = interest (discount) rate.

Internal rate of return is the rate of interest which equates the discounted benefits to the discounted costs over the whole span of project life. This can be shown mathematically as follows :

[4.6] $$\sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} = 0.$$

where,
B_t = benefit in year t
C_t = cost in year t
i = interest (discount) rate
$t = 1,2,\ldots\ldots,n$ year.

Since each of the criteria is of a different form, they clearly maximise different objective functions. IRR measures the compound rate of growth of returns over cost. If the social objective is to maximise the growth rate, then IRR is the appropriate criterion. If the maximand is net benefits and society is concerned explicitly with their flow over time, then NPV is the right criterion. In case of a capital constraint, and also when the net benefit is the maximand, the B/C ratio is appropriate. It is strongly suggested that one should not use a single criterion in appraising a project. Two criteria might be used either (a) NPV and IRR or (b) B/C ratio and IRR. However, the correct criterion is the NPV if capital is competitively available or B/C ratio if capital is constraint. Table 4.2 presents a comparison of discounted measures of project worth.

Table 4.2

Comparison of Discounted Measures of Project Worth

Item	*Net present worth (NPW)*	*Internal rate of return (IRR)*	*Benefit-cost (B/C) ratio*	*Net benefit-investment (N/K) ratio*
Selection criterion	Accept all independent projects with NPW of zero or greater when discounted at opportunity cost of capital (see "Mutually exclusive alternatives," below)	Accept all independent projects with IRR equal to or greater than opportunity cost of capital	Accept all independent projects with B/C ratio of 1 or greater when discounted at opportunity cost of capital	Accept all independent projects with N/K ratio of 1 or greater when discounted at opportunity cost of capital in order of ratio value until available investment funds are exhausted
Ranking	Gives no ranking for order of implementation	May give incorrect ranking among independent projects	May give incorrect ranking among independent projects	May be used to rank independent projects
Mutually exclusive alternatives	Accept alternative with largest NPW when discounted at opportunity cost of capital (NPW is the preferred selection criterion for mutually exclusive alternatives)	Cannot be used directly; must discount differences between incremental net benefit flows of mutually exclusive alternative projects	Cannot be used directly	Cannot be used directly
Discount rate	Must determine a suitable discount rate, generally the opportunity cost of capital	Determined internally; must determine opportunity cost of capital to use as a cut-off rate	Must determine a suitable discount rate, generally the opportunity cost of capital	Must determine a suitable discount rate, generally the opportunity cost of capital

Source: Adopted from Gittinger, J.P. (1982), Economic Analysis of Agricultural Projects, Johns Hopkins, Baltimore, p.360 .

4.2.9 Intangible benefits and costs

The methodology outlined by Gittinger (1982) is appropriate for considering only tangible or direct costs and benefits. A range of socio-economic considerations involving non-tangible factors, such as income distribution, employment generation, national integrity or security, effects on environment etc., may arise in the context of designing projects. Gittinger suggested that intangible costs and benefits should be noted for consideration of decision makers. When intangible costs and benefits of projects such as education, health, nutrition, electricity etc. are important , one might use some other methods like 'least cost combination' or 'cost effectiveness' method to any extent to deal with intangible benefits and costs in project appraisal.

4.3 Sensitivity Analysis

Risk and uncertainty are inherent in an ex-ante evaluation of agricultural projects. In project analysis one tries to incorporate the best estimates of future costs and benefits associated with development projects. It is very likely that actual values may differ from the used estimates for various reasons. For example, it is impossible to forcast the scale of uncertainty and probable fluctuations in future yields or prices with complete accuracy. Therefore, sensitivity analysis is used to assess the effects on the profitability of a project with variations in certain key parameters. Gittinger suggested that agricultural projects are sensitive to changes in four principal areas : prices, yield, cost overrun, and delay in implementation. One major source of uncertainty in irrigation projects relates to the actual supply of water for irrigation. Sensitivity analysis is usually conducted by calculating the measure of the project's worth over and again using the new estimates to see what happens under the changed circumstances. Therefore, in deciding on a level of sensitivity analysis, the analyst must consider the demands of the decision maker, the necessary trade-off among the dollars spent on the various tasks and how each task contributes to over all benefit-cost analysis.

Chapter 5

ESTIMATION OF INCREMENTAL BENEFITS OF IRRIGATION PROPOSAL

5.1 Background to the Analysis

5.1.1 Period of economic analysis

Although the physical and economic life of a dam may well exceed 100 years, any benefit accruing after 50 years or more will have practically no, or very negligible, present value unless a very low doscount rate is used. Therefore, this study has taken into account 50 years of economic life of the project. The project life includes a five year period of construction of the dam beginning from 1983/84.

5.1.2 Commodity yields and prices ; Present and future

Costs and benefits are calculated on the basis of 1983/84 yields and prices unless otherwise indicated.

5.1.3 Costs and benefits identification

It has been mentioned earlier that this study concentrates on the direct benefits of the agricultural aspects concerned with the construction of the dam. Keeping this in mind costs and benefits of the project are identified as follows :

Costs and Benefits to the Individual Farmer

The individual farmer's net benefit (NFB) from the dam is the gross farm income less the sum of all costs associated with the replacement of dryland farming by irrigation practice, which is shown by the following equation :

[5.1] $$NFB = B_{p1} - (C_{p1} + C_{p2} + C_{p3} + C_{p4})$$

where,

B_{p1} = Gross benefit from irrigated production accrued to a farm by using irrigation water supply from regulated stream flow;

C_{p1} = Cost incurred by the farm in developing irrigation infra-structure and pumping equipment;

C_{p2} = Variable cost incurred in in irrigated production of the farm;

C_{p3} = Operating overhead costs (fixed costs) incurred by the farm; and

C_{p4} = Oppotunity cost of land which would be used in dryland production in absence of irrigation facility.

Social Costs and Benefits

Apart from the costs and benefits associated with the farm level analysis as mentioned above, the following costs and benefits are included in the analysis from the society's viewpoint :

C_{g1} = Capital cost incurred by the Water Resources Commission for construction of the dam.

C_{g2} = Proposed expenditure to be met for maintenance and operation of the dam.

C_{g3} = Opportunity cost of acquired lands which would otherwise be used for dryland farming if no dam was built.

B_{g1} = Water charges accrued as benefit to the society, included as a cost to the farmer in C_{p2}

Therefore, the net social benefit from the dam is the algebric sum of all the benefits minus sum of all the costs, which is shown by the equation [5.2].

[5.2]

$$NSB = B_{p1} + B_{g1} - [(C_{p1} + C_{p2} + C_{p3} + C_{p4}) + (C_{g1} + C_{g2} + C_{g3})]$$

Social profitability analysis has been conducted by deriving proper economic values of the cost and benefit items as identified in equation [5.2] so as to reflect the true social costs and benefits associated with the project.

5.1.4 Choice of discount rate

The choice of appropriate discount rate is important in view of the fact that the result of benefit-cost analysis is quite sensitive to the discount rate. It has already been discussed in Chapter 3 that the lower the discount rate, the more weight is given to future gains in consumption relative to sacrifice in current consumption and hence, greater importance is given to savings. Consider for example, two projects X and Y with equal costs and benefits and a similar economic life. Project X earns most benefits during the early part of its life, while project Y derives benefits during the latter part. Project X will have a higher benefit-cost ratio at a high discount rate compared to a lower ratio at a lower discount rate, while the position of project Y will be the reverse. Therefore, the discount rate plays an important role in project selection based on monetary considerations.

There is much literature available on the discount rate issue. Experts disagree on both the proper numerical value of discount rates and their conceptual foundation. Some argue in favour of the adoption of the social rate of time preference as the conceptual basis for selecting a discount rate, concomitantly a rate below the market rate of interest , while others advocate the use of the social opportunity cost of capital and correspondingly a higher discount rate.

In Australia, there has been a strong advocacy of favouring the opportunity cost of investment approach to select the rate of discount. Clare (1982), Johnston et al. (1984), Swan (1983) and the Australian Treasury (1981) are the proponents of this approach. The Australian Treasury (1981, p.41) stated, "There is no simple method of determining the adequacy of the rate of the return earned on funds employed ...., whether the value placed on the capital by the authorities reflects its opportunity cost to society. Precise judgement here would require knowledge of the rates of return sought by authorities on new investment and the rate of return available from alternative private investment opprtunities. Such information is not available on a systematic basis, but discount rates around 10 per cent in real terms (pre-tax) appear to be relatively common in private sector investments analysis". An important reason for recommending the opportunity cost approach appears to be the public concern that Government may invest in many uneconomic projects at the cost of private sector if a lower discount rate is used in selecting projects. Clare (1982, p.1) opined that the opportunity cost approach should be taken as a necessary condition for the efficient use of resources. Johnston et al. (1984, p.7) commented, "It will generally not be open to a public authority to invest in the stock market as an alternative to investing in a new piece of equipment but the comparison is relevant if it is considered from the perspective of the community making decisions on the level of resources that are to be devoted to public and private sector activities".

Conversely, Marglin (1972), Bradford (1975) and Mishan (1982) argued that a synthesis approach should be adopted for evaluating public sector projects. An important premise of this approach is that all consumption flows should be discounted using the social time preferance rate and all costs and benefits following from a project should be evaluated in terms of consumption equivalent. Although the principle underlying the synthesis approach to discounting is clear, the information required to implement the approach is too great. Perry and Duhs (1979) have strongly advocated the use of the synthesis approach in selecting the discount rate for Australian projects and estimated some of the key parameters required in the formulae in regard to its practical use. Baumol (1968) and Mishan (1967) argued that in the interest of economic efficiency, the relevant discount rate is the marginal rate of return obtainable in the public sector.

When the Coombs Task Force (1973) reported on expenditure policies of the Commonwealth Government, it referred to a special paper issued in 1966 on Investment Analysis' and observed some inconsistency in the application of benefit-cost analysis in public investments. The important point of inconsistency was the use of different discount rates by the different government departments and other statutory bodies; and lack of coordination among them in this respect. The Australian Treasury (1981) , based on the opportunity cost of capital approach, recommended that an appropriate real rate of discount for all public sector projects was 10 per cent per annum with rates of 7 and 13 per cent to be used for sensitivity analysis. Musgrave (1974, p.7) stated, "All agencies engaged in benefit-cost analysis should use the same set of procedures which should be drawn up by an agency independent of construction or sectional interests". In the light of the above discussion, a real rate of discount of 10 per cent, as recommended by the Treasury, is adopted for this study. Further, other discount rates of 7 and 13 per cent are used for sensitivity analysis.

5.1.5 Data sources

To estimate the incremental net benefit at the farm level, as well as from the society's point of view, data of secondary origin have been used. The principal data sources are the Water Resources Commission, the N.S.W. Departmrnt of Agriculture, the Bureau of Agricultural Economics, the Australian Bureau of Stastistics. Besides, data from other published sources such as Complan (1984), Farm budget handbook (Bryant 1984) etc. have also been used in the study.

5.2 Estimation of Financial Returns to Individual Farmer

5.2.1 Introduction

It has been mentioned earlier that the N.S.W Government is considering various options as to how the available water will be allocated among different potential users. The present study is based on the option that all available water from Split Rock dam will be provided for bringing new areas under irrigation. Bryant, Buffier and Verdich (1984, p.3) found that the incremental net benefit to society would be greater if new land be brought under irrigation with the available water supply from the Split Rock dam rather than other options now under consideration. They observed that the allocation of irrigation water to users other than new irrigators might not be in the best interest of the state or the nation. Socio-economic criteria also suggest that the benefits of the dam should be spread over a large number of farms rather to allocate a part or whole of the available water to existing irrigators.

Farm investment analysis has been undertaken to determine the attractiveness of the proposed investment in regard to the potential farms and other participants of the project including society. It projects the effects on farm income of a particular investment and estimate returns to capital engaged (Brown 1979 ; Gittinger 1982). In estimating costs and returns, the direct and primary effects on the irrigation proposal are considered. The primary costs and benefits in this case are defined as in Section 5.1.3 as those costs and benefits immediately related to the agricultural aspects of the project. The secondary effects of the proposal have not included in the analysis. Secondary costs and benefits are cosidered in Chapter 6 while discussing the overall results of the analysis.

5.2.2 Initial farm model

The initial farm model is a mixture of actual and theoretical disciplines of farming practices. The existing physical characteristics of the farm model are defined using both the field interview and published data source. The optimal farm income has been derived by determining the optimum set of activities for the farm from a maximum of 243 hectares of land and the optimum allocation of limited water resource ,while the existing land use pattern of the remaining farm land and resources would remain unchanged. The aim in optimising the net increase of income from this partially changed farm activity is to derive a consistent measure of farm income which might be used for comparisons between 'with' and 'without' project situations. The optimum farm income does not necessarily represent income a farmer should achieve, neither is it implied that the partial change in activity, corresponding to optimal income, is to be the recommended activity to the farmers. In practice, there are many factors specific to any individual farmer which determines strategy in farm activity selection besides optimising income, such as reducing risk by diversifying operations etc.. While calculating net income from a partial change in activity , allowance for replacement costs of plant and machinery are made, but no allowance for returns to capital invested, farm family labour and management are made.

The net income to farmers due to a partial change in activity with the availability of irrigation water is estimated from the following assumptions .

1. Water is always a limiting resource. On economic grounds, it is desirable to operate a farm in such a way that it can efficiently use all available irrigation water.

2. With the availablity of irrigation water the present dryland farming would be replaced by irrigation crops as a partial change in activity. In this case, dryland wheat is assumed to be replaced by irrigated cotton.

3. An irrigation licence for a maximum of 972 megalitres will be provided to each participating dryland farmer.

4. A single crop in both without (dryland) and with (irrigated) project situations would be grown. A commonly used rotation of two years of irrigated cotton followed by one year of dryland wheat is adopted so as to maintain soil structure and the productive capacity of land.

5. Technology of irrigated cotton production is known to farmers.

6. Keeping in mind the crop rotation policy and the initial water availability, a total of 243 hectares of dryland is to developed for irrigation practice for each irrigation license in such a way that 162 hectares would be developed in year 5 and 81 hectares in year 7. All irrigation development costs are to be met by the farmers.

7. Irrigation water will be provided on a full development basis to irrigators from year 6. Individual farmers will be asociated with the project from year 5 to undertake irrigation infrastructure development works.

8. Determimistic water supply and yield per hectare in case of irrigated cotton are assumed. The opportunity crop- dryland wheat would be grown with the constant output level through out the project life.

5.2.3 Variations in Initial farm model

Two variations of the initial model are made to estimate net income of the individual farmers incorporating the following assumptions.

Farm model-A

Each licensee would receive a full allocation of water from storage each and every year during the period of analysis irrespective of the level of water in the storage. An average yield of 1235.25 kg of lint cotton per hectare, which has been derived by a simulation study conducted by the Agricultural Research Station, Myall Vale, is used. The simulation model included the effect of rainfall factor on productvity and used farm level production data for the period 1885- 1980 (personal communication, B. Hearn 1985).

Farm model-B

The simulation study conducted by the Water Resources Commission for determining the stochastic supply of irrigation water is used in this model. The simulation model was developed taking into account the stream flow data for the period 1924-1979. From the study it is envisaged that , on average, 804 megalitres of irrigation water at 66 per cent reliability level would be available annually to each licensee in the presence of Split Rock dam. As in the Farm model-A, an average yield of 1,235.25 kg of lint cotton per hectare is used.

Except the corresponding assumptions of the Farm model-A and Farm model-B stated above, all other assumptions of the initial model remained constant. The Farm model-A is based on maximum irrigation response and sets an upper limit, while the Farm model-B is assumed to be on minimum irrigation response and sets a lower limit of benefit that a farm can derive by adopting irrigation practice.

5.2.4 Incremental benefit and cost

The incremental net benefit due to a partial change in activity i.e., from dryland wheat to irrigated cotton of a participating farm is estimated at market price. The following costs and benefits are included in the analysis.

Gross income is calculated at $174.00 and $2 162.00 per hectare for dryland wheat and irrigated cotton respectively.

Variable cost is estimated at $60.97 and $1 122.72 per hectare for dryland wheat and irrigated cotton, while annual operating cost are $25.00 and $205.00 respectively.

Fertilizers and fuel prices are shown at subsidized prices.

An amount of $1 609.00 per hectare is taken as irrigation infra structure development cost.

No annual depreciation of capital equipment and machinery is accounted for ; instead full replacement costs were included where needed.

Costs of irrigation development, machinery and equipment are assumed to be constant in all the three models.

Detailed farm budgets i.e.,gross income, variable cost, operating overhead cost and net income are provided in Appendix 3, while the irrigation development cost is given in Appendix 4. The incremental net benefits of each of the Initial model, Farm model-A and Farm model-B, from the viewpoint of the individual farmer, are shown in Table 5.1, 5.2 and 5.3 respectively.

Table 5.1

Estimated Incremental Net Benefit with Initial Farm Model from the Viewpoint of Individual Farmer

(Figures in Dollars)

Item	Without Project	With Project Year														
		5	6	7	8-13	14	15-21	22	23-29	30	31-37	38	39-45	46	47-49	50
Inflow:																
Gross Income	28188		250244	350244	350244	350244	350244	250244	250244	350244	350244	350244	350244	350244	350244	350244
Salvage Value	7636					50063		50063		50063		50063		50063		113658
Total Inflow:	28188 (a)		250244	350244	350244	400307	350244	400309	250244	400307	350244	400307	350244	400307	350244	463902
Total Outflow:																
Investment cost:																
Capital cost	25620		181050			181050		181050		181050		181050		181050		
Irrigation Dev.		260658		130329												
Variable cost	9882		181880	181880	181880	181880	181880	181880	181880	181880	181880	181880	181880	181880	181880	181880
Operating cost	4050		33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210
Total Outflow:	13932 (b)	260658	396140	345419	215090	396140	215090	396140	215090	396140	215090	396140	215090	396140	215090	215090
Net Benefit:	13932	-260658	45896	4825	135154	4167	135154	4167	135154	4167	135154	4167	135154	4167	135154	248812
less Without Project Benefit			-11364	14256	14256	-3678	14256	-3678	14256	-3678	14256	-3678	14256	-3678	14256	30909
Incremental Net Benefit:		-260658	-34532	-9431	120898	7845	120898	7845	120898	7845	120898	7845	120898	7845	120898	217903

(a) Salvage value not included.
(b) Capital cost not included.

Table 5.2

Estimated Incremental Net Benefit with Farm Model- A
from the Viewpoint of Individual Farmer

(Figures in Dollars)

Item	Without project	With project year														
		5	6	7	8-13	14	15-21	22	23-29	30	31-37	38	39-45	46	47-49	50
Inflow:																
Gross income	28188	380700	380700	380700	380700	380700	380700	380700	380700	380700	380700	380700	380700	380700	380700	380700
Salvage value (7686)						50063		50063		50063		50063		50063		113658
Total Inflow:	28188	380700	380700	380700	380700	430763	380700	430763	380700	430763	380700	430763	380700	430763	380700	430763
Outflow:																
Investment:																
Capital cost(25620)			181050			181050		180150		180150		180150		180150		
Irrigation dev.		260658		130329												
Variable cost	9882		185929	185929	185929	185929	185929	185929	185929	185929	185929	185929	185929	185929	185929	185929
Operating cost	4050		33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210
Total Outflow:	13932	260658	400189	349468	219139	400189	219139	400189	219139	400189	219139	499189	219139	400189	219139	219139
Net Benefit:	14256	-260658	-19489	31232	161561	30574	161561	30574	161561	30574	161561	30574	161561	30574	161561	275219
less Without Project Benefit			-11364	14256	14256	-3678	14256	-3676	14256	-3676	14256	-3676	14256	-3676	14256	30909
Incremental Net Benefit:		-260658	-8125	16976	147305	34252	147305	34252	147305	34252	147305	34252	147305	34252	147305	244210

Table 5.3

Estimated Incremental Net Benefit with Farm Model-B
from the Viewpoint of Individual Farmer

(Figures in Dollars)

Item	Without project	With project year														
		5	6	7	8-13	14	15-21	22	23-29	30	31-37	38	39-45	46	47-49	50
Inflow:																
Gross income	23316	314900	314900	314900	314900	314900	314900	314900	314900	314900	314900	314900	314900	314900	314900	314900
salvage value	(7686)					50063		50063		50063		50063		50063		113658
Total Inflow:	23316		314900	314900	314900	364963	314900	364963	314900	364963	314900	364963	314900	364963	314900	428558
Outflow:																
Investment:																
Capital cost (25620)			180150			180150		181050		181050		181050		181050		
Irrigation dev.		260658		130329												
Variable cost	8170		153793	153793	153793	153793	153793	153793	153793	153793	153793	153793	153793	153793	153793	153793
Operating cost	4050		33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210	33210
Total Outflow:	12220	260658	368053	317332	187003	368053	187003	368053	187003	368053	187003	368053	187003	368053	187003	187003
Net Benefit:	11096	-260658	-53153	-2432	127897	-3090	127897	-3090	127897	-3090	127897	-3090	127897	-3090	127897	241555
less without project benefit			-14524	11096	11096	-6838	11096	-6838	11096	-6838	11096	-6838	11096	-6838	11096	27749
Incremental Net Benefit		-260658	-38629	-13528	116801	3748	116801	3748	116801	3748	116801	3748	116801	3748	116801	213806

5.3 Estimation of Economic Returns to Society

The economic analysis is aimed at estimating the return to society, incorporating the construction cost of the dam, which was a specific subsidy to farmers. Economic returns from the viewpoint of society as a whole are calculated on the basis of the equation 5.2 for all the three models used in the farm level financial analysis . In economic analysis, costs and benefits of the total 52 beneficiary farms are aggregated at the project level. A brief description of the calculation each of the components of cost and benefit associated with the analysis is given in the following sections.

5.3.1 Opportunity cost of acquired land

The opportunity cost of land acquired by the Water Resources Commission, for the construction of the dam and storage, is calculated on the basis of the benefit forgone from its use in terms of its production prior to its acquisition. No consideration is given to the possibility of improvement in future land use. To estimate returns from different farm activities on acquired land, a simple gross margins planning method is used. The assumptions and calculation of net income of the farms concerned is provided in Appendix 5 in detail.

5.3.2 Determination of economic values

As mentioned earlier, an economic assessment of a project's worth often requires the use of shadow prices to value costs and benefits which do not reflect true social value of resources used or output produced.

Transfer payments

The market prices used in the financial profitability analysis at the farm level in regard to fertilizers and fuel are distorted for inclusion of subsidy elements. The subsidy on superphosphate and nitrogen-based fertilizers are \$12.00 and \$20.00 per tonne respectively (BAE 1984, p.5). The fuel freight subsidy for off-road users is 7.155 cents per litres (Commonwealth Budget 1985). In the project, fuel use for the operations of tractors, module pickup and water lifting pumps in the farms is considered to be in that category. The subsidy elements in respect of fertilizers and fuel costs are eliminated to derive true social costs associated with fertilizer and fuel use.

Traded goods

Since the value of the Australian dollar is determined through a floating exchange rate system, the border prices of Australian export or import commodities can be obtained simply by multiplying the foreign currency value of the goods and services associated with the project by the prevailing exchange rate. It is assumed that the project will neither use any imported good or service, nor domestically produced good in which imported material is used in the implementation and operation periods. Although wheat, cotton, wool, barley and meat (beef and sheep), are exportable commodities associated with the project, export parity prices of cotton, wheat and wool at farm gate are used in the analysis. Meat is left out in view of having difficulty in finding the necessary data for deriving the export parity price, while the export parity price of barley is not used as it makes a very insignificant contribution to the income of acquired farms. The export prices, marketing and transport costs in respect of cotton , wheat and wool used in the analysis are shown in Table 5.4.

Table 5.4

Export prices, Marketing and Transport Costs of selected commodities

Items	FOB price $/t (a)	Handling and selling cost $/t (b)	Transport cost $/t (b)	Export parity price $/t
Cotton	1804.86	226.67	18.89	1559.30
Wheat	169.86	19.30	24.36	126.20
Wool	3156.62	480.00	15.69	2660.93

Source : (a) BAE, 1985

(b) Victorian Young Farmers, 1985 and Complan, 1984.

The project being a small one, the Australian share of cotton lint supply in the world market would not be increased to a significant extent due to increased cotton production resulting from the project. Therefore, the supply elasticity of cotton in the world market would remain unchanged. Under such a situation, the marginal export revenue of cotton would be the same as the f.o.b price. Similarly, the reduction in the output of wheat and wool due to the implementation of the project would not make any significant change to the Australian share of wheat and wool on the world market. But in the domestic market, though it would not be significant, a reduction of output of wheat and wool would, to some extent, reduce the pressure of the present over supply condition of these commodities (Quarterly Review of the Rural Economy 1985).

Non-traded goods and services

Labour:

Market wages reflect the true economic cost of skilled labour used for the construction and operation of the dam, the building of an irrigation infrastructure and farming operations. Therefore, market wages can simply be used in the economic analysis. It is expected that a considerable number of local unskilled labours will be employed in the project during the construction of the dam, but no reliable information on the types and man-hours to be required for this work is available at this stage. Although the opportunity cost of such unemployed unskilled labours is zero in accounting term, yet for unavoidable reasons market wages are used in the analysis. Unskilled labours will also be used for chiping of cotton field when there has been acute shortage of farm labours in that peak period. According to the Gittinger guideline (p.343) the market wages can be treated as opportunity cost of such unskilled labours used in the project.

Opportunity cost of land:

The opportunity cost of land of the farms put under irrigation is not calculated separately. It is assumed that the opportunity cost of changing land use from dryland wheat to irrigated cotton is the benefit forgone which is the out come of the use of land, capital, family labour and management .

Public capital cost:

The total capital cost of $42.57 million (land acquisition cost not included) for construction of the dam, as estimated by the Water Resources Commission (Table 2.5), is incorporated in the analysis.

Operating cost of the dam:

Cost of operation and maintenance of the dam, as estimated by the Water Resources Commission (Table 5.6) , is included in the analysis.

Water charges:

Water charge at the rate of $1.60 per megalitre paid by the farmers is taken into account as a benefit to society in the economic analysis.

5.3.3 Incremental cost and benefit to Society

The incremental cost and benefit from the viewpoint of society are estimated based on the facts and figures mentioned in the above Section for all the three models used in the financial analysis and provided in Table 5.5, 5.6 and 5.7.

5.4 Sensitivity Analysis

The result of the financial and economic analyses are subjected to sensitivity analysis with key variables. It has been mentioned earlier that the analyst must know which variables are considered by the decision maker to be the most sensitive for investment decision. The impact of variability of irrgation water supply from the dam and yield function have already been considered in the way of model variations. Next to those, it is assumed that the decision maker might be concerned to examine the impact on the profitability of the participating farmers as well as the society from the viewpoint of efficiency in water utilisation, which might be an unique feature in water resource projects. Therefore, sensitivity analysis is concentrated to test what happens to the profitability of the beneficiary farmers and society with increased water charges. If the water rent is increased to the extent on which the potential water users would be careful so asto maximise returns from the

Table 5.5

Estimated Incremental Net Benefit to Society

with Initial Farm Model

Item	Without project	With project year											
		1	2	3	4	5	6	7	8	14	15	16	22
Inflow:													
Gross Income:													
Value of output	1595						16142	16142	16142	16142	16142	16142	16142
Water charge							80	80	80	80	80	80	80
Salvage value	400									2603			2603
Total Inflow:	1595						16222	16222	16222	18825	16222	16222	18825
Outflow:													
Investment:													
i.Dam construction		9509	5670	11280	12130	3981							
ii.Farm capital cost	1332						9415			9415			9415
iii.Irrigation dev. cos						13554		6777					
Variable cost	514						7449	7449	7449	7449	7449	7449	7449
Operating cost	211						1727	1727	1727	1727	1727	1727	1727
Operating cost (dam)							140	140	140	140	190	140	140
Opportunity cost of acquired land		402	402	402	402	402	402	402	402	402	402	402	402
Total Outflow:	725	9911	6072	11682	12532	17937	19133	16495	9718	19133	9768	9718	19133
Net Benefit:	870	-9911	-6072	-11682	-12532	-17937	-2911	-273	6504	-308	6454	6504	-2911
less without project benefit							-462	870	870	-62	870	-62	870
Incrmental Net Benefit:		-9911	-6072	-11682	-12532	-17937	-2429	-1143	5634	226	5584	5634	-226

Table 5.5 (Cont'd)

(Figures in '000 $)

With project Year

23	25	26	30	31	35	36	38	39	45	46	47	50
16142	16142	16142	16142	16142	16142	16142	16142	16142	16142	16142	16142	16142
80	80	80	80	80	80	80	80	80	80	80	80	80
			2603				2603			2603		5910
16222	16222	16222	18825	16222	16222	16222	18825	16222	16222	18825	16222	22132
			9415				9415			9415		
7449	7449	7449	7449	7449	7449	7449	7449	7449	7449	7449	7449	7449
1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
140	190	140	140	140	190	140	140	140	190	140	140	140
402	402	402	402	402	402	402	402	402	402	402	402	402
9718	9768	9718	19133	9718	9768	9718	19133	9718	9768	19133	9718	9718
6504	6454	6504	-2911	6504	6454	6504	-2911	6504	6454	-2911	6504	12414
870	870	-62	870	870	870	-62	870	870	870	-62	870	1546
5634	5584	5634	-226	5634	5584	5634	-226	5634	5584	-226	5634	10868

Table 5.6

Estimated Incremental Net Benefit to Society

with Farm Model-A

Item	Without project	With project year 1	2	3	4	5	6	7	8	14	15	16	22
Inflow:													
Gross Income;													
Value of output	1595						17591	17591	17591	17591	17591	17591	17591
Water charge							80	80	80	80	80	80	80
Salvage value	400									2603			2603
Total Inflow:	1595						17671	17671	17671	20274	17671	17671	20274
Outflow:													
Investment:													
i.Dam construction		9509	5670	11280	12130	3981							
ii.Farm capital cost	1332						9415			9415			9415
iii.Irrigation dev cost						13554		6777					
variable cost	514						7449	7449	7449	7449	7449	7449	7449
Farm operating cost	211						1727	1727	1727	1727	1727	1727	1727
Dam operating cost							140	140	140	140	190	140	140
Opportunity cost of acquired land		402	402	402	402	402	402	402	402	402	402	402	402
Total Outflow:	725	9911	6072	11682	12532	17937	19133	16495	9718	19133	9768	9718	19133
Net Benefit:	870	-9911	-6072	-11682	-12532	-17937	-1462	1176	7953	1141	7903	7953	1141
less without project benefit							-462	870	870	-62	870	870	-62
Incremental Net Benefit:		-9911	-6072	-11682	-12532	-17937	-1000	306	7083	1203	7033	7083	1203

Table 5.6 (Continued)

(Figures in '000 $)

With project year												
23	25	26	30	31	35	36	38	39	45	46	47	50
17591	17591	17591	17591	17591	17591	17591	17591	17591	17591	17591	17591	17591
80	80	80	80	80	80	80	80	80	80	80	80	80
			2603				2603			2603		5910
17671	17671	17671	20274	17671	17671	17671	20274	17671	17671	20274	17671	23581
			9415				9415			9415		
7449	7449	7449	7449	7449	7449	7449	7449	7449	7449	7449	7449	7449
1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
140	190	140	140	140	190	140	140	140	190	140	140	140
402	402	402	402	402	402	402	402	402	402	402	402	402
9718	9768	9718	19133	9718	9768	9718	19133	9718	9768	19133	9718	9718
7953	7903	7953	1141	7953	7903	7953	1141	7953	7903	1141	7953	13863
870	870	870	-62	870	870	870	-62	870	870	-62	870	1546
7083	7033	7083	1203	7083	7033	7083	1203	7083	7033	1203	7083	12317

Table 5.7

Estimated Incremental Net Benefit to Society
with Farm Model-B

Item	Without project	With project year											
		1	2	3	4	5	6	7	8	14	15	16	22
Inflow:													
Gross Income:													
Value of output	1319						14550	14550	14550	14550	14550	14550	14550
Water charge							67	67	67	67	67	67	67
Salvage value	400									2603			2603
Total Inflow:	1719						14617	14617	14617	17220	14617	14617	17220
Outflow:													
Investment:													
i.Dam construction cost		9509	5670	11280	12130	3981							
ii.Farm capital cost	1332						9415			9415			9415
iii.Irrigation dev. cos						13554		6777					
Variable cost	440						6161	6161	6161	6161	6161	6161	6161
Farm operating cost	211						1727	1727	1727	1727	1727	1727	1727
Dam operating cost							140	140	140	140	190	140	140
Opportunity cost of acquired land		402	402	402	402	402	402	402	402	402	402	402	402
Total Outflow:	1983	9911	6072	11682	12532	17937	17845	15207	8430	17845	8480	8430	17845
Net Benefit:	-264	-9911	-6072	-11682	-12532	-17937	-3228	-590	6187	-625	6137	6187	-625
less without project benefit							-664	668	668	-264	668	668	-264
Incremental Net Benefit:		-9911	-6072	-11682	-12532	-17937	-2564	-1258	5519	-361	5469	5519	-361

Table 5.7 (Cont'd)

(Figures in '000 $)

With project year												
23	25	26	30	31	35	36	38	39	45	46	47	50
14550	14550	14550	14550	14550	14550	14550	14550	14550	14550	14550	14550	14550
67	67	67	67	67	67	67	67	67	67	67	67	67
			2603				2603			2603		5910
14617	14617	14617	17220	14617	14617	14617	17220	14617	14617	17220	14617	20527
			9415				9415			9415		
6161	6161	6161	6161	6161	6161	6161	6161	6161	6161	6161	6161	6161
1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727	1727
140	190	140	140	140	190	140	140	140	190	140	140	140
402	402	402	402	402	402	402	402	402	402	402	402	402
8430	8480	8430	17845	8430	8480	8430	17845	8430	8480	17845	8430	8430
6187	6137	6187	-625	6187	6137	6187	-625	6187	6137	-625	6187	12097
668	668	668	-264	668	668	668	-264	668	668	-264	668	1534
5519	5469	5519	-361	5519	5469	5519	-361	5519	5469	-361	5519	10563

same level of water allocation, the efficiency of its use would be greater. The economic cost of providing irrigation water in regard to the construction of the dam is estimated at $177.30 per hectare (based on 6 ML/ha). Sensitivity analysis is done incorporating 25%, 50%, 75% and 100% economic cost of water on the part of the farmers to test what would happen to the individual farmer's profitability in respect of the Initial model, Farm model-A and Farm model-B. NPV, IRR and B/C ratio are calculated using the same discount rates of 7, 10 and 13 per cent .

Similarly, NPV, IRR and B/C ratio are calculated adding corresponding levels of water charge as benefit to society to see the impact on social profitability. In view of the fact that the project will employ unskilled labours for the construction of the dam and roads during the construction period of the project, a further analysis has also been undertaken assuming 25 per cent of the cost allocated to that end will have zero opportunity cost for the use of unskilled labours.

Chapter 6

RESULTS AND DISCUSSION

This chapter presents a report and discusses the results of the appraisals from the viewpoint of the farmer and society. The secondary effects as well as the implications of the dam are also discussed.

6.1 Results of the Farm Level Analysis

The NPV, IRR and B/C ratios are calculated using the discount rates of 7, 10 and 13 per cent to assess farm level profitability in respect of the Initial farm model, Farm model-A and Farm model-B. The results of the appraisals are presented in Table 6.1 below.

Table 6.1

Measures of Financial Profitability of the Participating Individual Farmer

Farm model	Internal rate of return(%)	Net present value ('000 $)			Benefit-cost ratio		
Discount rates (%)		7	10	13	7	10	13
Initial model	24.80	928	542	324	1.25	1.20	1.16
Farm model-A	31.71	1 263	779	503	1.34	1.29	1.24
Farm model-B	23.94	887	512	301	1.27	1.21	1.16

6.2 Results of the Analysis from Society's Viewpoint

The Economic rate of return, NPV and B/C ratios are calculated using the same discount rates as those of the farm level analysis and of all the corresponding models. The results of the economic analysis are presented in Table 6.2.

Table 6.2

Measures of Economic Profitability from the Viewpoint of Society

Farm model	Internal rate of return(%)	Net present value ('000 $)			Benefit-cost ratio		
Discount rates (%)		7	10	13	7	10	13
Initial model	6.11	-6 353	-18 854	-24 071	0.96	0.84	0.74
Farm model-A	8.03	7 697	-9 980	-18 046	1.05	0.92	0.80
Farm model-B	5.93	-7 613	-19 666	-24 626	0.95	0.82	0.72

6.3 Results of the Sensitivity Analysis

Sensitivity analyses are undertaken with variations in water price as described in Section 5.4. The results of the analyses, from the view point of the farmer as well as the society, are furnished in Table 6.3 and Table 6.4 respectively. The results of the analysis incorporating zero opportunity cost of unskilled labours employed for the construction of the dam and roads are placed in Table 6.5.

Table 6.3

Sensitivity Analysis with Variable Water Charges from the Viewpoint of individual Farmer

farm model/ water charges	Internal rate of return(%)	Net present value ('000 $)			benefit-cost ratio		
Discount rates (%)		7	10	13	7	10	13
Initial model							
25 % ($7.39/ML)	23.38	856	492	286	1.23	1.18	1.13
50 % ($14.77/ML)	21.55	765	427	237	1.20	1.15	1.11
75 % ($22.16/ML)	19.76	673	363	189	1.17	1.13	1.09
100 % ($29.55/ML)	17.99	582	298	140	1.15	1.10	1.06
Farm model-A							
25% ($7.39/ML)	30.72	1 192	728	465	1.32	1.27	1.22
50% ($14.77/ML)	28.33	1 100	664	416	1.29	1.24	1.19
75% ($22.16/ML)	26.46	1 009	596	368	1.26	1.21	1.16
100% ($29.55/ML)	24.61	918	535	319	1.23	1.18	1.14
Farm model-B							
25% ($8.43/ML)	22.34	803	455	259	1.24	1.19	1.14
50% ($17.86/ML)	20.60	712	391	210	1.21	1.16	1.11
75% ($18.80/ML)	18.80	621	326	162	1.18	1.13	1.08
100% ($35.72/ML)	17.10	537	266	115	1.15	1.10	1.06

Table 6.4

Sensitivity Analysis with Variable Water Charges
from the Viewpoint of Society

Farm model/ water charges	Internal rate of return(%)	Net present value ('000 $)			Benefit-cost ratio		
Discount rates (%)		7	10	13	7	10	13
Initial Model							
25% ($7.39/ML)	6.51	-3 527	-17 066	-22 857	0.98	0.86	0.75
50% ($14.77/ML)	7.01	101	-14 775	-21 302	1.00	0.88	0.77
75% ($22.16/Ml)	7.50	3 719	-12 491	-19 750	1.02	0.90	0.79
100% ($29.55/ML)	7.98	7 347	-10 200	-18 195	1.04	0.91	0.80
Farm model-A							
25% ($7.39/ML)	8.39	10 529	-8 192	-16 832	1.06	0.93	0.82
50% ($14.77/ML)	8.85	14 157	-5 902	-15 277	1.08	0.95	0.82
75% ($22.16/ML)	9.30	17 775	-3 617	-13 725	1.11	0.97	0.85
100% ($29.55/ML)	9.78	21 655	-1 168	-12 062	1.13	0.99	0.87
Farm model-B							
25% ($8.93/ML)	6.34	-4 645	-17 792	-23 354	0.97	0.84	0.73
50% ($17.86/ML)	6.86	-1 017	-15 501	-21 799	0.99	0.86	0.75
75% ($26.79/ML)	7.35	2 601	-13 216	-20 248	1.02	0.88	0.77
100% ($35.72/ML)	7.83	6 260	-10 926	-18 693	1.04	0.90	0.78

Table 6.5

Social profitability Analysis with Zero opportunity
Cost for the use of Unskilled Labour

Farm model	Internal rate of return(%)	Net present value ('000$)			Benefit-cost ratio		
Discount rates (%)		7	10	13	7	10	13
Initial model	6.76	-1 598	-14 526	-20 123	0.99	0.87	0.77
Farm model-A	8.79	12 456	-5 652	-14 099	1.08	0.95	0.84
Farm model-B	6.57	-2 852	-15 337	-21 679	0.98	0.86	0.75

6.4 Interpretation of Results

It has been mentioned earlier that the national economic objective of Australia is to maximise the growth rate for which capital is competitively available for development projects. To reflect the social objective function, the appropriate decision criteria are NPV and IRR for interpreting the results of the analysis. From Table 6.1, it is observed that each participating farmer would derive a incremental net benefit ranging from $887,000 to $1263,000 over the life of the project at 10 per cent discount rate, where the financial rate of return ranged from 23.94 to 31.71 per cent accounted for the farm family labour, management and capital used. The results suggest that investment in irrigation farming would be attractive to potential new irrigators in the context of prevailing alternative private investment and terms of trade between prices received and prices paid by the farmers.

The results in Table 6.2 show that the society would derive a negative NPV of incremental net benefit ranging from -19,666 to -9,980 thousand dollars at 10 per cent discount rate, and the economic rate of return ranged from 5.93 to 8.03 per cent. The results indicate that investment in Split Rock dam from the viewpoint of the society is uneconomic based on the assumptions underlying the analysis. The construction of the dam is only economically viable with Farm model-A at 7 per cent discount rate when the society would earn a positive NPV of incremental net benefit with 8.03 per cent economic rate of return. If the assumptions of the Farm model-B hold good, reflecting the average minimum level of water supply from the dam, the society would derive a negative NPV with an economic rate of return of only 5.93 per cent. The social profitability, even with incorporating a zero opportunity cost of unskilled labours used in the costruction work as stated in Chapter 5, has marginally improved with NPV of incremental net benefit ranging from -15,337 to -5,652 dollars and economic rate of return ranging from 6.57 to 8.79 per cent.

In the sensitivity analysis, an attempt is made to show the impact on profitability from the view point of both the farmer and society with incoporating different rates of economic water cost in the analysis,

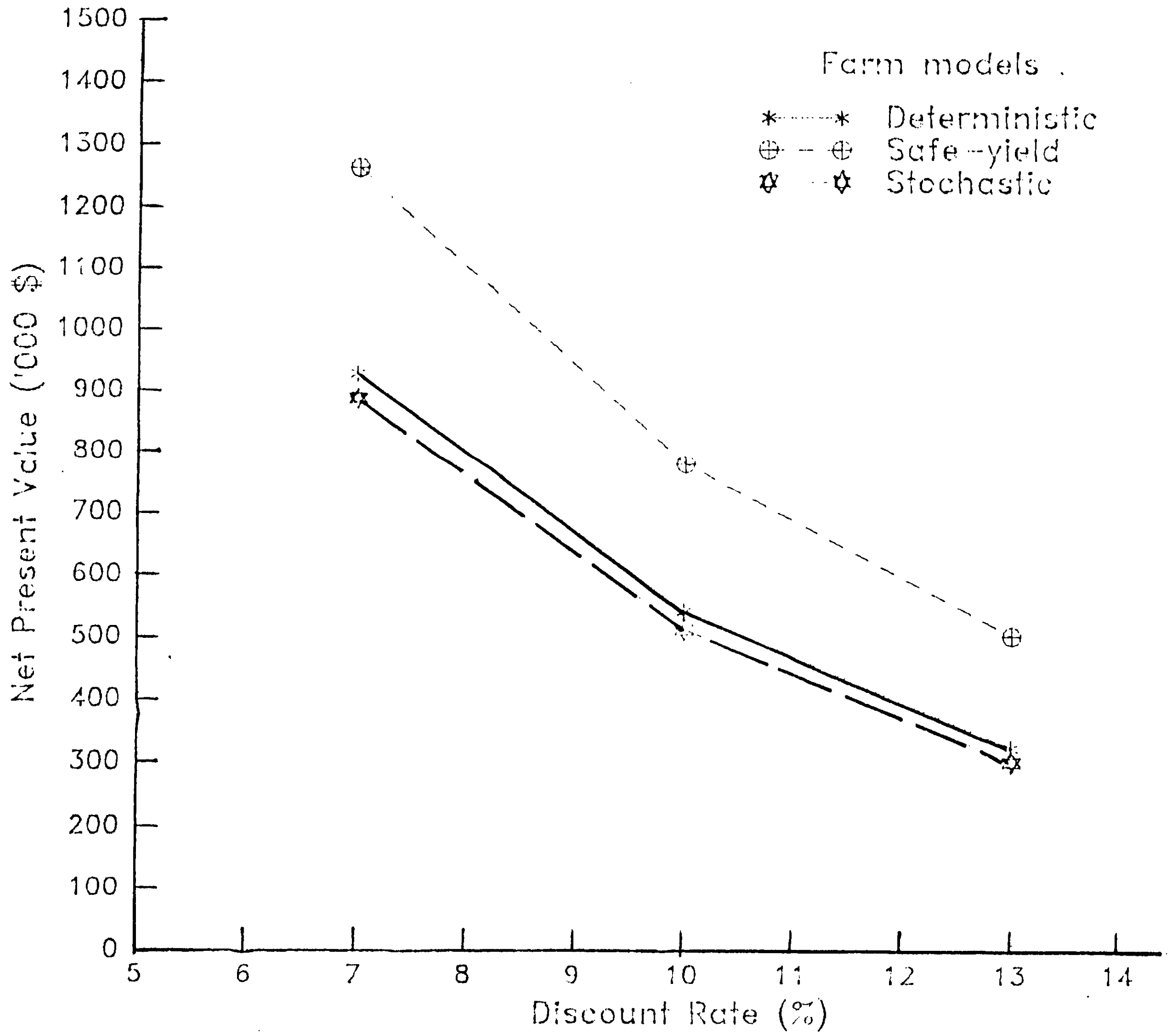


Figure:6.1 : Net Present Value from the viewpoint of the individual farmer.

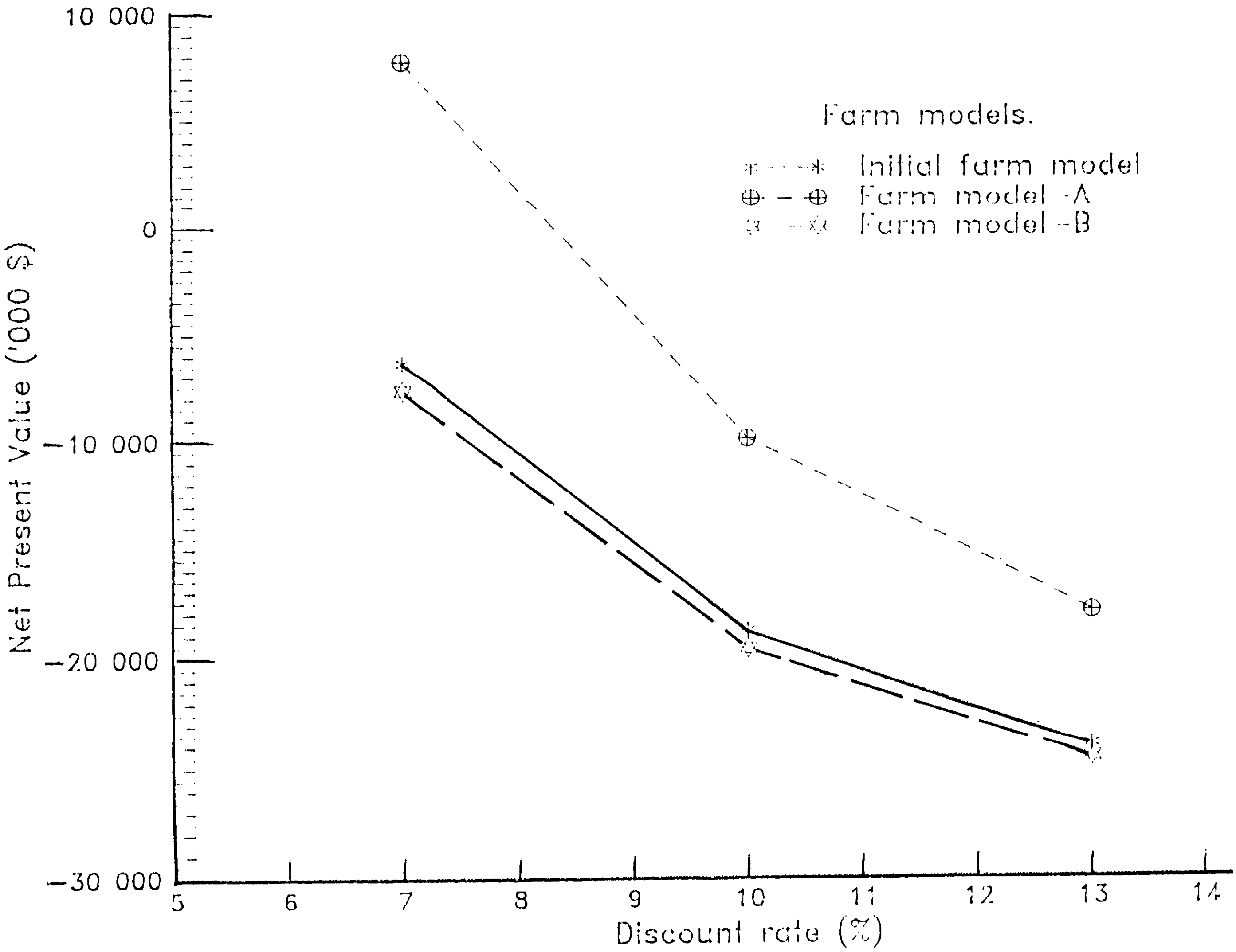


Figure 6.2: Net present value from the viewpoint of society.

because the fundamental requirement of the Australian water industry is economic efficieny. Producers should be allowed to purchase water inputs according to their marginal revenue functions. A perfectly competitive free enterprise system would create necessary conditions for efficient water utilization. Watson and Rose (1981); Watson et al.(1983); Musgrave (1983) observed that full water cost pricing would be the most appropriate system for the efficient and equitable allocation of water supplies. Increased water cost to a certain extent would improve efficiency, reduce wastage and release sleeper licenses. Sensitivity analysis at the farm level (Table 6.3) reveals that even with charging full economic water cost, the NPV of incremental net benefit ranges from $266,000 to $728,000 at 10 per cent discount rate where the the financial rate of return ranges from 17.10 to 24.61 per cent, an average decrease of 6.97 per cent . The results suggest that the potential farmers would still be interested in adopting irrigation with expected prices of inputs and output,; and the level of output of agricultural products. On the other hand, the sensitivity analysis from the view point of the society (Table 6.4) showed that with realizing full economic cost of water, the economic rate of return has increased significantly ranging from 7.83 to 9.78 per cent, but still incurs a negative NPV of incremental net benefit at 10 per cent discount rate. The relationship between the different rates of water charge and the internal rate of return at both the farm and society levels are provided in Figures 6.3 and 6.4 respectively.

6.5 <u>Secondary Costs and Benefits</u>

Secondary / intangible costs and benefits are reasonably easy to identify but, unlike the measurement of the direct costs and benefits associated with irrigation projects, they are most difficult to assess in quantitative terms. Whether or not those secondary /intangible costs and benefits are significant in decision making in regard to investment in Split Rock dam would require further assessment. However, in the context of the present study, a brief description of possible secondary /intangible costs and benefits associated with Split Rock dam are given in this section.

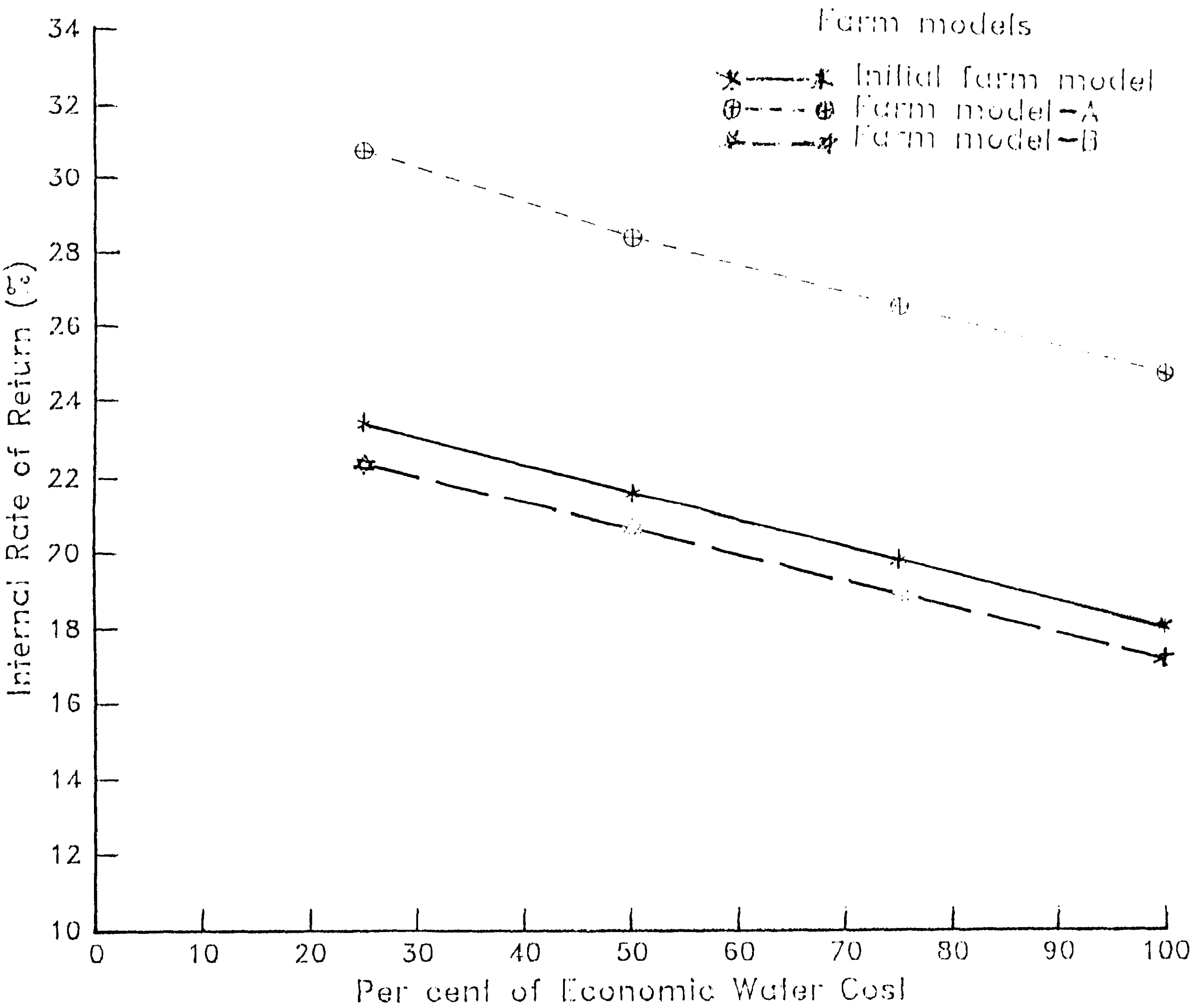


Figure 6.3: Financial Rate of Return to individual farmer with different rates of water charge.

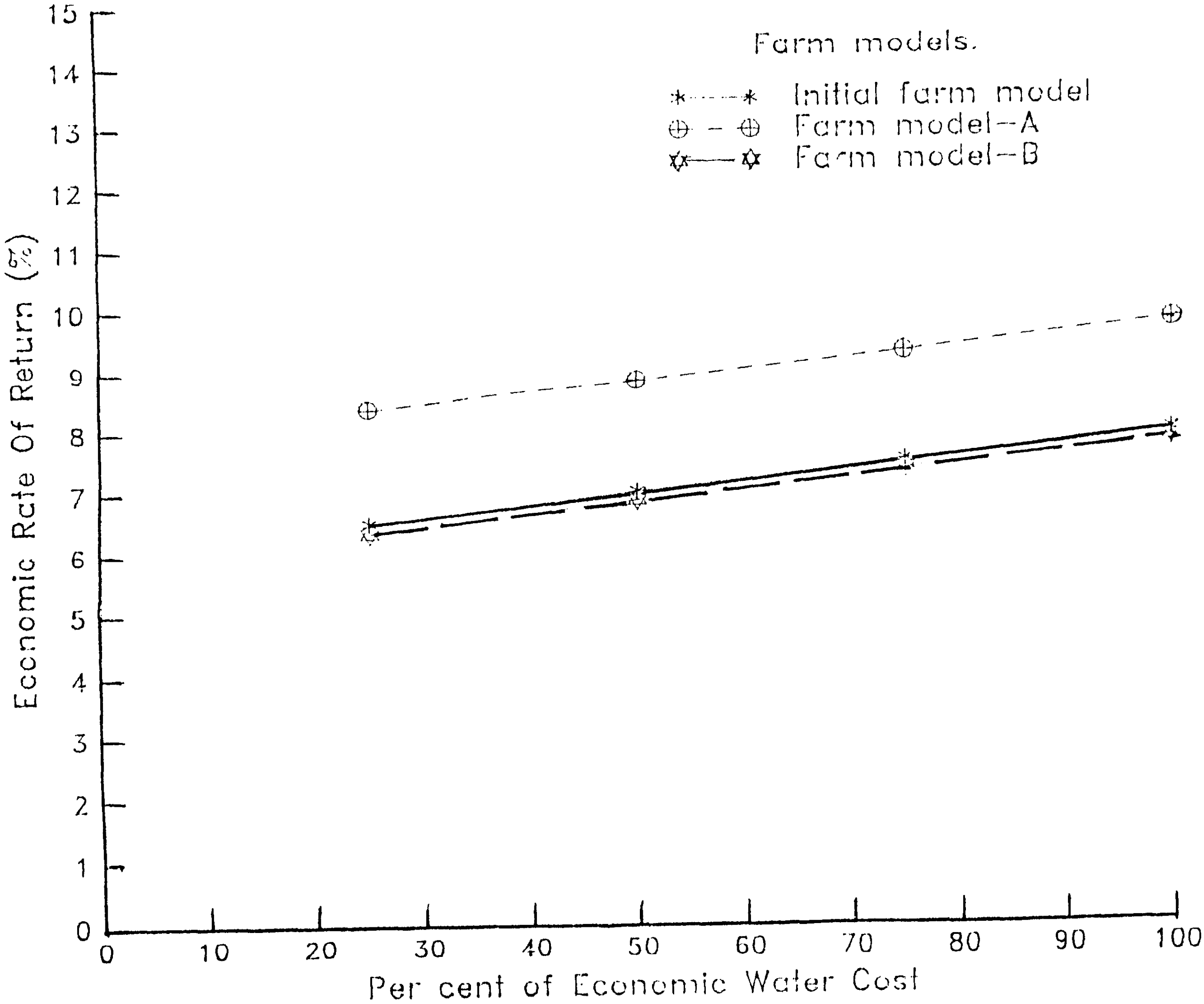


Figure 6.4: Economic rate of return to society with different rate of water charge.

6.5.1 Increased revenue in Transport sector

It is expected that the State Rail Authority /or private transport companies would benefit through the freight charges levied from carrying additional inputs and outputs associated with the construction of the dam and participating farms.

6.5.2 Flood control benefit

Flood control requirements may be expressed in terms of areas subject to flooding and protected flood damage levels, recognizing damage reduction capability of the dam. As in the Keepit dam study (1969), an average net benefit might be accrued as flood damage mitigating benefit accrue to the nation due to Split Rock dam.

6.5.3 Fishing and outdoor recreation benefits

The Fishery Division of the N.S.W. Department of Agriculture could undertake a program to develop the likely fishery in the storage area. The demand for fishing and hunting waterbirds as recreational pursuits would depend upon quality opportunities to be made in the storage area. Other environmental enchantments such as scenic river preservation, boat riding, special use areas of major significance etc. might be considered as outdoor recreation items. The net benefit to fishing and outdoor recreation would accrue depending on the facilities to be developed in future.

6.5.4 Increased employment opportunity

New employment opportunities would not only be created during the construction and operation of the dam, but also it would generate considerable additional employment opportunities for farm workers mainly due to extensive land use in irrigated production and supporting activities.

6.5.5 Drought protection

The drought protection benefit would be accrued to the account of the producers of irrigated crops due to improved stock of water supply which has already been accounted for in assessing direct benefit to irrigation production. The dam might be considered as some sort of security against short term drought during the crop production cycle.

6.6 Implications of the Project

The results of the analysis from the society's point of view demonstrate that except at a 7 per cent discount rate in the appraisal in respect of the Farm model-A , the project is found to be economically unsound. Therefore, the hypothesis that 'the construction of the Split Rock dam is not socially profitable' is upheld based on the assumptions underlying the analysis. On the other hand, the results of the farm level analysis clearly show that every participating farmer would derive a positive NPV of incremental net benefit with at least 23.94 per cent financial rate of return by utlizing irrigation water from the dam and therefore, the hypothesis that 'the rate of return to the participating farmers is less than the opportunity cost of capital' is not upheld. The results of the analyses, as referred above, clearly demonstrate that society and the participating farmers are not equally benefitted at a rate compatible with the accepted opportunity cost of investment. Apart from the implications discussed above, the project might have some impacts on the farmers, regional and national levels. At the farmer's level, provision of irrigation water would undoubtedly increase farm income significantly and provide a greater production stability in the future compared with dryland farming and therefore, would help raise living standard and greater satisfation of the concerned farm family.

From the regional point of view, the project would benefit the new irrigators with increased income and production stability. The region would benefit from an expanded use of goods and services purchased by the farms and the establishment of new processing industries related to additional or new farm output (e.g. cotton ginning). It is expected that there would be a multiplier effect from expenditures to additional labour employed in terms of growth of activity and the income in the area served by the dam.

Society would be benefited through increased tax-revenue from the beneficiaries associated with the project directly or indirectly, which could be invested in other productive projects/programs. The project would provide opportunity to raise the incomes of the services and supply enterprises (e.g. State Railway) and increased reliability of supply of cotton to overseas buyers. On the other hand, the project would , although not significantly, help ease pressure on the wheat industry now facing over supply problems as this commodity would no longer be produced in that particular area. It has already been mentioned that the dam would undoubtedly help accrue benfits through increased flood damage reduction capability, recreational benefit, greater foreign exchange income and production stability. On the other side of the disc, the project may create environmental problems through increased fertilizer and chemical residues, developing underground salinity problems due to incresed use of irrigation water in the long run. Considering both direct and indirect costs and benefits, it would be a difficult job to comment on the government investment decision in regard to Split Rock dam until all the secondary and intangible effects are considered adequately. It is important to know how the decision maker weighs these secondary and intangible costs and benefits or whether there was any political pressure in the decision making process. Whatever the facts behind the screen, the reality is that a large expenditure has already been incurred and the construction of the dam will have to be completed sooner or later. However, it is worth mentioning here that the results, based on the assumptions underlying the analysis, clearly demonstrate that investment decision in regard to Split Rock dam is not economically sound from the view point of society as a whole, i.e., the project would earn a negative NPV of incrementtal net benefit with economic rate of return ranging from 5.93 to 8.03 per cent compared with the opportunity cost of capital rate of 10 per cent recommended by the Australian Treasury.

Chapter 7

SUMMARY AND CONCLUSIONS

7.1 Summary and Conclusions

This study has been concerned with the assessment of the profitability on investment associated with the construction and operation of the Split Rock dam, from the viewpoint of society as well as the dryland farmers likely to adopt irrigation, based on direct effects related to agriculture. The primary benefit of the dam has been estimated from the production of cotton under irrigation by the private farm firms. The study also attempted to address the question of efficiency in utilizing available irrigation water from the dam. Benefit-cost models based on the conventional efficiency analysis (Gittinger 1982) are constructed to determine the impact of the dam in terms of NPV, IRR and B/C ratio. The salient features of the study are the use of three models based respectively on deterministic, safe-yield and stochastic assumptions to compare side by side the variations of result under different assumptions, where the benefit accrued in the Farm model-A and Farm model-B represent the upper and the lower limits respectively that society, or a participating farmer, could derive from the dam.

The total capital cost of the dam is shown at $47.17 million and annual opperating cost at $140,000 as envisaged by the Water Resource Copmmission. The life of the dam is assumed to be 50 years including a 5-year period of construction. Net private benefit is calculated per irrigation license basis with irrigated cotton, the most remunerative irrigated crop, as an alternative to dryland crops although a wide range of other irrigated crops are also grown in the project area. No prediction is made as to which specific crops would be grown in future.

In the social profitability analysis, private benefits are adjusted for tranfer payments in regard to fertilizers and fuel freight subsidies. Export parity prices in respect to cotton, wheat and wool are used. Non-traded goods and services e.g.labour, machinery and equipment etc. are valued at market prices. Water rent paid by the farmers is considered as a benefit to society. The opportunity cost of land acquired for the dam is taken as a benefit foregone for not being used in farming activity instead of land value. No secondary or intangible costs and benefits are quantified and included in the analysis. The impact of the secondary/ intangible costs and benefits are discussed in the interest of creating awareness about the probable consequence thereon.

NPV, IRR and B/C ratio are calculated at discount rates of 7, 10 and 13 per cent in respect of the three models with varied assumptions. Besides, sensitivity analyses are conducted with variable water charges to examine the profitability from the viewpoint of the society as well as that of individual farmers. At the farm level analysis, the results suggest that the participating farmers, with an irrigation license of 972 ML, would derive a NPV of incremental net benefit ranging between $887,000 and $1263,000 at 10 per cent discount rate, where IRR ranges from 23.94 to 31.71 per cent for family labour, management and capital used. The analysis from the viewpoint of society showed that society would derive a negative NPV of incremental net benefit at 10 per cent discount rate, where the IRR ranges from 5.93 to 8.03 per cent. The above results clearly demonstrate that the investment in Split Rock dam is uneconomic from the viewpoint of society, while it would be highly attractive to the potential new irrigators.

The results of the sensitivity analyses suggest that even paying the full economic cost of water, a farmer would derive a NPV of incremental net benefit ranging from $266,000 to $535,000 at 10 per cent discount rate with a financial rate of return ranging from 17.10 to 24.61 and still be interested in irrigation. On the other hand, society would still derive a negative NPV of incremental net benefit at 10 per cent discount rate raising the economic rate of return ranges from 7.83 to 9.78 per cent.

The conclusion of the study is that investment in Split rock dam is economically unsound from society's point of view based on the assumptions underlying the analysis, while it would be highly profitable to new irrigators. It is further concluded that increased water charges would help improve efficiency in irrigation water utilization, reduce wastage and facilitate effective use of sleeper licenses.

6.2 Policy Considerations

Although the results of the study clearly demonstrate that investment in Split Rock dam would be uneconomic from society's point of view, there is no question at this stage to turn back from the decision taken, because the Government has already invested a large sum of money in the dam and it is understood that considerable physical work has already been accomplished in implementing the project. Under this situation, policy directions should be how to maximise efficiency per dollar invested in the project. The results of the study give rise to some important policy cosiderations which are highlighted below.

i. In the interest of economic efficiency in water utilization, water users should be allowed to purchase water inputs on a competitive free market. This would reduce wastage and compell the irrigators to react in a more careful use of irrigation water and thus improve net benefit. The State Government should adopt appropriate policies in that direction.

ii. The Government policy direction should be to explore and examine the feasibility to provide an increased quantity of irrigation water from the regulated flow possibly by making minor adjustments in engineering design and resevoir size with a view to reduce the economic cost of water per megalitre so that the marginal productivity of water in irrigation production is maximised.

iii. Any delay in completing the implementation of the project would further reduce the benefit to society. Therefore, appropriate policy measures should be adopted to ensure the scheduled completion of the project.

7.3 Limitations of the Study

As in any project appraisal, using benefit-cost analyis, this study is based on certain assumptions and therefore, for obvious reasons , this study is subjected to certain limitations as discussed below.

i. The assessment is based on direct costs and benefits associated with agricultural aspects. Secondary costs and benefits are not quantified and included in the analysis.

ii. The task of obtaining adequate and accurate data was one of the biggest hurdles. The study used constant prices in assessing future costs and benefits which might not be a true reflection of future prices , demand and supply of the project's output particularly in the presence of uncertainty and elements of the external economy. The elements of uncertainty and externalities are not adequately treated in the study.

iii. The analysis is based on the most preferred crop, namely irrigated cotton, with wheat as a rotation crop, although a wide variety of other crops are grown under irrigated condition in the area.

vi. No consideration is given to the possibility of future improvements of land use in measuring net benefits with and without the project . It is restricted in scope to study only the project in question in that particular area and therefore, the costs and returns of the project are not compared with costs and returns of similar or less similar projects elsewhere in the State. To that extent it would not be possible to indicate how this particular project would rank in order of preference in terms of defined economic criteria.

7.4 Scope for further Research

Further research may be pursued in a number of areas which are not addressed in the present study. Further research may be coducted on the following directions :

i. Given that an efficient and equitable water supply is the major issue within the Australian water industry, a study should be undertaken to derive water demand functions with variable water charges to be levied in the Namoi valley so as to help determine appropriate water pricing policy for the area.

ii. Further research should be conducted to determine the optimum level of supply capacity in terms of extra costs and benefits, and assess the net economic impact on the national economy.

iii. The present study could be extended to incoporateng other potential crops (e.g. vegetables) as alternatives to irrigated cotton.

iv. Further study could be undertaken to adequately treat uncertainty, secondary effects and externalities associated with the project.

Appendix 1

Technical Details of the Split Rock Dam

General Information	
Location	Manilla River, 19 km upstream of Manilla
Catchment Area	1660 sq. km
Average annual flow	104 GL
Reservoir	372 GL
Strorage capacity	372 GL
Main Embankment	
Type	Concrete faced rockfill
Height	66 m
Crest length	480 m
Crest width	5 m
Fill volume	1 000 000 cubic metres
Concrete volume	13 450 cubic metres
Saddle Dams	
Type	Zoned earth, rock and gravel
Length	2.8 km
crest wide	4.7 m
Volume fill	777 000 cubic metres
Spillway	
Type	Ungatted ogee crest with partially lined Chute
Crest length	99.86 m
Volume of excavation	1 100 000 cubic metres
Volume of concrete	7420 cubic metres
Outlet Works	
Type	Reinfourced concrete tower with variable level intake facility , steel main conduit and steel bypass in concrete tunnel, and fixed dispersion cone valves in dissiptor at downstream end of tunnel.
Main conduit	20 m long x 5.8 m diameter concrete conduit reducing to a 140 m long x 2.6 m diameter steel penstock with 2/1400 mm fixed dispersion cone valves and 2/1800 mm Butterfly guard gates on 1800 mm bifurcation pipes.
Bypass	610 mm diameter steel conduit extending from intake tower, through tunnel to dissipator with 610 mm fixed dispersion cone valve.
Outlet capacity	6400 ML/day at full supply level 5000 ML/day at 30 % storage.

Source : Waetr Resource Commission Report, 1984a.

Appendix 2

Planting and Harvesting Time of Crops (including fruits)

Crop	Most usual manths of	
	Planting	Harvesting
Cereal Grains		
Wheat	May - June	November December
Maize	September January	January - July
Oats	March - May	October - December
Barley	May - June	October - December
Rice	October - November	March - May
Sorghum	September - January	March - June
Triticale	May - June	November - December
Oilseeds		
Linseed	May - June	November - December
Rapeseed	April - June	November - December
Soybean	November - December	April - May
Safflower	June - August	December - February
Sunflower	August - February	February - June
Other Crops		
Cotton	September - Nonember	April - June
Potatoes :		
Early	July - August	October - January
Late	November	February - August
Sugarcane	September	July - December
Tobacco	September - December	January - April
Fruit		
Apples	--	February - May
Apricots	--	November - January
Avocados	--	April - Augast
Bananas	--	October - March
Cherries	--	November - January
Citrus	--	All year
Grapes	--	February - April
Nectarines	--	November - February
Peaches and plums	--	October - April
Pears	--	January - April

Source: Skinner, T.J.(1984), Handbook of Local Statistics- New South Wales, ABS, Sydney.

Appendix 3

Farm Budget for Crop Activities

The budgets shown below are prepared based on information from New South Wales department of Agriculture, Namoi Valley Cotton Cooperative (Grower's Service), Michael Boyce and Co. report, Complan 1984 and discussion with the officials of the relevant Government departments.

A Opportunity cost per hectare of irrigated cotton

Dryland wheat is asuumed to be produced in absence of irrigation facilities.

Assumptions

Tructor with implement value - $ 241 075
Trade-in-value - 30% after 6000 hours of use
Tructor will be partly used as per requirements and the remaining capacity be used elsewhere so that replacement will be needed after eight years of operation.

Gross Income from Dryland Wheat (1 hectare)		
1.5 tonnes wheat @ $107.00 per tonne	$	160.50
$ 9.00/tonne average premium		13.50
Total :		174.00

Variable Costs	
Seed @ 25 kg/ha @ $0.21/kg	5.25
Tractor hrs @ $32.37/hr for 0.492 hr/ha	15.93
Implement repair and maintenance @ $3.53/hr	1.74
Contact sprays:	
2.1 litres of tri-allate/ha @ $9.90/ha	9.90
1.8 litres of 2,4-D/ha @ $4.15/ha	4.15
Harvesting contact @ $24.00/ha	24.00
Total :	60.97

Annual Operating Overhead Costs	
Administrative expenses	12.00
Permanent labour	13.00
Total :	25.00

Net Income of per Hectare of Dryland Wheat	88.03

Appendix 3(cont'd)

B Costs and Return for Irrigated Cotton Production

Assuptions

- Tructor and implement value $ 146 034 ; trade-in-value 30% after 6000 hours of use . life of the tructor is assumed 8 years.
- Pumps value $ 20 016 ; trade-in-value 20% after 8 years of use.
- Pickup value $ 15 000 ; trade-in-value 15% after 8 years of use.

Gross Income of Irrigated Cotton (1 Hectare)

5 bales/ha @ $400.00/bale of lint cotton (a)	$ 2 000.00
1800 kg/ha @ $0.10/kg seed (a)	162.00
Total :	2 162.00

Variable Costs

Seed 25 kg/ha @ $1.00/kg	25.00
Tructor hrs @ $17.22/hr for 4.87 hrs/ha	83.86
Implement repair and maintenance @ $11.00/ha	11.00
Water pumping cost @ $3.72/ML for 6 ML	22.32
Irrigation repair and maintenance @ $1.00/ML	6.00
Fertilizer 140 kg/ha of NH3 @ $576/tonne	80.64
Insect control contact and bug checker	219.00
Weed control contact @ $115.45/ha	115.45
Defoliant @ $49.80/ha	49.80
Water charge @ $1.60/ML for 6 ML	9.60
Picking @ $25.00/hr for 2.77 hrs/ha	69.25
Chiping labour	75.00
Module pickup and 25 km cartage to gin	100.00
Ginning and marketing cost @ $51.00/bale	255.00
Total :	1 122.72

Annual Operating Overhead Costs

Administrative expenses	34.00
Permanent labour	141.00
Irrigation channel maintenance	30.00
Total :	205.00

Net Income per Hectare of irrigated Cotton	834.28

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* Depreciation is not included in the calculation of net income.
(a)1985 prices are used.

Appendix 4

Irrigation Development Costs per Hectare

This is prepared on the basis of actual costs recorded by M/S michael Boyce and Co., Moree during 1983/84 growing season.

Land Development:

Clearing and stickpicking	$ 210.00
Discing and floating	62.00
Survey- 30 metres grid and blue top	37.00
Design and engineering	25.00
Land leveling and blue top work	445.00
Cutter bar, ripping and land plan	185.00
Roads	62.00
Fence	37.00
Sub-Total :	1 063.00

Water Investment:

Design engineering and survey	20.00
Levee construction	124.00
Supply construction	124.00
Structure	62.00
Pump	124.00
Tail water return	62.00
Control	30.00
Sub-Total :	546.00
Total :	1 609.00

Appendix 5

Opportunity Cost of Land Acquired for the Dam

Detailed information on the pre-acquisition conditions of the farm land now being used for the dam construction is not reliably available. Therefore, some assuptions are made for estimating farm budget on the basis of discussion with relevant Government Departments such as Valuer General Department, Department of Agriculture etc. and relevant persons working in this field. New England 1984 Budget Handbook, Farm Purchase Handbook 1983 and Complan 1984 were also consulted.

Basic Assumptions

Average farm size	1 450 ha
Improved and natural pasture (81%)	1 175 ha
Dryland crops (14%)	203 ha
Natural State (5 %)	72 ha

Property Details

Ewes	1 400 Nos.
Cows	147 Nos.
Improved natural pasture	145 ha
Good natural pasture	1 035 ha
Poor natural pasture	72 ha
Arable :	
Dryland Wheat	138 ha
Dryland Barley	40 ha
Dryland Forage Oats	25 ha

Production Parameters

Stocikg rate :

	LSM
Spring	24 286
Summer	42 795
Autumn	21 054
Winter	14 553

Labour :	
Owner/operator	Full time
Casual labour	$ 6 000 per annum
Ewe :	
Lambing percentage	80 %
Death:	
Adults	2 %
Lambs	8 %
Replacement	20 %
Beef-cattle (Yearling) :	
Calving percentage	85 %
Mortality	5 %
Bull ratio	5 %
Breders culled	15 %

Plant and equipment :

- Tractor with implement value $ 80 320,trade-in-value 30 % after 6 000 hours of use. Depreciation $ 3 124 per year.
- Vehicules value $ 20 000, trade-in-value 15 % after eight years 8 years of use. Depreciation $2 125 per year.

Appendix 5 (cont'd)

Property value:

Land 1450 ha @ $350.00/ha	$ 507 500
House	44 000
Sheds	50 000
Livestock :	
1 400 ewes @ $24.00	33 600
147 cows @ $300.00	44 100
31 rams @ $150.00	4 650
7 bulls @ $1 100.00	7 700
	90 050
Total :	691 550

Depreciation for house and sheds $ 1 692 per year, taking into account trade-in-value at 10 % after 50 years of use.

Farm Budget Analysis

Gross Income

Sheep :	
1 379 x 4.3 kg ewes wool @ $2.80/kg	$ 16 603
523 x 3.0 kg ewe hoggets wool @ $2.900/kg	4 550
30 x 8.0 kg rams wool @ $2.70/kg	648
515 wether labs @ $16.00/hd	8 240
280 c.f.a ewes @ $14.00/hd	4 554
207ewe hoggets @ $23.00/hd	4 761
6 c.f.a rams @ $10/hd	60
Total :	39 416
Cattle :	
57 yearling steers @ $289.00/hd	16 473
26 yearling heifers @ $240.00/hd	6 240
23 c.f.a cows @ $272.00/hd	6 256
1 bull @ $450.00/hd	450
Total :	29 419
Dryland Wheat :	
138 ha @ 1.5 tonnes/ha @ $110.00/tonne (on farm price)	22 770
Dryland Barley :	
40 ha @ 1.4 tonnes/ha @ $120.00/tonne (on farm price)	6 720
Grand Total :	98 325

Variable Costs

Sheep :	
Shearing 1920 x $2.00 + 30 x $3.00	3 894
Crutching 1431 @ $0.50/hd	716
Drenching 1905 @ $0.35 + 1030 @ $0.17 + 31 @ $0.56	859
Dip and jet 1372 @ $0.18 + 505 @ $0.18 + 31 @ $0.18	343
Wool packs etc. @ $.04/kg of wool	310
Purchase of Rams @ $150.00/hd	1 050
Total :	7 172

Appendix 5 (cont'd)

Cattle :	
Drench 147 Board spectrum @ $0.90/hd	132
375 fluck (autumn) @ $1.00/hd	375
Parasite control-375 Lice @ $0.40/hd	150
Veterinary costs 5 in 1 vaccine @ $0.16 /calves for 119 calves	19
pregnancy test @ $1.85/hd for 147 cows	272
Others @ $2.00/hd for cows and followers	782
Purchase of 1 bull @ $1100.00/hd	1 100
Total :	2 830
Dryland Wheat :	
Seed 35 kg/ha @ $0.21/kg	1 014
Tractor hrs @ $9.43/hr for 1.7 hrs/ha	2 212
Repair and maintenance @ $1.32/hr	310
Fertilizers 60 kg of Starter/ha @ $316/t	2 616
Contact spray @ $14.05/ha	1 939
Harvest contact @ $24.00/ha	3 312
Total :	11 403
Dryland Barley :	
Seed 35 kg/ha @ $0.30/kg	420
Tractor hrs @ $9.43/hr for 1.52 hrs/ha	573
Implement repair and maintenance @ $1.32/hr	80
Fertilizer 100 kg of Super/ha @ $144.00/t	576
Contact spray @ $14.05/ha	562
Harvest contact @ $24.00/ha	960
Total :	3 171
Dryland Forage Oats :	
Seed 40 kg @ $0.25/kg	250
Tractor hrs @ $9.43/hr for 1.52 hr/ha	358
Implement repair and maintenance @ $1.32/hr	50
Fertilizer 100 kg of Starter 15/ha @ $316/t	790
Total :	1 448
Improved Natural Pasture :	
145 ha @ $10.80/ha	1 566
Grand Total :	27 590

Operating Overhead CostS

Cash :	
Rates	$ 4 400
Fuel And electricity	2 400
Repair and maintenance of plant	7 200
Repair and maintenance of improvement	2 400
Insurance	1 400
Accountant	800
Telephone	500
Labour	6 000
Total :	25 100
Non-cash :	
Depreciation	6 941
Grand Total :	32 041
Net Farm Income	38 694

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