CHAPTER IV
CRITICAL REVIEW OF THE COST-BENEFIT ANALYSIS
OF THE INDO-SWISS PROJECT, KERALA.

1. Brief Description of the Procedure of Cost-Benefit Analysis Adopted.

We shall now make a review of the cost-benefit analysis of the Brown Swiss Cross-Breeding Programme of the Indo-Swiss Project, Kerala. National Dairy Research Institute, Karmal and Indo-Swiss Project, Kerala jointly conducted this survey and the report was published in 1976. Before making a critical review, a brief outline of the evaluation study and some of the results obtained are described below.

The Indo-Swiss Project, set up with the assistance of the Swiss Technical Co-operation Service, is an important institution in the field of cattle breeding and fodder development in Kerala. The work of the Project was started in 1963 in the high ranges of Kerala. The Project aims at the creation of a new breed of cattle adopted to Indian conditions along with a systematic promotion of fodder production.

The extension activities of the Indo-Swiss Project started in 1967-68 in the high ranges of Idukki district and the programme was extended in 1969-70 to the plains in Mavelikkara region of Alleppey district. In 1973-74, a massive cross-breeding scheme was launched by the Dairy Development Department as "Special Employment Programme (SEP)". In the Southern districts of Kerala more than 300 artificial insemination centres had been established and brought under the Brown Swiss cross-breeding programme.
An evaluation study was conducted in the different extension areas of the project in 1973-74.

Multi-stage stratified sampling was adopted to cover the objectives of the study. The selection of districts was done on a purposive basis, whereas, that of sample pockets and cattle owners was done by stratified random sampling procedure. The collection of data was done according to the cost accounting method.

As far as cost-benefit analysis of Indo-Swiss Project, Kerala is concerned the following procedure was adopted:

**Project Cost**

The project cost includes all the expenditure made to establish, maintain and operate the Indo-Swiss project. Both the investment and running costs have been taken into account. The running cost, including operational expenditure, has been estimated to increase at a compound annual rate of 5.5% from 1975-76 onwards, the actual expenditures made before that year are taken from the records of Indo-Swiss Project, State Animal Husbandry Department (AHD) and Special Employment Programme (SEP).

**Project benefits**

The study is concerned with measuring only the direct benefits accruing to the cattle owners in the area in terms of additional net income from the Brown Swiss Crossbred (BSC) cows over the local Non-descript (ND) cows. The direct benefits from the project are estimated as follows:

\[
B_{t+4} = (PF)(100-PM)10^{-6} \sum_{t=(CR)}^{(CR)}(AI)_{t}^{1+}CR_{1}^{t}+\sum_{t=(CR)}^{(CR)}(AI)_{t}^{2+}CR_{2}^{t}+\sum_{t=(CR)}^{(CR)}(AI)_{t}^{n}CR_{n}^{t}R_{2}^{t}Z
\]
where $B_{t+4}$ = Annual direct benefits in $(t + 4)$th year

$PF$ = Percentage of female calves born

$PM$ = Percentage of female calves that do not enter into production

$(CR)_t$ = Conception rate (%) for the $t$th year in Idukki district.

$(CR)'_t$ = Conception rate (%) for artificial insemination (AI) units in the plains under SEP in the $t$th year

$(CR)''_t$ = Conception rate (%) for artificial insemination (AI) units in the plains under AHD in the $t$th year

$(AI)_t$ = Number of inseminations in Idukki district in the $t$th year

$(AI)'_t$ = Number of inseminations of AI units in the plains under SEP in the $t$th year.

$(AI)''_t$ = Number of inseminations of AI units in the plains under AHD in the $t$th year

$R_1$ = Additional net income per BSC cow over ND cow in Idukki district.

$R_2$ = Additional net income per BSC cow over ND cow in the plains.

The factor $10^{-6}$ came in because $PF$, $PM$, $(CR)_t$, $(CR)'_t$, and $(CR)''_t$ are expressed as percentages.

The estimates of these benefits are based on the following assumptions:

1. 50% of calves born are female and 15% of female calves will not enter into production.

2. The number of inseminations will increase at the compound growth rate of 20% for the period 1974-79, 10% during 1979-84.
5\% for 1984-89 and afterwards, no annual growth for AI units working in Idukki district and SEP in Alleppey, Trivandrum and Quilon districts. But, for AMD the average of the last five years from 1969-70 to 1973-74 is taken as the expected number of inseminations per unit in future, since these are well established and working at about near optimum capacity.

(3) The conception rate, from 1975-76 onwards is based on estimates arrived through consultations with project specialists and other experts in State Department of Animal Husbandry. Before that year actual rate is obtained from existing records available with different agencies.

To estimate the cost per litre of milk, the following components were considered important:

1) Rearing Cost
2) Maintenance Cost.

Rearing Costs

The cost of raising a calf from birth to age at first calving is important from the point of view of the producer. Investment made during this period has to return through life-time production of an animal after meeting expenses on feed, labour, medicines and other miscellaneous items. To keep the cost of rearing minimum a proper understanding of the various components of cost in different age groups is important. The average cost of rearing of calves is relatively more in the plains than in the high ranges.

Feed cost is the major component cost of rearing. For BSC calves in plains feed cost is as high as 79\% of the gross cost of rearing.
Hired labour works out to be 2.57% of the gross cost for BSC calves in the plains. The inputed value of family labour is ignored due to the fact that the opportunity cost of family labour for dairy enterprise is more or less zero.

Interest on fixed capital, interest on working capital, depreciation on cattle-shed and miscellaneous expenditure are the other significant components of the gross cost on calves.

Veterinary expenses and depreciation on assets and equipments are a minor proportion of the gross cost of rearing.

**Maintenance cost**

The average cost of maintenance of cows, lactating as well as dry is relatively more in the plains. The maintenance cost of cows in milk is substantially higher than that of the dry cows because of concentrate (production) ration given to the former.

The cost of feeding is the major component in the total cost of maintenance. For BSC cows in the plains, feed constitute about 73% for lactating cows and 70% for dry cows, of the gross cost of maintenance.

It is seen that labour does not involve much cash outlay in the sense that family labour is predominantly utilized which has opportunity cost equal to zero.

After food and labour, the major items of expenditure are the interest on fixed capital, depreciation on animals and cattle-shed. The remaining components of cost, namely, veterinary expenses and depreciation on assets and equipments, are relatively small.
Estimation of rearing and maintenance costs

The rearing and maintenance costs of animals include cost of feed, paid labour, family labour, depreciation on animals, depreciation on capital investment, veterinary aid, interest on fixed and working capital, miscellaneous recurring expenditure, less income from dung.

Particulars of feeding were recorded by actual weighment at regular intervals of a fortnight. For purchased feeds, the actual purchase price was taken, whereas, for home grown feeds, the market value was recorded.

For working out the cost of labour, actual time spent was recorded and apportioned suitably for each animal. The cost of hired labour is based on actual wage rate.

Depreciation on milch cattle has been worked out by assuming linearity based on market value of the animals. The productive life of an animal is taken as five lactations for local breed and seven lactations for BSC cows.

Depreciation on cattle-sheds was calculated for the whole year, taking 5% rate for "pucca" sheds and 10% for "Kachcha" sheds. The cost was apportioned among the different categories of animals in the ratio 1:2 for young stock and adult stock respectively.

For the cost of veterinary aid, the actual expenses were recorded. Miscellaneous expenditure includes recurring expenditure on revenue of the land and on which the cattle shed is built, cost of repairs, service charges, lighting charges for the stall and grazing fee of the animal.
The interest on fixed capital comprising assets and the initial value of animals was worked out at the rate of 9% per annum. For working capital, interest was worked out at the rate of 12% per annum taking half the period for dry cows and young stock of different age groups. For lactating cows no interest was calculated on working capital, as the producer derives income on milk as soon as he invests money.

The quantity of dung produced in the stall was recorded and evaluated on the basis of market rates. The income from dung was apportioned in the ratio 1:2:3:4 for the four groups of animals, 3 to 6 months old, 6 to 12 months old, heifers and adult animals. No income was calculated from hides etc.

The estimate of gross cost was obtained by adding the costs of all components, viz., feed, labour (both hired and family labour), depreciation on animals (except young stock and heifers), depreciation on cattle-shed, miscellaneous expenditure and interest on fixed and working capital. The net cost was reckoned by deducting income from dung from the gross cost. Since, the opportunity cost of family labour for dairy enterprise more or less equals to zero, the imputed value of family labour was deducted from the net cost.

The rearing cost was estimated on the basis of the survey data for various age groups: 0 to 3 months, 3 to 6 months, 6 to 12 months, 1 year to 2 years and 2 years to the age at first calving. The cost of calf rearing was calculated by integrating the total cost incurred for rearing animals from birth to first calving.
The estimate of average of any component of cost was obtained by adopting the following equation:

\[
\frac{\Lambda}{C^K} = \frac{1}{M_{K0}} \sum_{l=1}^{N_K} \sum_{j=1}^{M_{Kl}} C_{Ki,j}
\]

where

\[\frac{\Lambda}{C^K} = \text{Average maintenance cost or rearing cost on an item per animal and per day in the Kth category.}\]

\[C_{Ki,j} = \text{Daily maintenance cost or rearing cost on an item for the ith animal in the jth round of investigation in the Kth category.}\]

\[M_{Ki} = \text{Total number of fortnightly rounds for the ith animal in the Kth category.}\]

\[N_K = \text{Total number of animals in Kth category}\]

\[M_{K0} = \sum_{l=1}^{N_K} M_{Ki}\]

The net cost was obtained by deducting income from dung from the gross cost.

**Estimation of average daily milk yield per cow in milk**

The milk yield of individual cows was recorded by actual measurement at regular intervals of a fortnight. An estimate of average daily milk yield per animal was obtained as follows:

\[
\frac{1}{Y_K} = \frac{1}{M_{K0}} \sum_{l=1}^{N_K} \sum_{j=1}^{M_{Ki}} Y_{Ki,j}
\]
where

\( \bar{Y}_k \) = Average daily milk yield for \( k \) category of cow

\( Y_{kij} \) = Milk yield for \( i \) cow in \( j \) round in \( k \) category

\( M_{ki} \) = Total number of fortnightly rounds for the \( i \) animal in the \( k \) category

\( N_k \) = Total number of animals in the \( k \) category

\( M_{k0} = \sum_{i=1}^{N_k} M_{ki} \)

The lactation yield of a cow was obtained by multiplying the average daily milk yield during milking period by the lactation length. The average daily milk yield per milch cow was obtained by dividing the lactation yield by calving interval.

**Cost of milk production**

From the point of view of the price, that should be charged to the consumers, cost of milk production is one of the most important considerations to the producer. The study of cost of milk production can also point out the directions in which the cost of production may be brought down.

The cost of milk production, inclusive of family labour cost and exclusive of it, would have different implications. Since, family labour used in dairying in the study area has hardly any opportunity cost, the extent of cost due to family labour input did not have any impact on producers decision making.

Though the cost of maintenance per cow per day is higher for BSC cows, the cost of milk production (per litre) is the least.
The higher maintenance cost is due to the extra expenditure on feed. This extra expenditure is however more than compensated by higher milk yield. The virtue of BSC genetic potential results in a significant reduction in the cost of milk production.

Observations illustrate that economic milk production involves greater reliance on fodder which can be supplemented with concentrates. However use of concentrates will raise the cost of milk production.

Cost-benefit analysis

To study the economic viability of the Indo-Swiss Project, the three criteria, namely, benefit-cost ratio, net present value and internal rate of return were used. The following table were obtained.

<table>
<thead>
<tr>
<th>Life of Project (Year)</th>
<th>Benefit-Cost Ratio (at 10% discount rate)</th>
<th>Net Present Value (at 10% discount rate, in million Rs.)</th>
<th>Internal Rate of Return (in percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>1.22</td>
<td>14.56</td>
<td>13.78</td>
</tr>
<tr>
<td>35</td>
<td>1.32</td>
<td>19.27</td>
<td>14.28</td>
</tr>
</tbody>
</table>

The evaluation reveals that the benefit-cost ratio is greater than 1.0, net present value is positive and the internal rate of return is higher than the prevailing bank interest rate. These
findings justify the Government investments in BS cross-breeding programme of cattle.

2. Critical Review of the Procedure of Analysis

We shall now proceed to make a critical review of the project appraisal.

For the project appraisal of the Indo-Swiss Project, Kerala, all the three criteria for judging the economic feasibility of the investment, namely, the benefit -cost ratio, net present value and the internal rate of return, were evaluated. This was however unnecessary, since all of them give the same information. It may be noted that, in a significant sense, the net present value is a better guide as it yields a measure of total gains which the other two measures do not yield.

As regards the estimation of project benefits, the report admits that the study has the limitation that the indirect benefits have not been considered. However a few more limitations can be seen to be present in this analysis. We shall now discuss them one by one.

The study measured only the direct benefits accruing to the cattle owners in the area in terms of additional net income from the BSC cows over the local cows. A careful scrutiny of the regression equation will reveal that the estimated project benefit is really net project benefit, net of rearing and maintenance cost. This may be treated as a procedural error. Because formally
all the costs due to the project should be grouped together and same is also to be done for the benefits.

The interest on fixed capital was included in the maintenance cost for milch cow and the interest on fixed capital and interest on working capital were included in rearing cost upto the age at first calving. Now the Indo-Swiss Project, Kerala, is a public sector project and for a public sector project the interests are really transfer payments within the economy rather than payments for the use of a resource. Thus these interests should have been excluded in social cost calculation.

Depreciation on capital investment was also included in cost calculation. Now depreciation is an accounting mechanism employed by firms to show how much of a physical asset has been used up during an accounting period. It may be noted that the cost of the asset was incurred at the time of acquiring the asset. Since investment costs are already shown in the year when incurred, the addition of depreciation amounts to double counting.

The concept of opportunity cost which is fundamental to social cost calculation, was introduced only for the family labour and capital and no other factor. Again the opportunity cost of capital is arbitrarily assumed to be 10%. Also the social rate of discount is assumed to be 10%, which implies that the shadow price of investment $p_{kw}$ is equal to one. This implies that the society is indifferent about the investment and consumption. This can never be a situation in a developing country.
No income was reckoned from hides etc. That means scrap value of an animal was assumed to be negligible. This is not a satisfactory assumption.

Again the report says that 15% of the heifers do not enter into production. Now that using the cost component given by the report it is seen that in the plains for a BSC cow the overall rearing cost, net of dung produced at the time of first conception is Rs.1468.15. For an unproductive heifer this amount minus the sale value to a butcher, which is approximately Rs. 120.09 (since the sale value of a male calf to a butcher, weighing about 100 kg. is given to be Rs. 66.35. It thus follows that sale value of an unproductive heifer to a butcher, weighing about 181 kg. on an average is Rs. 120.09) plus Rs. 15.04, the cost incurred due to insemination which comes to Rs. 1363.10 (since fortyfive percent of the inseminations result in conception and the social cost per insemination is Rs. 6.77 assuming that more than 1200 inseminations are done per year.) is necessary to identify the heifer to be an unproductive one. This amount is a social cost for each of the unproductive BSC heifer, and we know that fifteen per cent of the female calves will not enter into production. The corresponding figure for ND cows in the plains is Rs. 870.10 (since the net rearing cost upto the age at first conception is Rs. 940.43. The average body weight at that age is 106 kg. and the average slaughter value is Rs. 70.33. The cost for insemination may be assumed to be zero.). Thus in the plains the additional social cost to be incurred for each of the unproductive BSC heifer over ND heifer is Rs. 493.00.
Additional social cost incurred due to an unproductive BSC heifer over ND heifer can be calculated, similarly for Settler Farmers and Tea Labourers in the highlands. The figures obtained are Rs. 357.32 and Rs. 121.67 respectively. On the average additional social cost incurred due to an unproductive BSC heifer over ND heifer in Idukki district is Rs. 239.50.

In analogy to the regression equation used by the report to estimate the project benefits, we can write the regression equation for this social cost component as follows:

\[ C_{t+2} = (PF)(PM) \times 10^{-6} \left( (CR)_t(AI)_t + (CR)_t(AI)_t + (CR)_t(AI)_t \right) \]

Where

- \( C_{t+2} \) = Additional annual social cost in the \((t+2)\)th year
- \( PF \) = Percentage of female calves born
- \( PM \) = Percentage of female calves that do not enter into production
- \( (CR)_t \) = Conception rate in percentage for the \(t\)th year in Idukki district.
- \( (CR)_{t'} \) = Conception rate in percentage for AI units in the plains under SEP in the \(t\)th year.
- \( (CR)_{t''} \) = Conception rate in percentage for AI units in the plains under AHD in the \(t\)th year.
- \( (AI)_t \) = Number of inseminations in Idukki district in the \(t\)th year.
- \( (AI)_{t'} \) = Number of inseminations for AI units in the plains under SEP in the \(t\)th year.
- \( (AI)_{t''} \) = Number of inseminations for AI units in the plains under AHD in the \(t\)th year.
- \( K_1 \) = Additional social cost incurred due to an unproductive BSC heifer over an unproductive ND heifer in Idukki district.
- \( K_2 \) = Additional social cost incurred due to an unproductive BSC heifer over an unproductive ND heifer in the plains.
In the present case we have \( PF = 50\% \), \( PM = 15\% \), \( K_1 = \text{Rs. 239.50} \) and \( K_2 = \text{Rs. 493.00} \). This is to be noted here clearly that the values of \( K_1 \) and \( K_2 \) that have been calculated are based on the costs given by the report and have drawbacks mentioned above. However it can easily be seen that \( C_{t+2} \) is quite a big cost component and such a big cost component was ignored by the study team.

Finally the social value of the investment was not calculated on the basis of the national parameters like shadow price of investment, marginal propensity to save for the farmers. Only the social rate of discount was used mechanically without giving the logic why that particular discount rate was used.

3. Derivation of Some Results for the Plains and Highlanders.

Assuming the cost components given by the report to be true, let us now look into the report from a different angle. Before we proceed, let us note the following points pertaining to BSC cows in the plains.

1. Average number of lactations per crossbred milch cow is seven
2. Average inter-calving period for BSC cows is \((335+131) = 466\) days of which a cow remains in lactation for 335 days and dry for 131 days.
3. Depreciation on a BSC adult milch animal is Rs. 0.34 per day
4. Slaughter value for an animal is estimated to be approximately Rs. 120.09.
5. A milch animal becomes scrap as soon as it completes seventh lactation.
(6) 45% of artificial inseminations (AI) result in conception.

(7) Cost per artificial insemination is Rs. 6.77 (assuming that more than 1200 inseminations are done per AI unit per year)

(8) Average daily maintenance cost for BSC lactating cow is Rs. 5.11 and for BSC dry cow Rs. 3.62.

(9) Since the market value of the BSC adult milch cow is not given, we calculate the expected market value from depreciation.

(10) Rearing and maintenance costs are net of dung produced and excluding family labour.

With above points in our view let us now examine the following tables:

TABLE - IV.2

Comparison of Expected Market Value and Cost of Rearing Upto the Age at First Calving in the Plains:

<table>
<thead>
<tr>
<th>Total Depreciation (Rs)</th>
<th>Slaughter Expected Market value at the age at first calving (Rs)</th>
<th>Rearing cost (Rs)</th>
<th>Net loss due to rearing (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3) (1)+(2)</td>
<td>(4)</td>
</tr>
<tr>
<td>0.34x466.6x6+0.34x335</td>
<td>120.09</td>
<td>1184.63</td>
<td>2719.42</td>
</tr>
<tr>
<td>1064.54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thus according to the report the net loss due to rearing a BSC female calf in plains from birth upto the age at first calving instead
of purchasing from the market is ₹1534.79.

Let us now calculate the net return from a BSC milch cow in the plains:

**TABLE - IV.3**

Benefits From a Milch Cow (BSC) in the Plains

<table>
<thead>
<tr>
<th>Average output per lactation (Litre)</th>
<th>Average price per litre (₹)</th>
<th>Value of output per lactation (₹)</th>
<th>Slaughter value (₹)</th>
<th>Total Benefit (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>1727</td>
<td>1.42</td>
<td>2452.34</td>
<td>120.09</td>
<td>17286.47</td>
</tr>
</tbody>
</table>

**TABLE - IV.4**

Costs From a Milch Cow (BSC) in the Plains

<table>
<thead>
<tr>
<th>Net rearing cost upto maintenance</th>
<th>Average maintenance cost/lactation/milch cow (₹)</th>
<th>Average maintenance cost for last lactation/milch cow (₹)</th>
<th>Total cost (₹)</th>
<th>Total maintenance cost (₹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>2719.42</td>
<td>5.11x335</td>
<td>5.11x335</td>
<td>105.30</td>
<td>17652.99</td>
</tr>
<tr>
<td>3.62x131</td>
<td></td>
<td></td>
<td>1711.85</td>
<td></td>
</tr>
<tr>
<td>2186.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thus the net loss due to rearing a BSC milch cow in the plains from birth upto old age is ₹17652.99 - ₹17286.47 = ₹366.52
We shall now make a similar study for highlanders that is for Settler Farmers and Tea Labourers. Let us first consider the case of Settler Farmers and for that following points are to be noted:

1. Average number of lactations per crossbred milch cow is seven.
2. Average inter-calving period for BSC cow in the case of Settler Farmers is $350 + 120 = 470$ days of which a cow remains in lactation for 350 days and dry for 120 days.
3. Depreciation on a BSC adult milch animal is Rs. 0.32 per day.
4. Slaughter value for an animal is estimated to be approximately Rs. 146.72
5. A milch cow becomes scrap as soon as it completes seventh lactation.
6. 45% of artificial inseminations result in conception.
7. Cost per artificial insemination is Rs. 6.77 (assuming that more than 1200 inseminations are done per AI units per year).
8. Average daily maintenance cost for BSC lactating cow is Rs. 2.34 and for BSC dry cow is Rs. 1.38.
9. Since the market value of the adult BSC milch cow is not given, we calculate the expected market value from depreciation.
10. Rearing and maintenance costs are net of dung produced and excluding family labour.

With above points in view, let us now examine the following table:
TABLE-IV.5

Comparison of Expected Market Value and Cost of Rearing Upto the Age at First Calving
(for Settler Farmers)

<table>
<thead>
<tr>
<th>Total Depreciation (Rs.)</th>
<th>Slaughter value (Rs.)</th>
<th>Expected market value at the age at first calving (Rs.)</th>
<th>Cost of rearing upto the age at first calving (Rs.)</th>
<th>Net gain due to rearing (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)=(1)+(2)</td>
<td>(4)</td>
<td>(5)=(3)-(4)</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
0.32 \times 470 \times 6 &+ 0.32 \times 350 = 1014.40 \\
\end{align*}

Thus we see that for Settler Farmers the net gain due to rearing a BSC female calf from birth up to the age at first calving instead of purchasing from the market is Rs. 147.89.

Let us now calculate the net return from a BSC milch cow for Settler Farmers:

TABLE-IV.6

Benefits from a Milch Cow (BSC) for Settler Farmers

<table>
<thead>
<tr>
<th>Average output per lactation (litre)</th>
<th>Average price per litre (Rs.)</th>
<th>Value of slaughter output per lactation (Rs.)</th>
<th>Total Benefit (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
1455 & 1.79 & 1731.45 & 146.72 & 12266.87 \\
\end{align*}


TABLE IV.7
Costs From a Milch Cow (BSC) for Settler Farmers

<table>
<thead>
<tr>
<th>Net rearing cost upto age at first calving (Rs.)</th>
<th>Average maintenance cost per lactation (Rs.)</th>
<th>Average maintenance cost for last lactation (Rs.)</th>
<th>Total cost of AI (Rs.)</th>
<th>Total cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1013.23</td>
<td>2.34x350</td>
<td>1.38x120</td>
<td>7845.13</td>
<td>4421.74</td>
</tr>
<tr>
<td>1.38x120</td>
<td>105.30</td>
<td>819.00</td>
<td>984.60</td>
<td></td>
</tr>
</tbody>
</table>

Thus the net gain due to rearing a BSC milch cow from birth upto the old age for Settler Farmers is Rs. 12266.87 - Rs. 7845.13 = Rs. 4421.74.

To consider the case of Tea Labourers we are to note the following points:

1. Average number of lactations per crossbred milch cow is seven.
2. Average inter-calving period for BSC milch cow in case of Tea Labourers is (339+160) = 499 days of which a cow remains in lactation for 339 days and remains dry for 160 days.
3. Depreciation on a BSC adult milch animal is Rs. 0.26 per day.
4. Slaughter value for an animal is estimated to be approximately Rs. 132.36
5. A milch animal becomes scrap as soon as it completes seventh lactation.
6. 45% of artificial inseminations result in conception.
7. Cost per artificial insemination (AI) is Rs. 6.77 (assuming that more than 1200 inseminations are done per AI unit per year).
(8) Average daily maintenance cost for BSC lactating cow is Rs. 1.05 and for BSC dry cow is Rs. 0.61.

(9) Since the market value of the adult BSC milch cow is not given, we calculate the expected market value from depreciation.

(10) Rearing and maintenance costs are net of dung produced and excluding family labour.

With above points in our view let us examine the following tables:

**TABLE IV.8**

<table>
<thead>
<tr>
<th>Total</th>
<th>Slaughter</th>
<th>Expected</th>
<th>Rearing Cost</th>
<th>Net gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciation</td>
<td></td>
<td>market value</td>
<td></td>
<td>age at first calving</td>
</tr>
<tr>
<td>(Rs.)</td>
<td>(Rs.)</td>
<td>(Rs.)</td>
<td>(Rs.)</td>
<td>(Rs.)</td>
</tr>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)=(1)+(2)</td>
<td>(4)</td>
<td>(5)=(3)-(4)</td>
</tr>
</tbody>
</table>

0.26x499x6 +0.26x339 = 132.36 998.94 336.91 662.03
866.58

Thus using the data given in the report we see that the net gain due to rearing a BSC female calf from birth upto the age at first calving instead of purchasing from the market for the Tea Labourers is Rs. 662.03
Let us now calculate the net return from a milch BSC cow for Tea Labourers:

**TABLE- IV.9**

Benefits From a Milch Cow (BSC) for Tea Labourers

<table>
<thead>
<tr>
<th>Average output per lac-</th>
<th>Average price per litre output</th>
<th>Value of Slaughter per lac-</th>
<th>Total Benefit (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>1144</td>
<td>0.91</td>
<td>1041.04</td>
<td>132.36</td>
</tr>
</tbody>
</table>

**TABLE- IV.10**

Cost From a Milch Cow (BSC) for Tea Labourers

<table>
<thead>
<tr>
<th>Net rearing cost upto age (Rs.)</th>
<th>Average maintenance cost per lactation (Rs.)</th>
<th>Total cost for last lactation (Rs.)</th>
<th>Total cost of AI (Rs.)</th>
<th>Total cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)=(1)+(2)x6+ (3)+(4)</td>
</tr>
<tr>
<td>336.91</td>
<td>1.05x339+0.61</td>
<td>1.05x339</td>
<td>105.30</td>
<td>3519.46</td>
</tr>
<tr>
<td>x 160</td>
<td>=453.55</td>
<td>=355.95</td>
<td>=3519.46</td>
<td></td>
</tr>
</tbody>
</table>

Thus the net gain due to rearing a BSC milch cow from birth upto old age for Tea Labourers is Rs. 7419.64 - Rs. 3519.46 = Rs. 3900.18

From the above discussion it is seen that both the factors we have considered above, namely, (1) Net gain due to rearing a BSC—
female calf from birth up to the age at first calving instead of purchasing from the market and (2) Net return due to rearing a BSC milch cow from birth up to the old age, is negative in the plains and is positive in highranges, that is for Settler Farmers and Tea Labourers. It can also be seen that the average lactation yield per milch cow and the average selling price of milk is highest in the plains, lower for Settler Farmers and lowest for Tea Labourers. In spite of this sequence of productivity and selling price we see that the values of the above two factors in the plains are negative and positive in highranges. The reason may be readily attributed to net rearing and maintenance costs. These costs are highest in the plains, lower for Settler Farmers and lowest for Tea Labourers. Of these rearing and maintenance costs the feed component almost makes the entire difference. The following table will give us some idea in this regard.

<table>
<thead>
<tr>
<th>Feed Cost in Extension Area (in ₹.) for BSC Cows</th>
<th>Upto the age at first calving</th>
<th>Lactating (per day)</th>
<th>Dry (per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plains</td>
<td>2280.84</td>
<td>4.08</td>
<td>2.75</td>
</tr>
<tr>
<td>Settler Farmer</td>
<td>977.31</td>
<td>1.52</td>
<td>0.67</td>
</tr>
<tr>
<td>Tea Labourer</td>
<td>191.05</td>
<td>0.47</td>
<td>0.07</td>
</tr>
</tbody>
</table>
The reason for this cost structure is mainly due to the fact that green leaves and grasses constitute a major feed component for the cattle for Settler Farmers and Tea Labourers, with opportunity cost almost zero and especially so far Tea Labourers where the cows are primarily fed on the local grasses. Grazing facility, however, is not adequately available in the plains. The nutrient available from green leaves and grasses, which is the major feed component, to the animals of Settler Farmers and Tea Labourers goes without cost.

Thus we may infer that the cases of Settler Farmers and Tea Labourers are of very special type in nature and the situation in the plains is a representative situation. We shall now make a detailed cost-benefit analysis of BSC cows in the extension area in the plains of Alleppey district, Kerala, using the initial BSC cattle as cohort and the informations available in the project report.


Since the given tables in the report are the only source of information, it is not possible to make a detailed social cost-benefit analysis of the Indo-Swiss Project, Kerala. This is because the project costs provided in the tables are inclusive of depreciation and interest on investment. It has already been noted that these two components are irrelevant in social cost-benefit analysis for a public project. Instead a
social cost-benefit analysis for BSC cows in the plains will be made treating it as a private investment project and using the given distribution of BSC cattle in the plains as the cohort.

Since, on an average a BSC cow has seven lactations and seven lactation periods cover nine years, the cohort is projected for nine years. Nine years is taken as the project life. The projection is made with the following assumptions.

1) Fifty per cent of the calves born are female.
2) Fifteen per cent of female calves will not enter into production.
3) Average age at first calving is 32 months.
4) Number of lactations per milch cow is seven.
5) Average age of a calf at the end of the year of birth is 6 months, as calvings are more or less uniformly distributed in any year.

**Project costs**

The project costs include investment made to purchase the cattle in the cohort, rearing costs up to the age at first calving, maintenance costs of milch cows and cost due to artificial insemination. For the want of information about the investment on cattle-shed, this component is accommodated in the rearing and maintenance costs of the cattle as depreciation on cattle-shed.

Thus the investment cost due to the project is only the investment made to purchase the cattle in the cohort. Rearing costs, maintenance costs and cost due to artificial inseminations are the running costs.
Rearing cost includes feed, shadow price for hired labour, veterinary expense, interest on working capital, interest on fixed capital, depreciation on cattle-shed, depreciation on assets and equipments and miscellaneous expenses.

Maintenance cost includes feed, shadow price for hired labour, veterinary expense, interest on fixed capital, depreciation on cattle-shed, depreciation on assets and equipments and miscellaneous expenses.

Rearing and maintenance costs are net of dung produced. Family labour component is excluded from rearing and maintenance costs since the opportunity cost of family labour for dairy enterprise more or less equals zero. Depreciation on animal is also not included in the maintenance cost, as this will amount to double counting. Since we are evaluating a private investment project, interests are included in these two cost components. The reason for these inclusions and discussed in the next chapter. Interest on working capital came out to be insignificant for dry cow and as a milking cow yields immediate return, no interest on working capital is calculated for this category of cow. Thus this interest component is excluded from the maintenance cost.

**Project benefits**

Project benefits in different years of the project consist of milk output, sale of unproductive heifers and value of animals at the end of ninth year. The value of the dung produced is not considered here since we have taken the rearing and maintenance costs to be net of dung produced.
Sale value of an unproductive heifer is estimated on the basis of slaughter value. According to the report, in plains, the average body weight of an adult cow is 181 kg. and the corresponding price is estimated to be Rs. 120.09.

As the values of the animals are not provided by the report, the values are estimated on the basis of the given depreciation value for an adult animal.

Cost-benefit analysis

While performing the social cost-benefit analysis on BSC cows in the plains following points are taken into account. Since the given tables are the only source of information, wherever the particular information is not available average values are used. The points are:

1) Of the (47+2) milch cows in the cohort 80% are in first lactation and the rest are in second lactation.

2) Milch cows on an average remain in milk for 335 days and remain dry for 131 days. Thus the average inter-calving period is 466 days.

3) On an average a milch cow remains in milk for 262 days and remains dry for 103 days per year.

4) 45% of the artificial inseminations result in conception.

5) More than 1200 artificial inseminations are done per A.I. unit per years so that the cost per insemination is Rs. 6.77. Hence the average expenditure per conception on artificial insemination is Rs. 15.04.

6) Unproductive heifers are identified at the age of 22 months, that is the average age of conception is 22 months.

7) Heifers are immediately sold when it is found that it will not enter into production.
8) Rearing cost and selling price of a male calf are assumed to cancel each other.

9) Average disposing price for heifers which are unproductive is Rs. 120.09

10) Average milk yield per day per milking cow is 5.157 litres.

11) Average price per litre of milk is Rs. 1.42

12) Rearing and maintenance cost values used are net of dung produced, excluding family labour, using shadow wage rate for hired labour and including feed, medical care, depreciation on cattle-shed, depreciation on assets and equipments, interests on capital investment and miscellaneous expenditure.

13) Depreciation on an adult animal per day is Rs. 0.34, that is Rs. 124.10 per year. Thus the estimated market value at first lactation or pregnancy is Rs. 1236.99.

14) The term 'pregnant' means pregnant for the first time.

15) As per requirement of the distribution of cattle, the rearing cost is sub-divided into following groups: (I) Junior calf (upto 6 months), (II) Senior calf (6 months to 18 months), (III) Unproductive heifer (18 months to 22 months), (IV) Productive heifer (18 months to age at first calving).

16) Due to lack of information, following prices are assumed as standard market prices. The idea for these prices is taken from the given depreciation rate. (I) Junior female calf = Rs. 200.00, (II) Senior female calf = Rs. 400.00, (III) Heifer = Rs. 900.00

17) Ratio of shadow wage rate to market wage rate for the social rate of discount 0.08 and 0.10 are 1.80 and 1.364 respectively.
The shadow wage rate for the hired labour has been calculated by the formula

\[ sWR = m + s_{cap} \cdot (P^{inv} - 1)w \]

where 'm' is the marginal product in present employment, 's_{cap}' is the capitalists' rate of saving, 'P^{inv}' is the shadow price of investment and 'w' is the market wage rate.

The project extension area being predominantly rural, the hired labours are primarily agricultural labourers. 'w' stands for the prevailing market wage of agricultural labourers and it is assumed to be equal to the marginal product 'm'. The agricultural wage rates for male, female and child have been provided by the report. Due to the lack of information about the proportion of hired labour utilization among male, female and child, we use the average wage rate as the value of the market wage rate 'w'. The numerical value of 'w' is found to be equal to Rs. 1.97.

The shadow price of investment, 'P^{inv}', has been calculated by the formula

\[ P^{inv} = \frac{(1-s)}{1-sq} \]

where 'i' is the social rate of discount and is assumed to have values 0.08 and 0.10; 'q' is the marginal productivity of capital and is assumed to be equal to 0.15 and 's' is the rate of reinvestment which is assumed to be equal to 0.30. Thus \( P^{inv} \) becomes equal to 3.00 and 1.91 for 'i' equal to 0.08 and 0.10 respectively. The capitalists' rate of savings, 's_{cap}', is assumed to be 0.40. A detailed discussion regarding all these national parameters have been made in the next chapter.
Thus for $i = 0.08$

$$SWR(.08) = 1.97 + 0.4(3.0-1) 	imes 1.97 = 3.546$$

for $i = 0.10$

$$SWR(.10) = 1.97 + 0.4(1.91-1) 	imes 1.97 = 2.687$$

For $i = 0.08$, the ratio of shadow wage rate (SWR) to market wage rate (MWR) is

$$\frac{SWR(.08)}{MWR} = \frac{3.546}{1.97} = 1.80$$

For $i = 0.10$

$$\frac{SWR(.10)}{MWR} = \frac{2.687}{1.97} = 1.364$$

A greater than one ratio of shadow wage rate to market wage rate may appear to be surprising in a developing country. This result is however valid. A detailed discussion on this point and also the method of obtaining the values of the national parameters used above are given in the next chapter.

The costs and benefits for each year are calculated on the basis of the distribution of the projected population.

To find the discounted present value, two social rates of discount, namely, $i = 0.08$ and $0.10$ are used. Derivation of these two values of the social rate of discount is given in details in the next chapter.
### Table IV.12

**Projected Population (Female)**

(Using the Given Crossbred Cattle Distribution in the Plains of Kerala as Cohort)

<table>
<thead>
<tr>
<th>Year</th>
<th>Lactating cow</th>
<th>Dry cow</th>
<th>Pregnant</th>
<th>Heifer</th>
<th>Senior calf</th>
<th>Junior calf</th>
<th>Unproductive</th>
<th>Scrap</th>
<th>Number of cows that will not give birth*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>47</td>
<td>2</td>
<td>71+24</td>
<td>28</td>
<td>33</td>
<td>0+1</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2nd</td>
<td>2+71+24</td>
<td>97</td>
<td>28</td>
<td>33</td>
<td>1</td>
<td>48+24=72</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>47+28</td>
<td>75</td>
<td>1</td>
<td>1</td>
<td>72</td>
<td>37+49=86</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4th</td>
<td>97+1</td>
<td>98</td>
<td>61</td>
<td>72</td>
<td>86</td>
<td>49+37=86</td>
<td>11</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5th</td>
<td>75+61</td>
<td>136</td>
<td>98</td>
<td>73</td>
<td>86</td>
<td>60+48=116</td>
<td>13</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>6th</td>
<td>98+73</td>
<td>171</td>
<td>136</td>
<td>73</td>
<td>86</td>
<td>38+45=83</td>
<td>13</td>
<td>-</td>
<td>142</td>
</tr>
<tr>
<td>7th</td>
<td>136+73</td>
<td>209</td>
<td>171</td>
<td>99</td>
<td>116</td>
<td>90+86=176</td>
<td>17</td>
<td>-</td>
<td>28</td>
</tr>
<tr>
<td>8th</td>
<td>171+99</td>
<td>270</td>
<td>209</td>
<td>71</td>
<td>83</td>
<td>176</td>
<td>134+105=239</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>9th</td>
<td>209+71-47</td>
<td>270-2</td>
<td>150</td>
<td>176</td>
<td>239</td>
<td>86+134=220</td>
<td>26</td>
<td>47+2=49</td>
<td>61</td>
</tr>
</tbody>
</table>

* Occurs due to the difference between inter-calving period and one year.

\( \leftarrow \) indicates that the two stages together cover one year.
TABLE IV.13

Social Costs of Rearing and Maintenance for the Brown Swiss Crossbred Cattle in the Plains of Kerala (In Rupees)

<table>
<thead>
<tr>
<th>Category</th>
<th>Time</th>
<th>( i = 0.08 )</th>
<th>( i = 0.10 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Junior Calf</td>
<td>6 months</td>
<td>413.10</td>
<td>410.31</td>
</tr>
<tr>
<td>Senior Calf</td>
<td>1 year</td>
<td>827.68</td>
<td>818.14</td>
</tr>
<tr>
<td>Heifer (Productive)</td>
<td>18 months</td>
<td>1641.49</td>
<td>1621.39</td>
</tr>
<tr>
<td></td>
<td>age of age to</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>age first</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>calving*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heifer (Unproductive)</td>
<td>4 months</td>
<td>308.95</td>
<td>305.23</td>
</tr>
<tr>
<td>Pregnant (For Cohort only)</td>
<td>10 months</td>
<td>1178.07</td>
<td>1163.54</td>
</tr>
<tr>
<td>Milch cow</td>
<td>1 year</td>
<td>1725.34</td>
<td>1700.26</td>
</tr>
</tbody>
</table>

\( i \) = Social rate of discount.

* For convenience of projecting the population it is assumed that the average age at first calving is 30 months instead of 32 months without changing the social cost incurred for 32 months.
**TABLE- IV.14**

Cost-Benefit Table for the Brown Swiss Crossbred Cattle in the Plains of Kerala

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Benefit (Rs.)</th>
<th>$i = 0.08$</th>
<th>$i = 0.10$</th>
<th>$i = 0.08$</th>
<th>$i = 0.10$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>94492.25</td>
<td>423832.73</td>
<td>421062.52</td>
<td>-</td>
<td>329340.48</td>
</tr>
<tr>
<td>2nd</td>
<td>276880.29</td>
<td>329188.39</td>
<td>324785.05</td>
<td>-</td>
<td>52308.10</td>
</tr>
<tr>
<td>3rd</td>
<td>330000.92</td>
<td>396121.45</td>
<td>390860.77</td>
<td>-</td>
<td>66120.53</td>
</tr>
<tr>
<td>4th</td>
<td>333240.52</td>
<td>512405.04</td>
<td>505738.80</td>
<td>-</td>
<td>179164.52</td>
</tr>
<tr>
<td>5th</td>
<td>450515.91</td>
<td>651457.48</td>
<td>642929.02</td>
<td>-</td>
<td>200941.57</td>
</tr>
<tr>
<td>6th</td>
<td>590574.44</td>
<td>787597.72</td>
<td>777044.29</td>
<td>-</td>
<td>197023.28</td>
</tr>
<tr>
<td>7th</td>
<td>731113.33</td>
<td>971830.62</td>
<td>958964.22</td>
<td>-</td>
<td>240717.29</td>
</tr>
<tr>
<td>8th</td>
<td>920455.27</td>
<td>1198297.79</td>
<td>1182466.88</td>
<td>-</td>
<td>277842.52</td>
</tr>
<tr>
<td>9th</td>
<td>1824578.15</td>
<td>1414884.10</td>
<td>1396313.44</td>
<td>-</td>
<td>409694.05</td>
</tr>
</tbody>
</table>

**Net Present Value**

- $-950901.64$ for $i = 0.08$
- $-860891.78$ for $i = 0.10$

**$i$ = Social rate of discount.**
The marginal propensity to save (Sp) for the Indian farmers is calculated to be 0.21. The calculation is shown in the next chapter.

The 'Net Present Value' of the project is the sum of the discounted net benefits over the entire project period. Multiplying this net present value by the factor \( \frac{1}{(1-Sp) + P^m\cdot Sp} \), the 'Social Value' of the net consumption benefit (C) is obtained.

For \( i = 0.08 \) \( C_{0.08} = -1350280.30 \)
and for \( i = 0.10 \), \( C_{0.10} = -1025408.20 \)

Thus for both the social rates of discount, \( i = 0.08 \) and \( i = 0.10 \), we find that taking the level of milk production, price per litre of milk, values of the different components of rearing and maintenance costs as given in the report, the social value of the net aggregate-consumption benefit of this project is negative. It may therefore be concluded that the project should not have been recommended in the plains of Kerala.

In the present analysis we have not taken into account the effect of mortality of the crossbred cows while projecting the population. However, exclusion of this factor does not alter the conclusion, because inclusion of this factor would have further added to the cost component.

For convenience in this case we have taken the average age at first calving to be 30 months instead of 32 months. This also does not affect our conclusion since here all the crossbred
cows are assumed to yield return two months early. This implies that the benefit component is inflated. The actual amount of benefit will be less.

Thus, if the above two points were taken into consideration while projecting the population, the net present value would have been a bigger negative figure than what we have got in the present case. Thus, inclusion of the above two factors while projecting the population, would have made the project further less desirable.