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REFERENCES

1. Robert E. Evenson: The Contribution of Agricultural Research and Extension to Agricultural Production, Ph.D. Dissertation, University of Chicago, 1968, quoted by Willis L. Peterson, "The Returns to Investment in Agricultural Research in the United States," in Walter L. Fishel (Ed.): Resource Allocation in Agricultural Research, University of Minnesota Press, Minneapolis, U.S.A., 1971, p. 152.
2. R.S. Ganapathy, "R and D, Marketing and Social Goals," *Economic and Political Weekly*, Vol. VIII, No. 8, February, 24, 1973.
3. Zvi Griliches, "The Sources of Measured Productivity Growth: U.S. Agriculture, 1940-60," *Journal of Political Economy*, Vol. LXXI, No. 4, August, 1963, pp. 331-346.
4. Zvi Griliches, "Estimates of the Aggregate Agricultural Production Function from Cross-Sectional Data," *Journal of Farm Economics*, Vol. 45, No. 2, May, 1963, pp. 419-428.
5. Zvi Griliches, "Research Expenditures, Education and the Aggregate Agricultural Production Function," *American Economic Review*, Vol. LIV, No. 6, December, 1964, pp. 961-974.
6. Yujiro Hayami, "Sources of Agricultural Productivity Gap among Selected Countries," *American Journal of Agricultural Economics*, Vol. 51, No. 3, August, 1969, pp. 564-575.
7. Earl O. Heady and John L. Dillon: Agricultural Production Functions, Ames, Iowa, U.S.A., 1964.
8. A.S. Kahlon, "Presidential Address—New Farm Technology—Its Implications in Agricultural Economics," *Indian Journal of Agricultural Economics*, Vol XXV, No. 4, October-December, 1970, pp. 1-14.
9. A.S. Kahlon and Karam Singh, "Returns to Investment in Agricultural Research (A Critical Review)," Occasional Paper for I.C.A.R. Committee for Estimating Returns to Investment on Research, Punjab Agricultural University, Ludhiana, 1973.
10. R. Latimer and D. Paarlberg, "Geographic Distribution of Research Costs and Benefits," *Journal of Farm Economics*, Vol. 47, No. 2, May, 1965, pp. 234-241.
11. Rakesh Mohan, D. Jha and Robert Evenson, "The Indian Agricultural Research System," *Economic and Political Weekly*, Vol. VIII, No. 13, March 31, 1973.
12. S.S. Sidhu: Economics of Technical Change in Wheat Production in Punjab (India), Ph.D. Dissertation, University of Minnesota, St. Paul, U.S.A., 1972.
13. M.S. Swaminathan, "Eighth Annual Convocation Address," Andhra Pradesh Agricultural University, Rajendranagar, August 27, 1973.
14. Jan deVeer, "Economic Evaluation of Research in the Agricultural Sciences and of Extension Work," in Policies, Planning and Management for Agricultural Development—Papers and Reports, Fourteenth International Conference of Agricultural Economists, Oxford Institute for Agrarian Affairs for International Association of Agricultural Economists, Oxford, 1971, pp. 542-550.

RETURNS ON INVESTMENT IN RESEARCH AND EXTENSION: A STUDY ON INDO-SWISS CATTLE IMPROVEMENT PROJECT, KERALA*

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An attempt has been made in this paper to estimate the returns on investment in cattle improvement programme of the Indo-Swiss Project in Kerala by computing the benefit-cost ratio, the external and internal rates of return. As the research and extension activities of the project involves public investment, this study designed to throw light on the economic viability assumes great significance.

* The basic data for this study were obtained from R. K. Patel, V. Voegele, P. Kumar, *et al.*: Economics of Cross-Bred Cattle (Report of a Survey): A Study of the Cattle Breeding Programme of Indo-Swiss Project, Kerala, National Dairy Research Institute, Karnal, 1976.

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The Indo-Swiss Project for cattle breeding was started in Kerala jointly by the Government of India, State Government of Kerala and the Confederation of Switzerland in 1963-64 with the objectives of evolving a new breed of high-yielding milch cattle adapted to Indian condition and undertaking systematic research on and promotion of fodder production. The breeding policy of the project is to evolve a milch cow with an optimal ratio of indigenous (non-descript) and exotic (Brown-Swiss) inheritance representing the adaptability, hardiness and disease resistance of the former and high yield potential of the latter breed. In this task the project is collaborating with the State Departments of Animal Husbandry and Dairy Development. The project covers the district of Idukki, Alleppey, Quilon and Trivandrum in Kerala.

The extension activities of the project were started in 1966-67 in the High Ranges of Kerala now included in Idukki district. At present, there are about 87 insemination centres providing service to nearly 68,000 breedable cows in the district. The cross breeding programme was extended to Mavelikkara region of Alleppey district in 1969-70 in collaboration with the State Department of Animal Husbandry. Finally, in 1973-74, an extensive cross-breeding programme was launched by the Dairy Development Department as 'Special Employment Programme.' The project will serve about five lakh breedable animals with a network of more than 500 artificial insemination centres at the final stage of its development.

Research activities of the project relate to the evolution of an optimal genotype having the desired qualities, determination of types and composition of feed and management practices for efficient performance of the newly created breed. Apart from the expenditure on adaptive research, the project also spends a large sum of money on extension and development activities to fulfil its broad objective of increasing milk production in the project area. It is difficult (and perhaps not desirable) to extricate the costs and benefits of research from the overall costs and benefits of the project because of the interwoven and interdependent nature of research and extension activities. Hence, for the purpose of this study, research and extension (or development) have been treated as a single entity.

METHODOLOGY

Following Schultz,[1] the value of inputs saved by adopting the new technology of milk production (Indo-Swiss Cattle Breeding Programme), a product of research and extension, is treated as benefit of the project. Benefits and costs over years are estimated by using 1973-74 prices. The methodology has been developed in five steps: (1) estimation of population of adult cross-bred cows, (2) estimation of milk production and value of inputs, (3) value of inputs saved (benefit), (4) computation of benefit as annual flow and cumulated research and extension expenditure, and (5) computation of external

1. T.W. Schultz: The Economic Organization of Agriculture, McGraw-Hill, New York, 1953.

rate of return (ERR), benefit-cost ratio (B/C) and internal rate of return (IRR). The estimation and computation procedures followed in this study are detailed below. It should be mentioned here that, for the purpose of this study, the project area is divided into two regions: (*a*) High Ranges comprising Idukki district and (*b*) Plains covering Allepey, Quilon and Trivandrum districts since the estimation parameters vary considerably over the regions. The insemination and other extension activities are conducted by the Indo-Swiss Project (ISP) directly in the High Ranges, and by the Animal Husbandry Departmnt (AHD) and Special Employment Programme (SEP) in the Plains.

Estimation of Population of Adult Cross-Bred Cows

The population of adult cross-bred cows is estimated by using the following formula:

$$N^{h}_{*\,t,j} = \sum_{k=0}^{t} A_{t-k,\,j} \cdot N_{t-k,\,j} - \sum_{k=0}^{t-p_1} A_{t-p_1-k,\,j} \cdot N_{t-p_1-k,\,j} \quad \ldots\ldots\ldots\ldots \quad (1)$$

$$N^{h}_{*\,t} = (1-m) \sum_{=1}^{n} N^{h}_{*\,t,j} \quad \ldots\ldots\ldots\ldots \quad (2)$$

j=1 for High Ranges, 2 for Plains (AHD), 3 for Plains (SEP)

where

$$\overset{*}{t} = t + G + F \quad \ldots\ldots\ldots\ldots \quad (3)$$

$$A_{t,\,j} = c_{t,\,j} \cdot f \cdot (1-g) \quad \ldots\ldots\ldots\ldots \quad (4)$$

t = years, G = gestation period in years, F = age at first calving in years, p_1 = productive life of a cross-bred cow in years, $N_{t,\,j}$ = number of artificial inseminations (AI) in t th year in j th region, $c_{t,\,j}$ = conception rate in j th region in t th year, f = ratio of female calves to the total number of calves, g = proportion of female calves which do not enter production cycle, m = mortality rate in adult cross-bred cows, $N^{h}_{*\,t,j}$ = number of adult cross-bred cows in j th region in year $\overset{*}{t}$ and $N^{h}_{*\,t}$ = number of adult cross-bred cows in the project area (all regions combined) in $\overset{*}{t}$ th year.

The estimates of number of inseminations and conception rate are given in Annexure 1. The number of inseminations depends on the total number of AI units and the intensive coverage of each AI unit. For estimating the total number of inseminations for each year after 1973-74, it is assumed that the number of inseminations will increase at the annual compound rate of 20 per cent for the period 1974-79; 10 per cent during 1979-84; 5 per cent for 1984-89 and zero per cent thereafter for AI units working in Idukki district and SEP in Alleppey, Trivandrum and Quilon districts. For AHD the average number of inseminations per unit for five years (from 1969-70

to 1973-74) is assumed to continue unchanged since the AI units of AHD are well established and working at near optimal capacity.

The conception rate (Annexure 1) from 1975-76 onwards is based on the estimates obtained in consultation with project specialists and other experts in the State Department of Animal Husbandry. For the years preceding 1975-76, the actual rates of conception are taken from the existing records of different agencies.

In estimating the number of adult cross-bred cows in t th year the sum of gestation period and age at first calving (G+F) and the productive life of a cross-bred cow (p_1) are taken to be four years and seven years respectively. The ratio of female calves to the total calves (f), the proportion of female calves which do not enter the production cycle (g), and the annual mortality rate in an adult cross-bred cow (m) are assumed to be 0.50, 0.15 and 0.07 respectively.

Estimation of Milk Production and the Value of Inputs

The estimates of milk production and the value of inputs used in the project area are obtained with the help of the following formula:

$$O_t = \sum_{j=1}^{n} N^l_{0,j.} Y^l_j + (1-m) \sum_{j=1}^{n} N^h_{t,j} (Y^h_j - Y^l_j) \quad \ldots\ldots\ldots \quad (5)$$

$$I_t = \sum_{j=1}^{n} N^l_{0,j.} M^l_j + (1-m) \sum_{j=1}^{n} N^h_{t,j} (M^h_j - M^l_j) + m \sum_{j=1}^{n} N^h_{t,j.} (R^h_j - R^l_j) \ldots (6)$$

$j = 1, 2, 3.$

where O_t = milk production (litres) in the t th year in the project area, $N^l_{0,j}$ = number of non-descript (ND) in the j th region at the beginning of the project, $N^h_{t,j}$ = number of cross-bred Brown-Swiss (BS) cows in j th region in t th year, Y^l_j = average annual milk yield (litres) per ND cow in the j th region, Y^h_j = average annual milk yield (litres) per cross-bred cow in the j th region, m = mortality rate of adult cross-bred cow, M^l_j = average annual maintenance cost (rupees) in the j th region per ND cow, M^h_j = average annual maintenance cost (rupees) in the jth region per BS cow, R^l_j = rearing cost (rupees) per ND calf from birth to the age at first calving in the j th region, R^h_j = rearing cost (rupees) per cross-bred calf from birth to the age at first calving in the j th region, I_t = value of inputs (rupees) used for the production of O_t litres of milk in the t th year.

The costs of maintenance and rearing a calf from its birth to the age at first calving and the annual milk yield per ND and the BS cow are obtained from R. K. Patel, *et al.* These costs and milk yield figures which are given in Annexure 2 are based on sample survey conducted in 1973-74 by adopting the cost accounting method.

Estimation of Inputs Saved

The value of inputs saved is estimated by the following approach:

$$S_t = I_t . P_t^* \quad \ldots\ldots\ldots\ldots\ldots \quad (7)$$

$$P_t^* = (P_t - P_o)/P_o \quad \ldots\ldots\ldots\ldots\ldots \quad (8)$$

$$P_t = O_t/I_t \quad \ldots\ldots\ldots\ldots\ldots \quad (9)$$

where S_t = value of inputs saved (rupees) in t th year, I_t = value of inputs (rupees) in t th year, O_t = milk production (litres) in t th year, P_t^* = proportionate increase in productivity of inputs (O_t/I_t) in year t over the base year 1963-64 productivity (P_o).

The value of inputs saved gives the additional expenditures on inputs that would have been required to produce O_t litres of milk in t th year by indigenous technology (ND cows). It should be mentioned that the computation of the increase in productivity of inputs implicity assumes that the productivity would remain constant without the project.

Computation of Return as an Annual Flow and Cumulated Research and Extension Expenditure

For the computation of benefit and cost it is assumed that the project has an infinite life. The accumulated depreciation and interest on capital will be used to replace the obsolete capital as and when needed. The formulae used to obtain the cumulated present value of the stream of returns (value of inputs saved), return as an annual flow, average annual future return and the cumulated present value of research and extension expenditure are given below:

$$\text{Cumulated Present Value of Returns (PVR)} = \sum_{t=0}^{T-1} S_t (1+i)^{-t} \quad \ldots\ldots \quad (10)$$

$$\text{Return as an Annual Flow (A)} = (\text{PVR}) . i/ [1(1+i)^{-T}] \quad \ldots\ldots\ldots\ldots \quad (11)$$

Present Value of Research and Extension Cost (PVC)

$$= C_T (1+i)^{-T}/i + \sum_{t=0}^{T-1} C_t (1+i)^{-t} \quad \ldots\ldots\ldots\ldots \quad (12)$$

$$\text{Average Annual Future Return (AFR)} = S_T (1+i)^{-T} \quad \ldots\ldots\ldots\ldots \quad (13)$$

where T is the number of years since inception of the project for the return or cost to become constant (36 years in the case of return and 13 years in the case of cost), i is the discount rate, S_T is the value of inputs saved in T years after the inception of the project which remains constant into perpetuity, and C_t is the research and extension cost in T years after the inception of the project which remains constant into perpetuity.

The project cost includes both the investment and operating costs. The investment cost consists of depreciation and interest on the capital. The operating cost includes expenditure of operational nature. Thus the project cost includes all the expenditure incurred to establish, maintain and operate the research and extension activities of the project. The project cost, *i.e.*, the cost of research and extension at the constant prices of 1973-74 is given in Table II. It is assumed that the expenditure on research and extension will not increase after 1975-76. The actual expenditures for the period 1963-64 to 1975-76 are obtained from the records of ISP, AHD and SEP.

Computation of External Rate of Return, Benefit-Cost Ratio and Internal Rate of Return

The external rate of return (ERR) is computed by adopting the method followed by Griliches.[2] It is given by:

$$ERR = (A + AFR)/PVC \quad \ldots\ldots\ldots \quad (14)$$

The benefit-cost ratio (B/C) can easily be derived from the external rate of return (ERR) as shown below:

$$B/C = \frac{ERR}{100\ i} \quad \ldots\ldots\ldots \quad (15)$$

As the external rate of return and the benefit-cost ratio are sensitive to the discount rate used in their computation, an internal rate of return (IRR) is computed for the sample benefit and cost streams. The IRR is defined as the rate of interest that makes the sum of the discounted present value of the flow of returns equal to the sum of the discounted present value of the flow of costs at a given point in time. That is,

$$PVR + [AFR/i] - PVC = 0 \quad \ldots\ldots\ldots \quad (16)$$

As defined above, PVR, AFR and PVC are functions of the interest rate (i) which has been computed by iterative process to satisfy the equation (16).

RESULTS AND DISCUSSION

The number of adult cross-bred cows (N_t^h), total milk production (O_t), value of inputs (I_t) and index of resource productivity (O_t/I_t) are presented in Table I. Since the insemination started through the extension activities only in 1967, the first batch of 300 cross-bred adult cows appeared in 1971. The number grew to 16,800 in 1975 and the estimated population of cross-bred cows is expected to reach a level of about 810 thousand at the end of this century. The population remains constant after the year 1999 into perpetuity.

2. Zvi Griliches, "Research Costs and Social Returns: Hybrid Corn and Related Innovations," *Journal of Political Economy*, Vol LXVI, No. 5, October, 1958, pp. 419-431.

TABLE I—POPULATION OF CROSS-BRED COWS, MILK PRODUCTION, VALUE OF INPUTS AND RESOURCE PRODUCTIVITY IN INDO-SWISS PROJECT, KERALA

Year	Number of adult cross-bred cows (thousand)	Total milk production (million litres)	Value of inputs* (million rupees)	Index of resource productivity (1963-64=100)
1964	—	140.7	225.9	100.00
1965	—	140.7	225.9	100.00
1966	—	140.7	225.9	100.00
1967	—	140.7	225.9	100.00
1968	—	140.7	225.9	100.00
1969	—	140.7	225.9	100.00
1970	—	140.7	225.9	100.00
1971	0.3	140.9	226.1	100.09
1972	0.9	141.4	226.4	100.31
1973	2.0	142.2	226.9	100.66
1974	11.3	151.8	238.1	102.39
1975	16.8	157.5	244.6	103.40
1976	25.7	166.4	254.9	104.83
1977	35.7	176.4	266.1	106.44
1978	55.8	197.1	290.4	109.00
1979	88.6	231.8	332.1	112.09
1980	133.2	279.2	389.3	115.16
1981	177.9	326.4	445.9	117.55
1982	232.5	383.8	514.2	119.85
1983	291.0	445.0	587.2	121.69
1984	356.5	510.5	665.1	123.25
1985	411.0	570.5	735.9	124.48
1986	461.8	622.4	796.4	125.50
1987	506.8	668.1	849.0	126.36
1988	548.5	711.3	898.5	127.13
1989	589.6	751.6	944.8	127.74
1990	625.8	788.3	986.7	128.29
1991	660.5	823.3	1026.8	128.75
1992	694.0	857.2	1065.7	129.16
1993	725.6	889.1	1102.3	129.52
1994	750.5	914.2	1131.1	129.79
1995	769.4	933.3	1152.9	129.99
1996	784.9	948.9	1170.7	130.15
1997	796.9	961.0	1184.6	130.26
1998	805.4	969.5	1194.5	130.33
1999	809.7	974.0	1199.4	130.53
2000	809.7	974.0	1199.4	130.53
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

* Evaluated at 1973-74 prices.

The initial milk production (140.7 million litres) remained constant until the benefit of the project started coming in 1971. Milk production increases by about seven times the initial level at the end of this century and remains constant thereafter. The increase in milk production is due not only to an increase in the population of milch cows but also to the higher milk yield of the cross-bred cows compared to the local ones. Likewise, the value of inputs used remained constant at about Rs. 226 million from the initial year 1964 to 1970. The value of inputs increases to about Rs. 1,200 million and becomes constant in the year 1999 onward. This increase is due mainly to higher costs of maintenance and rearing the female calves, in addition to an increase in population. The productivity indices computed

by using 1963-64 as the base year show that a maximum increase of 30.53 per cent will be achieved at the end of this century and will remain at this level afterwards.

Value of Inputs Saved

The value of inputs saved and the expenditure on research and extension are given in Table II. A low value of inputs saved in 1971 (Rs. 0.2 million) was due mainly to a very little (0.09 per cent) rise in productivity. However, the value of inputs saved increases with the increase in productivity over the

TABLE II—INCREASE IN RESOURCE PRODUCTIVITY, VALUE OF INPUTS SAVED AND EXPENDITURE ON RESEARCH AND EXTENSION IN INDO-SWISS PROJECT, KERALA

Year	Value of inputs* (I_t) (million rupees)	Proportionate increase in productivity (P_t^*)	Value of inputs saved*($I_t P_t^*$) (million rupees)	Expenditure on research and extension (C_t) (million rupees)
1964	225.9	0	0	0.00
1965	225.9	0	0	3.01
1966	225.9	0	0	3.06
1967	225.9	0	0	2.53
1968	225.9	0	0	3.34
1969	225.9	0	0	4.46
1970	225.9	0	0	5.53
1971	226.1	0.0009	0.2	6.34
1972	226.4	0.0031	0.7	6.25
1973	226.9	0.0066	1.5	6.22
1974	238.1	0.0239	5.7	6.77
1975	244.6	0.0340	8.3	7.60
1976	254.9	0.0483	12.3	8.94
1977	266.1	0.0644	17.1	8.94
1978	290.4	0.0900	26.1	8.94
1979	332.1	0.1209	40.1	8.94
1980	389.3	0.1516	59.0	8.94
1981	445.9	0.1755	78.3	8.94
1982	514.2	0.1985	102.1	8.94
1983	587.2	0.2169	127.4	8.94
1984	665.1	0.2325	154.6	8.94
1985	735.9	0.2448	180.1	8.94
1986	796.4	0.2550	203.0	8.94
1987	849.0	0.2636	223.8	8.94
1988	898.5	0.2713	243.7	8.94
1989	944.8	0.2774	262.1	8.94
1990	986.7	0.2829	279.1	8.94
1991	1026.8	0.2875	295.2	8.94
1992	1065.7	0.2916	310.7	8.94
1993	1102.3	0.2952	325.4	8.94
1994	1131.1	0.2979	336.9	8.94
1995	1152.9	0.2999	345.7	8.94
1996	1170.7	0.3015	352.9	8.94
1997	1184.6	0.3026	358.5	8.94
1998	1194.5	0.3033	362.3	8.94
1999	1199.4	0.3053	366.2	8.94
2000	1199.4	0.3053	366.2	8.94
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

*Evaluated at 1973-74 prices.

years and becomes maximum (Rs. 366.2 million) in 1999. This maximum value of inputs saved will be repeated each year after 1999. The expenditure on research and extension attains its constant maximum value (Rs. 8.94 million) in 1976 and continues into perpetuity.

Benefit-Cost Ratio and External and Internal Rates of Return

The external rate of return, benefit-cost ratio and the internal rate of return are given in Table III. A 93 per cent external rate of return computed by using 10 per cent discount rate means that the project yields a 10 per cent return on investment in research and extension until the year 1999 and a 93 per cent return in the future (after 1999). The benefit-cost ratio (9.3) is high enough to suggest that the project is economically viable. The external rate of return or benefit-cost ratio obtained from this study indicates a high rate of average return to investment in the Indo-Swiss cattle improvement project.

TABLE III—BENEFIT-COST RATIO, EXTERNAL AND INTERNAL RATES OF RETURN IN INDO-SWISS PROJECT, KERALA

Item	Amount (million rupees) (at 10% discount rate)
1. Cumulated returns upto 1999 year	429.6
2. Returns as an annual flow	44.4
3. Annual returns after 1999 year	11.7
4. Total annual returns (2+3)	56.1
5. Cumulated research and extension expenditure	60.3
6. External rate of return	93 per cent
7. Benefit-cost ratio	9.3
Internal rate of return	28.8%

The internal rate of return was found to be about 29 per cent—implying that on the average each rupee invested in the research and extension activities of the Indo-Swiss cross-breeding project yields a return of 29 per cent annually from the date of investment. The internal rate is lower than the external rate because of the time lag between investment and the accrual of the benefit in the initial years when the extension and development activities were on a low key. The internal rate of return obtained in this study (29 per cent) is higher than that obtained by Peterson[3] for poultry in the United States (21 per cent) and falls within the range of internal rates of return in agricultural research obtained by previous workers in India and abroad.[4]

In view of the low milk production in the country, the cattle improvement programme which has a high return to investment in research and extension should be introduced on an extensive scale to help increase not only

3. Willis L. Peterson, "Return to Poultry Research in the United States," *Journal of Farm Economics*, Vol. 49, No. 3, August, 1967, pp. 656-669.

4. Thomas M. Arndt, D. G. Dalrymple, and Vernon W. Ruttan (Ed.): Resource Allocation and Productivity in National and International Agricultural Research, University of Minnesota Press, Minneapolis, U.S.A., 1977.

the nutritional standard but also the socio-economic conditions of the people, particularly the small, marginal farmers and the landless agricultural labourers who can look forward to increased employment and additional income generated by dairy farming with the improved cattle.

ANNEXURE 1

NUMBER OF INSEMINATIONS AND CONCEPTION RATE IN THE INDO-SWISS PROJECT, KERALA

Year	High Ranges		Plains			
	ISP		AHD		SEP	
	Number	Conception rate (per cent)	Number	Conception rate (per cent)	Number	Conception rate (per cent)
1967	1,080	65.2	0	..	0	..
1968	3,293	52.0	0	..	0	..
1969	5,400	50.4	0	..	0	..
1970	6,854	54.9	51,708	38.2	0	..
1971	7,226	35.9	39,804	28.8	0	..
1972	12,223	39.6	43,896	40.3	0	..
1973	17,734	36.7	44,640	42.0	0	..
1974	20,852	41.4	90,720	42.2	12,887	35
1975	25,002	35.0	1,54,344	43.0	25,668	37
1976	30,026	37.0	1,54,344	44.0	93,786	39
1977	36,031	39.0	1,54,344	45.0	1,32,300	40
1978	43,237	41.0	1,54,344	45.0	1,58,760	41
1979	51,884	42.0	1,54,344	45.0	1,89,000	42
1980	57,072	43.0	1,54,344	45.0	2,07,900	43
1981	62,779	44.0	1,54,344	45.0	2,26,800	44
1982	69,506	45.0	1,54,344	45.0	2,49,480	45
1983	75,961	45.0	1,54,344	45.0	2,79,720	45
1984	83,557	45.0	1,54,344	45.0	3,06,180	45
1985	87,734	45.0	1,54,344	45.0	3,21,300	45
1986	92,120	45.0	1,54,344	45.0	3,36,420	45
1987	96,726	45.0	1,54,344	45.0	3,51,540	45
1988	1,01,526	45.0	1,54,344	45.0	3,70,442	45
1989	1,06,640	45.0	1,54,344	45.0	3,89,340	45
1990	1,06,640	45.0	1,54,344	45.0	3,89,340	45
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.

ANNEXURE 2

REARING COST, MAINTENANCE COST AND MILK YIELD FOR BROWN-SWISS (BS) AND NON-DESCRIPT (ND) COW IN INDO-SWISS PROJECT, KERALA 1973-74

Items	Plains		High Ranges*	
	BS	ND	BS	ND
Cost of rearing a calf from birth to age at first calving (Rs.)	2,719	1,143	868	434
Cost of maintenance per annum per milch cow (Rs.)	1,712	482	671	247
Milk production per annum per milch Cow (litres)	1,353	262	1,067	354

* The figures are weighted averages, the weights being the number of breedable cows belonging to the tea labourers and settler farmers in the High Ranges.