CHAPTER IX

SUMMARY AND CONCLUSION

This chapter summarises the main findings of the study. Basically, the study concerns itself with socio-economic aspects of rural electrification programme, attempting to analyse socio-economic factors underlying the use of electricity for irrigational purposes, which is its pre-dominant use among other uses in rural areas.

The existing stock of literature, keeping pace with the accelerating momentum of rural electrification programme in the post-Independence era, has also laid emphasis on irrigational use of electricity while analysing different facets of the programme. The stress on irrigational use of electricity in the literature emanates from emerging pattern of power use in rural areas, as also the importance accorded to the development of this use in Plan Documents. The past studies on the subject have addressed themselves to the analysis of (a) benefits and costs of the programme so as to judge the economic viability of the programme (b) financial aspects of the programme, tracing the factors responsible for unsatisfactory financial position obtaining for State Electricity Boards (SEBs) and (c) all aspects of the implementation of programme such as growth in various parameters of the programme over time and space, reviewing Government Policy and changes therein, various measures initiated by SEBs to accelerate the programme, inter-agency co-ordination, and gauging the impact of the programme on different sectors of village economy in physical terms. Despite the application of sophisticated tools, the matter of fact approach of past studies to the development of use of electricity is, therefore, quite evident. Thus conceived, the present study attempts to bridge the gap in the existing literature on the subject.

As is well-known, electricity is the cheapest among alternate sources of power for drawing water from the well for irrigational purposes. In spite of the ensuing economies through use of electricity, its use has not registered anticipated growth, and hence a hypothesis is set up that adoption of electricity as a source of motive power for lift irrigation by farming community is not basically related to cost considerations. Towards testing the above hypothesis, the study undertook a field enquiry in one of the divisions (Poona Division) of Maharashtra State Electricity Board (MSEB).

Thus, the study aims at comparing and contrasting conditions obtaining for farmers using different types of modes of lift irrigation, viz., electric motors, oil engines and bullock-operated lifts, and in case of farmers using different types of modes on their different wells, the conditions obtaining on different wells leading to adoption of different modes. As a corollary to the testing of above hypothesis, the study attempts to estimate costs of irrigation by different types of modes of irrigation.

Though the findings of the study relate to the year of enquiry (1965-66) in the villages covered by Poona Division of MSEB, the factors influencing the use of electricity as brought out by the study are of general applicability and may well be valid even to-day, since the socio-economic conditions and agrarian structure then obtaining in rural areas and observed to be influencing the use of electricity have not witnessed significant changes over these years (Chapter I).

As a backdrop to importance accorded by the study to irrigational use of electricity as also scanty development of irrigational use in electrified villages, an attempt is made to review the policy prescriptions on rural electrification programme as contained in Five Year Plan Documents and the working of MSEB, over the years. It is observed that emphasis on development of irrigational use of electricity has grown sharper in relatively recent Plan (IV, V, VI) Documents. It is also seen that in the State of Maharashtra, the agricultural use of electricity has not recorded significant growth in terms of number of pump-sets per electrified village, over the years. Further, it is found that financial position of MSEB has not shown improvement consistently over the years, and this, in the opinion of MSEB, is due to non-realisation of load in rural areas (Chapter II).

The sample design adopted for the study involved sampling at two stages, viz., selection of electrified villages and selection of different modes of irrigation within the selected villages. In selection of electrified villages, 3 characteristics were considered, namely, development or otherwise of the use of electricity for irrigational purpose in the village, year of electrification of the village, and location of the village with respect to different regions (talukas) covered by Poona Division. In selecting electric motors, due weightage was given to the size of motor expressed in terms of horse power and the time-lag in connection of motor with respect to date of electrification of village. Such of oil engines and bullock operated lifts had been selected whose places of operation could be deemed as potential places for use of electricity. In all, 75 electric motors (37.5 per cent of total motors in selected villages) 65 oil engines and 59 bullock operated lifts were studied. Corresponding to above mentioned different modes of irrigation selected in the sample, 185 farmers are covered by the study. Apart from details of costs of irrigation by selected mode, information from the respondents was also gathered in respect of their irrigational holdings, ownership pattern of their modes of irrigation and sources of irrigation, socio-economic status, etc., through canvassing schedules (Chapter III).

Details of costs of irrigation of electric motor are worked out for two predominant sizes of motors, viz., 3 HP and 5 HP. The rainfall for the reference period (June 1965-May 1966) was observed to be normal, which determined the working of electric motors. The crops irrigated by modes of irrigation in selected villages were representative of crops irrigated in the region. The costs of irrigation by electric motor is divided into (a) fixed costs consisting of depreciation charges and interest costs and (b) variable costs consisting of operation (electricity) charges and the costs of maintenance of equipment. Unit prices of different equipments were more or less stable for the motors installed in different years which determined the depreciation charge for use of motor during reference period. The variation in initial investment cost was accounted for by different sizes of pipes employed and, to certain extent, by different qualities of equipment. In the context of discriminatory rates being charged by the dealers in motors to farmers purchasing them through institutional finance as also some of the unscrupulous local elements exploiting the farmers, it is suggested that financial institutions should closely supervise the installation of motors as well as provide all guidance in selection of motors of different makes. Both the sources (owned and borrowed) played equally important role in installation of motors in the sample. Where the motor was financed out of both the sources, there was a systematic relationship between the horse power connected, total amount of investment and proportion of borrowed capital. It was observed that higher the amount of total investment, smaller was the proportion of borrowed capital. Separate rates of interests are considered for computing interest costs for two sources of finance. Interest costs were observed to be higher for motors financed out of borrowed sources and connected in relatively recent period with respect to reference period. Interest costs constituted about 25 to 30 per cent of fixed costs and about 15 per cent of total costs of irrigation.

Operational costs are computed on the basis of energy bills actually paid by the respondents, which in turn, were determined by the then prevalent tariff structure. Because of the slab system in the tariff, for the same amount of electricity consumed, less amount was billed under an infrequent meter reading as compared to the amount billed when meters were read regularly. Regular meter reading would thus augment revenue to the Board. Due to enforcement of minimum consumption guarantee and slab system in the tariff structure, operational cost per hour declined with increase in hour of operation. Like-wise, the fixed nature of certain items of maintenance such as greasing and minor repairs and overhauling led to reduction in cost incurred on them per hour with increase in the scale of operation of motor. However, expenditure on major break-down did not bear relationship with the scale of operation of motor since these breakdowns were of accidental nature. On the whole, economies of scale accrued through distribution of fixed costs as also certain expenses on items of variable costs (minimum consumption guarantee operative in respect of electric motors and expenditure on greasing, minor repairs and overhauling) which were of fixed nature, over a larger number of hours. Both, quadratic and double log fits were attempted for deriving the cost functions for electric motor, considering hours of operation as independent variable and costs per hour as dependent variable. Double log function was observed to be better fit, since it explained larger percentage variation. Due to above mentioned fixed nature of certain items of variable costs, the shape of the curve is seen to be asymptotic to both the axes. Since minimum consumption guarantee was higher in respect of 5 HP motor vis-a-vis 3 HP motor, it was observed that, all other things remaining the same, it would be economical to operate 3 HP motor between two sizes of motor at low level of operation (Chapter IV).

Costs of irrigation by an oil engine of 5 HP is worked out following the method adopted in estimation of such costs for electric motor. However, there were two distinguishing features of oil engines. One was that the engines in the sample were installed over a longer span of time as compared to the period of installation of electric motors and hence there were large variations in their initial investment costs. Older the engine, lower was its initial investment, and hence, lower was its depreciation charge. However, this advantage of old engines vis-a-vis new engines was negatived by their higher operation and maintenance costs with respect to new engines. While all the accessories of motors could be assumed to have uniform life, the same could not be assumed in respect of accessories of oil engines, since pipes of engines were of different quality being hose pipes. The life of these pipes was much less as compared to galvanised pipes used along with electric motor and was observed to be varying with the price paid per foot of such pipes. In respect of old engines, therefore, the replaced pipes have been considered for computing depreciation charges since original pipes were reported to be replaced. Further, some of the oil engines were observed to have been purchased second-hand, as against all the motors being found to be new installations. In respect of second-hand engines, the depreciation charges is computed considering price paid for the engine and the remaining years of its normal life worked out on the basis of age of engine on the date of purchase reported by the cultivators. Most of the second-hand engines as also majority of oil engines in the sample were observed to be of Kirloskar make which appeared to be popular due to its better performance in respect of consumption of fuel and maintenance cost. These engines were kept out of subsidised interest rate scheme of the Government, and hence, rate of interest considered (i.e., actual interest charged for engines financed out of borrowed funds) for computation of interest costs in respect of them was higher than in case of engines of other makes covered by subsidised scheme of the Government. Thus, for computation of interest costs for oil engines, three rates of interest are considered; one for engines financed out of owned sources and two separate rates of interest for engines financed through borrowed funds due to the exclusion of Kirloskar oil engines from the subsidised interest rate scheme of the Government. Both the sources of finance (owned and borrowed) played equally important rote in financing of engines. Share of interest costs in total costs of irrigation ranged between 5 per cent. and 18 per cent; variation being accounted by such factors as age of the engine, source of finance, size and quality of pipes and year of purchase of pipe.

Variable costs consisted of operational charges and costs for maintenance of engine incurred during the year. Oil engines required lubricating oil besides fuel for its operation. Two different types of lubricating oil and fuel were used by engines in the sample. Some of the oil engines were operated on diesel, while the others were operated by crude mixed with some quantity of petrol. Likewise, fresh lubricating oil was used for some engines, while in respect of others, reclaimed oil was used. Due to higher prices of inputs required for operation of oil engine in comparison to electricity charges, on an average, per hour operational cost of engine worked out at Rs.1.03, as against Rs.0.61 for electric motor of 5 HP. While diesel was a better quality of fuel between the two types of fuel, fresh lubricating oil was better quality oil vis-a-vis reclaimed oil. The lower quality of fuel and lubricating oil resulted in incurring of higher cost on maintenance per hour in respect of engines using such types of fuel and oil in comparison to maintenance cost incurred on engines using better quality of fuel and oil. It was also observed that age of the engine and its annual maintenance costs were positively related. Higher the age of the engine, higher was its annual maintenance cost during the year. Cost incurred on greasing the pump and oil engine was not related to the scale of operation of engine, since more or less same quantity of grease was reported to have been consumed by oil engines in the sample. Nearly 75 per cent of the engines reported expenses being incurred on minor repairs and overhauling together and over 50 per cent of the engines reported cost on overhauling being incurred during the reference period. Thus minor repairs and overhauling being undertaken regularly for engines, the cost per hour on them declined with the increase in the scale of operation of engine. Similarly, some of the spare parts appeared to have been replaced at regular interval in respect of sample engines irrespective of their level of operation. Hence, the expense on this account was observed to be of a fixed nature.

For these reasons, the shape of the cost function(double log fit) of oil engines was also asymptotic to both the axes as in the case of electric motors. However, there being no minimum consumption guarantee in respect of oil engines, the rate of fall was less at lower level of operation of oil engines as compared to the one obtaining for electric motors. On the other hand, due to fixed rate of consumption of fuel, and therefore, the cost of operation remaining constant, the curve did not taper off as much as in case of electric motors at higher level of operation. In respect of electric motors, the slab system of tariff structure contributed to tapering of the curve at higher level of operation due to reduction in average cost per hour of operation resulting from larger number of units being covered by the lowest rate of tariff prescribed under the slab system. It should be however noted that whereas total hours of irrigation in respect of motor were the hours relating to operation of motor on one well, total hours of oil engine were the sum of hours of operation of engine on all the wells where these were operated; it being a mobile mode of irrigation. Hence for a scattered irrigated holding with low requirements on all the wells, it would have been economical to operate engine, since it would not only effect savings in initial investment but also in costs of operation, which is observed to be lower for engines at low level of operation. The cost function of oil engine is observed to be intersecting cost function of electric motor of 5 HP from below at around 175 hours of operation. However, it should be noted that level of intersection of these curves is much below the level stipulated by minimum consumption guarantee for 5 HP electric motor (Chapter V).

All the costs of bullock operated lift are imputed costs since in respect of both the items of costs (fixed and variable), money costs were not expended but either payments were made in kind or in some cases, farmer had spent his own resources in other form (fodder and other feed to bullock). Further, the bullocks operated for the lift were also home-bred. Hence, opportunity cost or the cost the farmer would have incurred for purchasing the same from the market has been imputed and considered for working the cost of irrigation by this mode. Bullocks being used for many farming and non-farming operations apart from their use for irrigational purpose, no relationship was observed between size of holding and bullock holding on one hand, and requirement of bullocks for irrigational purposes and bullock holding, on the other. An assumption was therefore made regarding normal working days in a year of bullocks, on the basis of which costs of feeding bullock for idle days have been apportioned between its deployment for irrigational purposes and all other purposes. Fixed costs are deemed to be the costs of wooden structure and the costs of leather bag wherever such bags lasted for more than a year. Variable costs are defined as the costs of accessories attached to wooden structure and leather bag (since they were consumed in a year), costs of bullock and human labour and maintenance cost of leather bag.

Results of Farm Management Survey Reports in respect of certain items of maintenance cost of bullocks (upkeep value, etc.) and normal working days of a bullock in a year were used for estimating costs of bullock labour apportionable to its use for irrigation purposes. To a large extent, positive relationship was observed between expenses incurred on feed per bullock and the size of cultivated holding, since majority of the feed was produced on cultivator's own farm. Cost of human labour per day was seen to be dependent upon the proximity of village from the town. Shorter the distance of the village from the town, higher were the daily wages of casual agricultural labour. Costs on other items of variable costs were observed to be directly varying with the scale of operation of lift.

The size of lift in the sample differed according to the number of bullock pairs deployed on the lifts. It is assumed that efficiency of the lift is directly proportional to number of bullock pairs employed on lift. Thus costs of irrigation are worked out for different levels of operation expressed in terms of pair hours. In all size-groups of pair hours, predominance of variable costs in total costs was observed. On the whole, the share of variable costs in total costs was over 96 per cent. This was mainly on account of low depreciation charges and interest costs on wooden structure (item of fixed cost), which did not cost much to the farmer. Further, out of 78 leather bags, only 43 lasting for over one year got included in fixed costs.

The shape of the cost function (double log fit) of bullock lift (derived following the method as in case of electric motor and oil engine) shows much less slope in comparison to other modes of irrigation, largely on account of preponderence of variable costs in total costs of irrigation (Chapter VI).

Due to different discharge capacities of different modes of irrigation as evident from different H.P.s of electric motors and non-mechanised nature of bullock operated lift, levels of operation of these modes, and hence costs of irrigation, are not directly comparable. To facilitate their comparison, their hours of operation are reduced to a common standard, viz., one hour of operation of 5 HP electric motor. For evolving the standard, the data collected on number of irrigations and duration of each irrigations given to different crops by these modes during the reference period is taken into consideration. Five commonly irrigated crops by these modes are selected for the purpose of comparison. Further, from total number of modes of each type, such of the modes are considered which had fully irrigated these 5 crops.

For 5 selected crops, more or less stable relationship was observed between average hours of irrigation per acre of crop by different modes. Hence an attempt was made to standardise their hours of operation through evolving a formula. Simply defined, the formula for any given mode is a sum of crop-wise ratios of average hours of irrigation per acre of crop by that mode to average hours of irrigation per acre of same crop by 5 HP electric motor, with weights assigned to ratio of individual crops in proportion of total area under that crop irrigated by all the modes to total area under all the 5 crops irrigated by all the modes. Based on conversion rates so obtained, graphs in the earlier chapters of respective modes (other than 5 HP motor) are modified and costs of irrigation by different modes are compared. From the comparison of costs of irrigation of different modes, it is observed that for a scale of operation lower than 300 hours equivalent of 5 HP electric motor, it is costliest to operate 5 HP motor, followed by oil engine and 3 HP electric motor, while bullock operated lift is the cheapest to operate. However, it may be noted that operation of bullock-lift for a period equivalent to 300 hours of 5 HP electric motor actually means deployment of one pair of bullocks exclusively for irrigation purposes, and hence, unless the cultivator could afford to maintain two pairs of bullocks or could gainfully employ them, he would not opt for this mode even if requirement was equivalent to 300 hours of 5 HP motor. Further, it is observed that, though, the graph could be extended to cover any extent of level of operation, the observed values of hours of operation reflected ceilings for operation of these modes on account of technicalities involved in their operation.

The recent prices (1979-80) of electric motors and oil engines show higher increase in investment costs of electric motor of 5 HP vis-a-vis 5 HP oil engines, presumably on account of rising demand for electric motors arising out of spread of rural electrification programme, but more particularly, due to shortage of diesel in recent months. However, the influence of rise in investment cost of electric motor on the cost function of electric motor vis-a-vis that of oil engine would be negated by the disproportionate rise in operational cost of engine (i.e., fuel and oil cost) in relation to moderate rise in electricity tariff over the years. It is, therefore, observed that sum effect of the rise in fixed and variable cost would not change the relative costs of irrigation by these 2 modes obtaining at different levels, though the cost functions would shift to the right on account of absolute increase.

Incidentally, during the course of discussion on selection of standard for expressing hours of operation of different modes, it was mentioned that the officials of MSEB sometimes forced the farmers to install 5 HP electric motor, though the dealers recommended 3 HP motor on the basis of depth of well, area to be irrigated, etc. The Board officials desired installation of bigger sized motors, since these motors with higher minimum consumption guarantee ensured 15 per cent return over the investment, thus fulfilling the financial yardstick for the scheme. However, this policy was short-sighted in as much as it led to installation of bigger size transformer as also creating higher generating capacity without corresponding increase in its utilisation, thus leading to idle capacity (Chapter VII).

It is observed that socio-economic status of the farmers did influence selection of a type of mode between mechanised (oil engine or electric motor) and non-mechanised type. For instance, it is observed that a cultivator with a relatively bigger-size of holding, larger income from subsidiary occupation (thus having regular flow of cash income to meet the expenses of mechanised mode), smaller size of family and with better educational background is likely to opt for mechanisation vis-a-vis cultivators having relatively smaller holding, low income from subsidiary occupation, bigger size of family and illiterate or low level of education.

Further, it was noticed that individually owned wells offered better prospects for mechanisation in comparison to jointly-owned wells. This phenomenon was the result of system of rotation for use of well among its partners constraining the use of mechanised modes on jointly owned wells, apart from the objections from other partners of the well for an installation of a mode having higher discharge capacity. Likewise, there was relationship between net area under the command of well and type of mode employed by the farmer. Higher the net area under the command of well, better were the prospects for the well being covered by mechanised modes.

The pattern of employment of mechanised modes on jointly-owned wells revealed that oil engines had better prospects of being deployed on jointly-owned wells between two types of mechanised modes. Uncertainty in supply of power deterred the farmers from installing motor on jointly owned well having a fixed system of rotation for using the well water. Further, it was observed that the oil engine deployed on jointly-owned well was not stationary but moved from one jointly-owned well to another, or in some cases, even to fully-owned well by its owner-cultivators. Such possibilities did not exist for electric motor, being an immobile unit. The pattern of utilisation of oil engines, and in few cases of electric motors, on jointly-owned wells showed their low level of operation (in most cases, less than 100 hours in a year). However, with an increase in area under the command of well, the chances of deployment of electric motor, between two types of mechanised modes, improved, presumably for reaping the benefits of scale economies from operation of electric motor.

While mobile characteristic of oil engine and its relatively higher maintenance cost reduced the prospects of its joint-ownership, immobility of electric motor and its lower maintenance as well as operational cost fostered its joint-ownership. Thus, on a jointly-owned well, between two types of mechanised modes, the chances of an engine being installed are more vis-a-vis electric motor if it is to be an individually owned installation. But in respect of jointly-owned installations on such wells, the chances for thriving of partnership are better for an electric motor as compared to an oil engine.

Interplay of non-economic factors (such as uncertainty in supply of power, lack of rights to dispose of the engine) was observed to be stronger than that of economic factors in preventing cultivators using oil engines from switching over to electricity. In the context of a large number of cultivators using oil engine mentioning lack of rights to dispose of the engine financed through loans from institutional sources as hindrance for switching over to electricity, it is suggested that financial institutions might consider conferring such rights but at the same time keeping lien on electric motors installed out of sale-proceeds of oil engines till the loan is fully repaid. Cultivators having fragmented irrigational holdings were generally found to be averse to switch-over to electricity, since not only oil engine was operationally economical with low level of irrigational requirements on different wells, but also, being mobile, it helped in restricting total investment in mechanised lift-equipment.

However, cultivators were observed to have misconceived notions about the levels of operation of motor which would yield economies in cost, mainly on account of enforcement of minimum consumption guarantee in respect of electric motor. To dispel these misconceptions, it is suggested that MSEB should undertake propoganda compaign, demonstrating economies accruing through the use of motor vis-a-vis engine even at levels below the one stipulated by minimum consumption guarantee.

Village-wise distribution of sample engines likely to be substituted by electric motors showed slow rate of replacement of oil engines by electric motors. While the validity of the criterion adopted by MSEB of judging the potentiality of irrigational use of electricity on the basis of number of oil engines in the village is unquestionable, the estimate of likely revenue cannot be based on number of oil engines existing in the village at the time of its electrification. On the other hand, a number of oil engines were observed to have been installed in these villages after their electrification, which makes out a strong case for Board officials to maintain effective rapport with the villages even after their electrification, so that, as far as possible, farmers going in for oil engines could be brought within the fold of electricity.

It was observed that nearly 25 per cent of total electric pump-sets in selected villages showed a delay of over 6 months in their connection. Delay of two types was observed in the development of use of electricity for irrigational purpose. The first one was the result of time taken for formulation of scheme and construction of scheme, while the second type was on account of individual cultivators not availing of the supply of power even after the completion of scheme. The time taken for formulation of scheme was observed to be varying directly with the number of jointly owned wells in the scheme, the distance of the village from town and inversely with the degree of influence of local leaders over the farmers. For the schemes constructed departmentally, the time taken for construction was observed to be more than for the schemes entrusted to labour contractor for construction. The analysis of delay in connection of pumpsets after completion of scheme showed that individually owned motors took more time for connection than jointly-owned motors.Since taking electricity to the well required performing complex jobs, division of labour in respect of jointly-owned motors facilitated their relatively faster installation vis-a-vis individually owned motors. It was also observed that shift over from bullock lift to electric motor was quicker than shift over from oil engine to motor. This was due to time taken for disposing of the engine on conditions favourable to the seller as also at a price which would facilitate installation of motor with minimum additional expenses. Further, among the cultivators shifting from oil engines, the delay was observed to be less in respect of cultivators having alternate venues for deployment of engine than those not having other well where the engine could be moved after its displacement. The source of finance for electric motor also determined the delay; electric motor financed out of owned sources showing relatively less delay in connection with respect to engines financed out of borrowed funds (Chapter VIII).

Thus the analysis of factors influencing the use of electricity for irrigational purposes incline us to accept the hypothesis set out earlier. On the other hand, the analysis suggest multi-pronged action to further the cause of rural electrification, particularly energisation of wells. Areas where action needs to be initiated for popularising the use of electricity for irrigational purposes are (a) consolidation of irrigated holdings, (b) ensuring continuous supply of electricity in rural areas, (c) modifying conditions stipulated for disposal of oil engines financed through institutional sources, (d) undertaking propoganda compaign for demonstrating the economies of use of electric motor at various levels of operation, (e) maintaining effective rapport with village even after its electrification by Board officials, and last but not the least (f) encouraging formation of 'Rural Electric Co-operatives" on jointly-owned wells, where consolidation of irrigated holding is not possible.