CHAPTER I

INTRODUCTORY - REVIEW OF LITERATURE AND STATEMENT OF PROBLEM

Electricity has come to be regarded as an important factor for bringing about radical change in the socio-economic life of a community. With multifarious uses of electricity, such as for lighting and as a source of motive power, its introduction does not merely facilitate provision of better amenities but augments productive capacity in different sectors of the economy through its wide range of applications. In fact, per capita consumption of electricity is deemed as one of the indicators of the state of economic development of a nation. As can be seen from table 1.1, per capita consumption of electricity in developed countries is significantly above that in underdeveloped/developing nations. Thus, it could be seen that barring a few exceptions, there is positive relationship between per capita consumption of electricity and per capita Gross National Product of different countries.

Table 1.1 : Per capita consumption of electricity and per capital gross national product - 1975

Country	Per capita consumption of electricity* (in kwh) 1975	Per capita gross national product** (in US Dollars) 1975-76
India	143	150.51
Algeria	223	710.40
Brazil	730	988.00
Burma	25	106.07
Bangladesh	22	114.81
China Peoples' Republic	153	335.58
Ethopia	24	99.72
Egypt	280	303.29
France	3416	5755.86
Germany Federal Republic	5008	6645.26
Israel	2881	3573.49
Morocco	170	442.51
Nepal	10	108.09
Libyan Arab Republic	368	4881.89
Nigeria	51	356.45
Japan	4288	4391.06
Indonesia	26	173.18
Pakistan	135	135.83
Sri Lanka	82	144.21
Sweden	9947	7856.45
Canada	11617	6557.04
U.S.A.	9396	7013.20
U.K.	4855	3843.02
U.S.S.R.	4038	2594.42

* Source: World Energy Supplies (1971-75) Statistical Papers, Series J-20, Department of Economic & Social Affairs, United Nations, New York,1977.

** Source: Fifty Major Countries of the World (selected Statistics), Commerce Research Bureau, Bombay, December,1977.

Review of Literature :

With wide range of applications of electricity, thus providing great potentialities for economic development, rural electrification has aroused tremendous interest among academicians, journalists, planners, and a lot has been written on different aspects of rural electrification programme implemented on a large scale in the post-Independence period. The existing stock of literature on the subject has already covered different aspects of the programme such as engineering, economic and sociological, and the studies on the topic have ranged from the one analysing the programmes implemented in the country as a whole touching all aspects to those restricing its scope to the programme as implemented in certain States of the Indian Union and covering specific aspects. Besides, a number of articles/notes have been written analysing specific problems emerging out of implementation of the programme.

In the above context, the review in the following paragraphs is restricted to the literature dealing with economic/socio-economic aspects of the programme. Further, it is limited to such literature appearing in book-form because (a) by and large, this form of literature covers more ground of economic aspects of the programme, both spatially and topically than the other form and (b) other forms (articles etc.) of literature are referred to while analysing field data.

To begin with, we shall describe the most comprehensive and

exhaustive work done on the topic to date, i.e., Evaluation of Rural Electrification programme, a report prepared by the Programme Evaluation Organisation, Planning Commission, Government of India.[1] It analysed all the aspects related to the problem such as the review of Government policy on rural electrification, both Central and State Governments, the comparative financial positions of State Electricity Boards and the administrative and organisational problems involved in the planning, programming and execution of rural electrification schemes. Still more comprehensive was the survey part of the work both in terms of objective and coverage. The objective on the one hand was to assess the extent of coverage, the cost involved, the then existing pattern of power use and the disparity in use among different areas in the State. On the other hand, the objective was to analyse the problems hampering better utilisation of power in the rural areas, to find out possibilities and ways of minimising seasonal variation in the consumption of energy at the village level and to assess the direct benefits and ascertain the nature of indirect benefits from rural electrification. The study covered the then existing 15 states of the Indian Union. In all states, two districts were selected in each - one having the maximum percentage of rural places electrified (defined as 'good' district) and the other where the proportion was more or

1 Government of India, Planning Commission, Programme Evaluation Organisation, Report on Evaluation of Rural Electrification Programme, Publication No.45, New Delhi, 1965.

less equal to the average (defined as 'average' district) for the State as a whole. In each of the remaining four States where the implementation of rural electrification programme was not extensive, only one district was selected with the maximum number of rural places electrified. Thus it can be seen that purposiveness was deliberately introduced in designing the sample. This was due to the fact that one of the objectives of the survey was to study the disparity in use of electricity among different areas of the State. But by doing so, it had assumed away the disparity rather than explaining it. In short, no attempt was made to explain the disparity between the two districts of the State in the matter of percentage of rural places electrified in terms of such factors as availability of cheap source of power (Hydro versus Thermal), proximity of one district as compared to other to a cheap source of power or comparatively more rural places with population above 5000 in one district than the other. The same element of purposiveness in the sample design assumed away many important aspects which should have been analysed. This can be seen from the following description of sample design.

Within a district so selected, a frame of section offices (administrative units of State Electricity Boards) was prepared from which four section offices were selected. The procedure adopted was first to select two section offices, one having the maximum percentage of agricultural load to the total rural load and the other having minimum percentage. Out of the remaining

section offices in the frame, the one showing the maximum percentage of industrial load to total rural load was selected. The fourth section office, selected in each district, was the one that had a percentage of industrial load to the total rural load, nearest to the average percentage of industrial load to total rural load for all the section offices in the frame of selection.

All the villages within the jurisdiction of the four selected section offices in each district constituted the population for the selection of sample villages. The method of selection of villages was to classify them, first, in three groups, i.e., i) those electrified upto 31-3-1951, (ii) Those electrified between 1-4-1951 and 31-3-1956, (iii) those electrified between 1-4-1956 and 31-3-1959. Then each of these three groups of villages were classified into two categories, i.e., (i) primary agricultural and (ii) primarily industrial. Then one or two villages from each of these six groups were selected.

A village was considered primarily agricultural if the percentage of agricultural load to total connected load was higher than the percentage of industrial load to total.[1]

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1 While comparing the performance of 'good' and 'average' districts under various parameters of electrification, the villages have been further classified into 4 groups viz., primarily agricultural, primarily industrial, agricultural - industrial and others, on the basis of composition of their connected load, as under - primarily agricultural and primarily industrial villages being those where 50 per cent or more of their connected load was agricultural or industrial as the case may be, agricultural - industrial village being the one where both the types of load existed but neither came upto 50 per cent and the remaining were categorized as 'others'. (see pp.111-112, Chapter VI of the Report, ibid.)

For selection at the household level, a frame was prepared for a households in each village. The households in the frame were classified into three groups : (i) users of electricity; (ii) prospective users; (iii) non-users of electricity.

From this complicated sampling design what follows is the comparison of 'good' and 'average' districts in respect of coverage, number of consumers per village, connected load per 1000 population and annual consumption per KW of connected load. Having compared the performance of 'good' and 'average' districts in terms of above-stated broad indicators, the attempt is made to analyse the disparity between these districts in respect of use of electricity for different purposes, viz., irrigation pumping, industrial, commercial, domestic and street lighting, growth in number of consumers under each category (for example, number of pumpsets, number of electrically operated industries, number of electricity using commercial establishments, number of domestic users) and growth in connected load under each use. It should be noted that the definition of 'good' and 'average' district is in reference to only one characteristic, namely electrification, i.e., percentage of rural places electrified in the district. Furthermore, the analysis gives only the comparative picture of the two districts ('good' and 'average') with reference to above-stated indicators of performance, without explaining the disparity in the indicators.

Thus, what is found out is : "A comparison of the two

selected districts in each of the 11 States show a substantial disparity in coverage, except in Bihar and Madhya Pradesh. The disparity is more marked in respect of coverage in the State of Uttar Pradesh. The percentage of places electrified in the good district (21 per cent) located in Western Uttar Pradesh is almost 11 times of that in the average district (2 per cent) located in eastern Uttar Pradesh. Even in Madras where rural electrification has made a substantial headway, the good district shows almost five times as good coverage as the average district... "It appeared that the proportion of electrified villages with electric pumpsets was higher in the good district than in the average district in nearly all the States (except in Maharashtra). Further, the average number of pumpsets per electrified village in the good district was higher than that in the average district for seven States, notable exceptions being Gujarat and Madras...[1] and so on to, "It appears from this comparison that while the good and the average districts are more or less at par in respect of growth in the average number of pumpsets per village, the good districts show a higher growth in percentages of villages having electric pumpsets. In respect of industrial units, the growth in the percentage of villages having electrified industrial units has been more for the average districts than for the good ones, on the other hand, the good districts give a better account in respect of growth in the number of

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1 Ibid, page 7859-4.

electrified industrial units per village.... In the case of domestic load, the good districts show an index of 205 on the basis of villages covered, as compared to an index of 311 for the average districts. A similar trend is noticeable in the case of the other indicator on domestic load viz., the number of consumers for domestic load per village".[1]

From the above quotation, it can be seen that not only the disparity in the performance (where the 'good' districts have fared better) of two districts is not explained but even where the performance of an average district has been better (contrary to the expectation) it is not explained. The analysis, thus, seems to be suffering from circular reasoning. Firstly, the districts have been defined good or average with respect to the status of electrification and then the indicators on performance are compared without further explanation implying thereby that since good district is better than an average district in the matter of electrification, the better performance needs no explanation.

For an economics-oriented discussion (or analysis) on the topic, these indicators on performance should have been related to economic factors which underlie a better performance in case of one district as compared to the other. For example, a better performance by one district when compared to the other as regards the development of agricultural load in terms of more

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1 Ibid, pp.97-104.

coverage of villages by this load, more number of pumpsets per electrified village, higher level of consumption per electric pumpset may be because of the fact that the prevailing agronomical conditions in the district such as the rainfall, subsoil water conditions, and cropping pattern (more percentage of land under irrigated crops) is offering better potential for the development of agricultural load when compared to such conditions in the other district. Similarly, better performance by an industrial load in one district as compared to the other may be due to the better development of other economic overheads such as better means of communications and transport facilities, development of marketing centres or proximity to a big industrial centre which offer market to finished products in one district as compared to the other. Lastly, the so-called 'good' districts (which have maximum percentage of rural places in them electrified in the respective States as per the definition) might have been given temporal preference over the 'average' district by the respective State Electricity Boards for the very existence of such conditions, as described above, which offer better potential for load development and, therefore, better revenue as compared to the average district.

In the absence of such analysis, it appears as if the rural electrification programme is studied in isolation. However, the analysis of the status (good and average) of electrification of districts would have been well in order of the theme of evaluation,

particularly when the earlier chapter reviews the Government policy on rural electrification in detail. The said chapter discusses at length the various policy suggestions from the Centre on matters such as earmarking of power for rural schemes, priorities on rural electrification schemes, integrated programming (co-ordination of rural electrification schemes with other developmental activities at the district level) and advance planning. Furthermore, the chapter also gives the direct measures adopted by various State Governments to promote the use of electricity in rural areas which include lowering of financial yardstock,[1] low tariffs, etc. Besides this, the chapter also reviews the policy followed by State Electricity Boards to achieve balanced regional development in terms of preferences given to backward areas. In brief, most of the policy measures relate to distribution of electricity over space and over time.

Following this review, if the analysis of percentages of places electrified in the 'good' and 'average' districts in terms of various policy measures from different levels (Centre, State Government) would have been made, it would have not only helped in the understanding of disparity between the two districts but would have thrown light on the deviations in the

1 Financial yardstick is usually adopted by State Electricity Boards to sanction rural electrification schemes. The yardstick is a ratio of expected revenue from rural electrification schemes to the expected capital investment required for electrification. Unless it exceeds certain percentage, the scheme is not sanctioned. If the percentage so adopted, breaks at no-profit no-loss basis, the lowering of the yardstick by State Government involves subsidizing the scheme.

performance of State Electricity Boards from such measures in distributing electricity over space and time.

Chapter VI of the Report under review analyses the level of consumption of electricity (per capita and per consumer) and its growth over time under each category of uses of electricity (viz. agricultural, industrial, etc.). It draws comparison between the sample estimate with the All-India statistics from Central Water and Power Commission and then compares the level of consumption and its growth over time between States and between districts ('average' and 'good) of the State. The comparison of level of consumption is also carried out in terms of four groups of villages according to the nature of electricity load of the village i.e., primarily agricultural, primarily industrial, agricultural-industrial and the residual. Here again, no analysis of the factors which lead to the development of electricity in a direction such that it comes to be characterised as predominantly agricultural-purpose-electricity-consuming village or predominantly industrial-purpose-electricity-consuming village, is attempted. The analysis has, therefore, very little predictive value for the benefit of State Electricity Boards. The same can be said of comparison of consumption of electricity per connected load.[1]

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1 The connected load is in K.W. (kilo watt) while consumption is in k.w.hr. (kilo watt hour). The ratio of k.w.h. to k.w. gives the degree of utilization of connected load. Here again the analysis is in terms of comparison of utilization of connected load between different categories (between agricultural and industrial) and between districts ('good and 'average') for the

The later part of the Report discusses the impact of electrification on rural economy. As stated above, within each selected village, a frame was prepared of all households in the village. The households in the frame were classified into three groups, i.e. (i) users of electricity, (ii) prospective users (who applied for electricity but did not get connection), and (iii) non-users of electricity. The uses of electricity covered by the enquiry were : (i) power-loom, (ii) cereal processing, (iii) oil crushing, (iv) pumpsets, and (v) others. The category 'others' included uses for the purposes like commercial and domestic lighting, drawing waters from wells for drinking purposes, etc. For each of these five 'user categories' two separate lists of households were prepared, one of 'current users' and the other of 'prospective users'. Three households of 'current users' and two households of 'prospective users' were selected for each of the five categories. From the list of non-users of electricity three households were selected at random from each sample village along with one household having a diesel engine. The discussion on impact of electrification relates to the analysis of the response to the questionnaire served to these households in the sample villages.

The impact of electrification is discussed separately for each category of use, viz., agricultural, industrial, domestic,

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same category. But it is not analysed in terms of rotation of crops, availability of water (for agricultural category) or for different types of industries (for industrial category).

commercial and public lighting use. The effects of electrification are more tangible in the case of agricultural and industrial use than in the case of domestic, commercial and public lighting use. This is because the effects of electrification on agriculture (in terms of change in irrigated area, cropping pattern, employment of human and bullock labour) and on industries (in terms of change in employment, output, fuel cost) can be stated in exact quantitative terms. However, the effects of domestic use of electricity on working schedule, reading habit etc. are difficult to state quantitatively. Same is the case of effects of street lighting on the movement during nights or on feeling of security. Moreover, the effects on agriculture or industries can be translated in value terms (rupee measure of effects). But "it is not easy to put a value on the benefit of electric lights at home, nor is value likely to be the same for all households". Moreover, "certain amenities like street lights benefit not only individuals but also the group or community having these. They raise the problem of aggregation of individual and social benefits."[1]

The effects of electrification are grouped under two broad heads, i.e. (i) tangible and direct effects, (ii) intangible and indirect effects. The effects of electrification on agriculture and industries which lend themselves to quantitative assessment are categorized under the first group, while the effects of

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1 Ibid, Chapter VII, page 149.

electrification due to domestic lighting, lighting of public places and street lighting are grouped under the second category, and described in qualitative terms. Even such effects on industries which cannot be quantified (such as effects on working hours or change in working time) are discussed under the second category. However, in the Report, the quantitative assessment of the tangible effects is not in value terms but limited to such indicators which are physically quantifiable. Thus, the effects on agriculture is measured in terms of change in irrigated area (in acres), change in cropping pattern (acreage under crops), change in employment of bullock-labour and human labour (number and hour-days), but no attempt is made to estimate the resultant effect on the incomes of pumpset user due to all these effects stated separately. On the other hand, the intangible effects are stated in such terms that they cannot be measured in physically quantifiable units. Thus, the impact on reading habit, due to electric lights at home, is stated in terms of percentage of respondents reporting increase, decrease or no change.

The procedure adopted to measure the change is to compare the two situations of the user of electricity, i.e., the situation that existed before electrification with the situation that existed during the year of enquiry (situation after electrification). Secondly, even though the prospective users and non-users of electricity were selected from each of the sample villages, no attempt was made to compare their situation with

the situation of electric pumpset users to highlight the factors that delay or prevent their shifts to the use of electricity. Of course, a reference is made, in a later chapter of the Report (Chapter IX), to the difficulties that come in way of prospective users and non-users of electricity in switching over to the use of electricity. But, mostly the analysis is either in terms of viewpoints expressed by the respondents on such matters as the nature of financial difficulties (or the facilities required), the simplification of organisational set-up (lower authority be empowered to sanction the load-application), or in terms of indicating procedural delays (time-lag between the date of application and getting the connection). Even where the comparison is made, it does not go beyond the comparison of physical factors (e.g., for agricultural use, comparison of the depth and water column of the wells having pumpsets with the wells not having pumpsets).

Undoubtedly, these factors are important and should be analysed in order to look into the difficulties in the way of extension of the use of electricity in rural area. However, in a socio-economic study, other factors pertaining to socio-economic conditions of the non-users must also be considered. To cite an example, a comparison of the user and non-user (for example, pumpset user, diesel engine user and bullock-lift operator) in terms of their irrigated area, their cropping pattern (in consequence the annual water requirement), the ownership of the source

of irrigation (ownership-rights in the well), the number of irrigated plots and their location in the village (whether scattered or at one place) should be made to indicate the situation under which switch-over to the use of electricity is possible.

The other aspects of the rural electrification programme dealt in the Report are : (i) the costs of village electrification and (ii) the tariff rates. The latter aspect appears more as an appendix to the Report because they are not assessed in the sense of an evaluation. It is a matter of fact study giving a comparative picture of the types and rates of tariff structure operative in the sample areas of the States for different uses of electricity. The different aspects of the tariff structure such as line rental, minimum charges, the incidence of tariff rates (in terms of actual revenue billed category-wise) and the internal subsidization to certain categories (Agricultural category) by other categories, is described. The users' view on the prevailing tariff rates, the reasonable rates, the mode of payment and minimum charges are also analysed at the end. However, no discussion on the underlying issues[1] involved in fixing up of the tariff rates, is undertaken. As a matter of fact

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1 Discussion on such issues as implication of a flat rate or a slanting slab rate or the implications of a discriminatory tariff structure (off-peak rate and a seasonal rate) in terms of its effect on reducing demand or increasing demand during peak time and off-time, respectively and thereby reducing the costs of generation of electricity.

evaluation of tariff rates involves many other intricate issues[1] than are discussed here and a separate study can be undertaken to assess them. All the same, the discussion here is highly informative.

As regards, the costs of village electrification, it can be said that the treatment to costs is unevenly balanced between engineering and economic aspects. Admittedly, the engineering data on the components of cost are important for the understanding of the economic issues involved and the implications thereof. But, almost half of the discussion on the topic merely described the cost reducing measures adopted by various State Electricity Boards on different components of costs such as wooden poles, R.C.C. fabricated poles as against rail poles or alluminium conductors, as against copper conductors or lower ground clearance, as against higher and many others without estimating its total effect on the reduction of cost and thereby on the pace of rural electrification programme.

Secondly, the economic aspects of the costs of village electrification are analysed in the manner which has very little relevance to the field operations of the State Electricity Boards. Broadly, the line of analysis has been to compare the average village electrification cost and components thereof for different states (i) as given by the Chief Engineers of respective State

1 For discussion on issues involved, refer "Price Discrimination in Selling Gas and Electricity", by Ralph Kirby Davidson. Baltimore, John Hopkins Press, 1955, Chapters V, VI and VIII to X.

Electricity Boards (S.E.B.) in respect of a 'typical village' in their States, (ii) as collected during the field investigations for the sample villages. There is also an analysis of average cost per village for villages of different population size-groups and for the villages electrified during the First, Second and Third Five Year Plan period to indicate the movement in cost over the period. The average cost per village and its components (H.T. line, L.T. line costs) is also compared for the much-spoken four groups of villages classified by the predominence of load.

Thus, the costs considered for analysis are : (i) individual village costs,(ii) the realised costs (ex-post costs), i.e., the costs actually incurred on different items of expenditure (components of costs) and as entered into the books of the S.E.B. against the name of the village. However, while planning and executing the rural electrification programme, the S.E.B.s do not, by and large, sanction power to an individual village. Usually the scheme comprising of a group of villages is sanctioned for execution in the field.[1] The procedure, as followed by the S.E.B.s, is to estimate the costs and revenue for a group of villages on the basis of some basic data such as the map of the region showing distances of the proposed villages, and number of wells, number and type of industries for the group of villages. Then the returns are compared with the costs

1 This point is accepted by the Report, but dismissed by stating that the working out cost on a scheme basis is time-consuming job - Ibid, Chapter VIII, page 168.

to see whether the scheme satisfies the feasibility test as required by the financial yardstick. The reason for adopting a schematic approach to the execution of programme is that sometimes small-sized distantly situated villages do not pass the feasibility criterion, as dictated by financial yardstick, if they are considered individually. But if they are clubbed with villages which give higher returns than postulated in the yardstick they can derive the benefit of electrification. The analysis of the ex-post cost (and that too for individual sample villages drawn from the scheme), as attempted in the Report, in effect ignores the discussion on the choice of villages made by different S.E.B.s for inclusion in the scheme. In other words, how sparsely located villages of different population sizes are clubbed for the dispersal of the programme over a wide region is not analysed. All this apart, even the comparison of realized revenue with the actual cost is not attempted to indicate whether for the sample villages the respective S.E.B. had suffered losses or earned profits.

To sum up, though the Report on the whole deals with all the aspects of rural electrification programme, such as reviewing the Government policy suggestions, coverage of programme and its growth over time, the impact of programme on rural areas, the cost involved and the tariffs charges, exhaustively, there is no common theme around which the discussion is centred, i.e., all the aspects are treated in isolation with each other.

Secondly, even though it is explicitly stated in the preface that the socio-economic viewpoimt would be in forefront in the analytical framework, often the said viewpoint is put into the background in the actual analysis. Further, even from the evaluation point of view, the analysis is partial in two ways: (1) Though there is review of Government policy, there is no corresponding evaluation of the performance of the State Electricity Board vis-a-vis policy suggestions. (2) Even in terms of "Benefit-Cost Analysis", which is an accepted tool for evaluation purposes, the analysis, as attempted by the Report, is partial because: (a) the costs and the impact are treated separately, (b) the effects (or impact) of electrification are not tramslated in rupee terms to make them comparable with the costs, a foremost requirement of the "Benefit-Cost Analysis".

This brings us to the study of National Council of Applied Economic Research (N.C.A.E.R.) wherein the second approach to the evaluation viz., 'Benefit-Cost Approach', is carried a step ahead with the effects of rural electrification programme being translated in value terms, i.e., benefits and compared with the costs of electrification.[1] The study is confined to rural electrification programme in one of the States in the Indian Union namely, Punjab, Furthermore, it should be noted that

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1 NCAER, Impact of Rural Electrification in Punjab, 1967.

evaluation of the programme is undertaken with a limited objective[1], viz., "to rank the projects" rather than to guage the effects of the entire rural electrification programme in relation to its costs for the whole State. In other words, the objective of evaluation is to compare the benefits in relation to costs of electrification for villages of different population size-groups and thus rank the villages in order of their Benefit/Cost ratio.

Initially, 10 electrified villages belonging to four population size-groups are chosen from each of the five districts (the districts are selected with probability proportional to number of villages electrified in the district) of Punjab. Care is taken to see that within each population size-group, the selected villages are electrified in different years of the period of reference. This provision is made to account for the possibility of both benefits and costs varying for the same population size-group villages as their years of electrifications increase. Within the selected villages, four users of electricity for each category of use (Agricultural, Industrial and so on) are selected, except for the residential category, for which eight users are selected, at random. From this sample design an attempt is made to work out benefit-cost ratio for villages of different sizes and having different number of years of electrification.

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1 For full discussion on objectives of Benefit/Cost Analysis, see "Proposed Practices for Economic Analysis of River Basin Projects" prepared by the Sub-Committee on Evaluation Standards, Washington D.C., May 1950; Chapter II.

However, some obvious errors are committed in the estimation of both benefits and costs. They are discussed separately, in brief, below. Apart from this, there is some misconception of the term 'benefit' as implied in the 'Benefit-Cost-Analysis'.

i) Estimation of Benefits : The procedure adopted to arrive at the estimate of benefits is to compare the two situations of the user of electricity namely, the situation that existed year before electrification with the situation during the year of enquiry. Thus, the method relies heavily on the memory of the respondent for the estimation of benefit. Now, so long as the past is not too distant from the date of enquiry one can rely on such estimates. But, as the data show, 27 of the 50 selected villages had completed eight years of electrification when the enquiry was conducted. Under such circumstances, one feels doubts about the accuracy of the estimates, especially the estimates of the benefits received by the farmers. Accuracy of the estimates of the benefits derived by a pumpset user depend on how correctly he reports of the past, among other things, on the cropping pattern, the area under crops, besides other capital and operation and maintenance expenditure of the old lift equipment and other inputs such as bullock-hours, manhours utilized for drawing water. It is a well-known fact that most of the farmers do not maintain such detailed records[1] and to expect that they would revive such

1 The National Council concedes this point in its yet another publication: "Criteria for Fixation of Water Rates and Selection of Irrigation Projects", see page 49.

a distant past and would report accurately on such minor details, is untenable. Alternatively, what could have been done was to select few farmers using oil engine and bullock-lift[1] alongside the farmers using electric motor in each of the Selected villages to estimate the benefits of electric pumpset users (a control-block method). This method would have had the added advantage of analysing the causes of the farmers using oil engines and using bullock-lift in an electrified village and not shifting to the use of electricity.

Secondly, in the benefit-cost analysis, it is necessary to bring benefits and costs to the same level of unit of accounting before a comparison between the two can be made. In this particular case the unit has been village, partly because the objective of the study is to compare benefits and cost for villages of different sizes and partly because the costs of electrification, as maintained by S.E.B. are available at the village level only. It is, therefore, necessary that the estimates of benefits, in whatever way arrived for sample number of consumers, be brought to the village level (estimates of benefits for all the consumers in the village) before a valid comparison can be made with the costs. The procedure adopted towards this by the study is to multiply the category-wise sample estimates of benefits by

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1 When electricity comes in a village all the wells do not get connected by it at the same time. Few oil engines and bullock-operated lifts exist side by side of the electrically operated pumpsets.

inverse of sampling fraction[1] for each of the categories so as to arrive at the estimates for each category at the village level and then aggregating the category-wise benefits to derive gross benefits from electricity. The underlying assumption of the procedure is that within each category the consumption of all the users is the same. Obviously, it is unrealistic to assume so since consumption will differ from consumer to consumer depending upon his connected load, requirement, etc. In fact, the benefit should be estimated in relation to per unit of electricity consumed (per KWH of electricity consumed) within a category. However, there is no mention of estimate of the benefit in relation to per unit of consumption of electricity for each category of use and, therefore, to the extent the average consumption of electricity of sample users is higher or lower than the average consumption for all the users in a category, the estimate as arrived by the study, is an over-estimate or an under-estimate of the true benefits generated by electrification.

(ii) Estimation of Costs : The items under costs of electrification of a village considered are (a) transmission at high voltage from the tap-off point (b) transformer to step-down voltage at sub-station (c) low-voltage distribution to the consumers (d) installations and apparatus, (e) operation and maintenance. It should be noted here that since villages in the region are

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1 Where sample fraction = $\frac{\text{Number of consumers selected in the category}}{\text{Total number of consumers in the category}}$

scattered over a wide area, the usual practice followed by S.E.B. is to build a high voltage line between two points (say a generating station and a township or a city in the region) to cater the demand of the whole region. (This line is known as main line. Its voltage is 33 KV or 66 KV or 132 KV as the case may be.) Whenever a group of villages is to be electrified, this line is tapped off at various points tobring electricity to the concerned villages. At the village boundary the voltage is stepped down ('b' above) for distribution within the village at consumption points ('c' above). The 'a' above refers to building a high tension line for transmitting electricity from tap-off from the main line upto the village. It is true that the cost of main line is not allocated to the villages (to which it supplies power) to bring down the chargeable costs of rural electrification programme[1] by some of the S.E.B.s. But in "Benefit-Cost-Analysis" this cost needs to be apportioned for the villages for the reasons: (a) the cost in the said analysis is supposed to reflect the costs to entire economy of electrifying a village, (b) because in absence of main line the village would not have had the benefit of electricity and, therefore, whether charged or not in the accounting practices followed by the S.E.B., for the purposes of this analysis it should be apportioned on some principle to the villages served by it. The N.C.A.E.R. study includes costs

1 P.E.O. Report on 'Evaluation of Rural Electrification Programme', op.cit., p.172.

on items stated above for the estimation of costs of village electrification but completely ignores the discussion on the main line costs, let alone its allocation. The estimate is, therefore, an under-statement of true costs to the economy in the electrification of a village.

However, while working out benefit/cost ratio for villages of different population sizes, there is misconception about the term 'benefit' as generally implied in benefit/cost analysis. For its discussion, little diversion to the issues involved in the analysis of project-economies is necessary.

There are two ways of judging the feasibility of a project: (i) to compare the revenue that the project would yield with the costs of the project and to see whether the returns exceed the costs or not for judging the feasibility of project; (ii) to see whether the benefits that the project would generate in the economy, by way of production of more goods and services, would exceed the costs involved in the production of such goods and services for judging the feasibility of the project. While the first approach takes a limited view of the project-economies from purely-financial viewpoint, the second approach takes an all-pervasive view of the project economies. The benefits, as defined in the second approach, are "the value of the products and services resulting from project, net of all associated costs incurred in their realization".[1] They are, therefore, to be

1 "proposed practices for Economic Analysis of River Basin Project", prepared by Sub-Committee on Evaluation Standards, Washington D.C. May 1950, p.8.

distinguished from the revenue return. Thus conceived, in this particular case the benefits are, among other things, the value of farm produce, net of associated costs;[1] and not the receipts accrued to the Board by way of electricity charges paid for the consumption of electricity incurred for the production of farm produce. In contrast to this, in the actual calculations of benefit/cost ratio, the term 'benefit' has been given wide connotation by the study to include the revenue accrued to the S.E.B. for the electricity consumption over and above the value of products and services realized due to the different uses of electricity in the villages.[2] In effect, therefore, what is attempted is neither an evaluation from purely financial viewpoint nor from an economic viewpoint.

All this apart, there are some sweeping statements made, based on the comparison of category-wise benefits realized in different population size villages, to further the case of small-population size villages for electrification. The per capita benefits for agricultural category(agricultural use of electricity), industrial category and commercial category are found to be higher in smaller villages than bigger villages. From this, the

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1 Associated costs are the costs of goods and services which are required over and above the project services for the realization of benefits. Thus, in this case the associated costs are the costs of the motor, pumpset and other accessories which are required along with the electric current for the production of farm produce. In this context, it should be noted that there is no discussion on the associated costs in the study.

2 N.C.A.E.R., Impact of Rural Electrification in Punjab, op.cit., Tables 34 and 37, pp.55-57.

following conclusion is reached, "although the revenue realized by S.E.B. in small villages may not be sufficient to meet the investment costs of electrification and other costs, the benefit realized by users in smaller villages is relatively high and for this reason there seems to be a case for providing electricity to smaller villages".[1]

In the first place, the net benefits of these two population size group villages are not strictly comparable because of the procedure adopted by the Council. As stated elsewhere the procedure adopted is to compare the two situations of the users - situation as existed before electrification with the situation during the year of enquiry. Furthermore, it is to be noted that all the selected villages in the two size groups are electrified in different years and no single price level has been adopted for converting the physical units of the period before electrification, into value terms. Hence, to the extent that average prices were higher or lower in the year preceding the year of electrification of the villages of one population size group in relation to villages of other size group, there would be downward or upward bias in the comparison of benefits of one with another. Secondly, even if they are comparable and found higher in smaller population size villages, the conclusion does not follow because there is no reason to assume that factors which give rise to higher benefits in agriculture and industry due to

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1 Ibid, pp.13-14.

electrification are inversely related to the size of the village.

In brief, it can be said that the study has not appraised fully the data on hand. Neither there is much methodological discussion on the issues involved in the problem. On the contrary, there is enough evidence to prove that the concepts are misconstrued and a wrong methodology is followed. The net result is that the study does not evaluate the rural electrification programme either from financial viewpoint or from economic viewpoint.

The study, Economic Benefits of Rural Eelectrifications in Gujarat[1], conducted in the Department of Economics, M.S. University of Baroda has also attempted to apply "cost benefit" technique to electrification projects, by estimating social cost of electrification and comparing the same with the benefits stemming out of the electrification of rural areas in Gujarat State. A sampling design with probability proportion to both the dates of electrification of villages and their size of population for all the four major regions of Gujarat has been evolved for the purpose of study.[2] Besides, methodology has been evolved, which is indeed an improvement over similar studies conducted in the past, for segregating costs of electrification of rural areas from the

1 V.N. Kothari, and M.M. Dadi : Economic Benefits of Rural Electrification in Gujarat, M.S. University of Baroda, 1977.

2 In the sample design adopted for our study, we have also given weightage to date of electrification of the village as well as the taluka (region of the district) in which it is located.

published data on Investments under different heads, assets, etc. of State Electricity Board in its Annual Reports. The study has also addressed itself to discussion on various concepts, i.e., shadow pricing, discount rates, etc.[1] so necessary for quantifying social benefits of electrification projects. Further, while selecting a particular method for valuation of goods emanating from the project (electrification of rural areas), the study has analysed the relevant Approaches (UNIDO V/s. OECD Approaches)[2] for evolving a suitable criterion for evaluation of investment project.

Since the electricity is one of the alternate sources of energy and supply of electricity is nothing but "producer good" used as an input in the production of final output by different category of users save in case of domestic lighting consumers, the estimates of benefits from rural electrification have been provided at three different levels as under :

- Social benefits of total output arising out of cost-differences of resource-saving resulting out of substitution of electricity for an alternative source, which provides the lower limits of the benefits.
- Estimate of benefits by applying both the cost differences attributed for part of the total output which could have been obtained even with alternative sources and the other part

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1 See Chapter IV, pp.90-93, V.N. Kothari & M.M. Dadi, op.cit.

2 Ibid, see pp.94-97.

3 [illegible], p.172.

which could not have been obtained through alternative sources being arrived through value added approach.

- Estimate of benefits considering whole of output or service produced by electricity as value added. This estimate gives the upper limit of the benefit, since it assumes extreme situation that it is the electricity which only creates all the benefits.

The study favours the second estimate of benefits as a criterion to judge the desirability of investment.[1]

As major portion of benefits arises out of cost-difference due to substitution of electricity, an attempt is made in the study to estimate the cost of alternative sources of power for different uses (irrigational uses, industrial uses, domestic lighting, street lighting and public water works) of electricity in rural areas. For estimating portion of benefits (i.e., additional water lifted attributable to electrification) which could not have been obtained through alternative sources, assumptions have been made regarding the capacity of oil engines vis-a-vis electric motors as also working of electric motors vis-a-vis oil engines, etc. Needless to state that electrification of rural areas has been found to be an economic proposition, i.e., net benefit/cost ratio exceeding zero.[2] Finally, an upper limit (break-even) of investment in electrification, meeting the

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1 Ibid, Chapter IX, p.172.

2 V.N. Kothari & M.M. Dadi, op.cit.

criterion of social benefit cost analysis, has been arrived at.

In the first part of the study, spatial electricity distribution policy of the State Electricity Board has been studied by analysing the characteristic features of the electrified places vis-a-vis non-electrified places and average size of distances of 'small, medium and large-sized villages',[1] from the nearest towns. Also, impact of electrification of rural areas has been described in terms of number of connections, connected load, growth of industrial load, and its resultant effect on employment, growth of irrigational load and intensity of mechanisation of wells, etc.

As could be seen from the above, the emphasis of the study has been to analyse the justification or otherwise of the investment on the electrification of rural areas. Since the process of mechanisation was almost complete,[2] by the time the study was undertaken, no attempt has been made to analyse the factors influencing the growth of electricity in rural areas particularly for irrigational use, in terms of socio-economic conditions obtaining in these areas. In fact, the connected load and the consumptions of electricity for the reference period (i.e. 1972-73) have been taken as datum for estimating the benefits of electrification. Our study attempts to analyse the factors influencing the growth of electricity for irrigational use of electricity which is the pre-dominant use in rural areas. In other words,

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1 Ibid, Chapter II, p.13.

2 Ibid, Chapter III, p.55.

socio-economic conditions underlying the choice of electricity, among other sources of power for irrigation have been analysed in our study.

Yet another study on rural electrification programme in Gujarat State conducted by Indian Institute of Management (Ahmedabad), has attempted to analyse the problems relating to the Programme from different angle. The mimeographed report entitled 'Studies on economics of rural electrification and lift irrigation - Gujarat State' is an exercise in application of Managerial Economics to problems of rural electrification.[1] As such, the study is geared to facilitate decision-making at three levels[2], viz.,

(a) at apex level of State Electricity Board concerning selection of villages for electrification;

(b) at middle level (Executive Engineers) of management of State Electricity Board in matters relating to selection of wells for electrification with a view to enhancing revenue to the Board, and

(c) decision-makers at various levels, i.e., State Department of agriculture, banking organisations and farmers in regard to investment decisions for selection of mode (dieselisation versus electrification) of lift irrigation.

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1 Patel, S.M. and Patel, K.V.: Studies on Economics of Rural Electrification and Lift Irrigation (Gujarat State). Indian Institute of Management, Ahmedabad (Mimeographed), 1969.

2 For details, see Chapter I, particularly, pp.7-11 of the Mimeographed Report.

For the fulfilment of the above objectives, a field survey was conducted in selected villages of 2 sub-divisions of Gujarat State Electricity Board. Further, case-studies of farmers employing different modes of irrigation was conducted to focus attention on economics of alternate modes of lift irrigation. Incidentally, it may be noted that the findings of the study under reference have been widely quoted in the study conducted by M.S. University of Baroda - Economic benefits of rural electrification in Gujarat - cited earlier.

The shift in policy of the Board from general purpose electrification to special purpose (agricultural) electrification for the small villages is found to be justifiable, with revenue return on latter type of villages being observed to be greater than the same on former types of villages.[1] Within the electrified villages, revenue from pre-tested wells is observed to be higher than that from untested wells. Further, as a result of better utilisation of installed capacity on tested wells, the load factor of the network is also observed to be higher, thus showing improvement in the rate of return over investment. In the light of above-mentioned observed phenomenon, the study has suggested revision in the present policy of granting agricultural connections as also the teriff for irrigational use of electricity with a view to inducing the farmers to test their wells and install motors of appropriate sizes so that the load factor would be improved.[2]

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1 See Chapter II, for details.

2 See Chapter 4, pp.65-69.

In the latter chapter, the cost of operations of an oil engine vis-a-vis electric motor is analysed in great details, establishing functional relationship between total costs of irrigation and levels of operation of these two modes of irrigation. Further, the gains to (a) the farmers wishing to electrify the wells not yet tapped for power-operated pumps, and (b) farmers desirous of shifting from oil engine to electric motors, are worked out separately.[1]

The implication of these gains to the farmers in terms of financing future rural electrification programme are brought out in clear perspective.[2]

Based on cost comparisons of two modes of irrigation the study recommends electrification of dieselised wells as also wells of small farmers so as to maximise benefits to the farmers. However, the choice of technique between different alternatives of modes of irrigation does not solely depend on cost-considerations. The structure of irrigated holding of the farmers also determines the choice of particular mode of irrigation because of peculiarities of these two modes of irrigation. Our study attempts to analyse the factors, besides cost of irrigation, determining the farmer's choice of particular mode of irrigation.

The study conducted by the National Institute of Bank Management (NIBM) has attempted to analyse the financial viability

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1 See Chapter 5.

2 Ibid, see page 111.

of rural electrification scheme for one of the districts (Jalgaon District) in Maharashtra.[1] Since the nationalisation of major commercial banks in July 1969, the banks in public sector have been assisting the State Electricity Boards in their rural electrification schemes. As the title of the book suggests - Appraisal of Rural Development project through system Analysis - the study analyses the validity of the underlying assumptions of costs and revenue forecasts of the Board in respect of one of the rural electrification schemes financed by the public sector bank.

Since bulk of the load of electricity in rural areas pertain to its use for irrigational purpose[2], a detailed analysis of ground water potential of the district is undertaken to find out the validity of the estimates of the Board in respect of wells proposed to be connected under the scheme. Towards this end, the data on water sheds in the district provided by Groundwater Survey & Development Agency (GSDA) is scrutinised in depth which is supplemented by observations made through visit to field[3] on resharging of wells, ground-water potential, cost of wells,etc. It is important to note that the study has revealed that the Board's expectations on the number of agricultural connections under the scheme are highly optimistic[3] and are untenable in consideration of groundwater potential.

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1 Patil, R.K., Datye, K.R., Bhide, S.B.: Appraisal of Rural Development Projects Through Systems Analysis - A Case Study of Rural Electrification Programme, NIBM, 1976.

2 Ibid, see Chapter IV, p.41. 3. Ibid.

3 Ibid, also see Appendix 4B to 4F, pp.95-102.

In a latter chapter, the authenticity of the revenue estimates of the scheme provided by the Board is tested in the light of past performance of electric pumps operating in different parts (talukas) of the district. Here again, the analysis is confined to estimates regarding irrigational use of electricity. As in the case of number of connections, it is found that 'the Board's estimates of energy consumption appear to be over-optimistic.... The results of the past performance do not lend support to the norm of energy consumption[1] provided by the Board.

Based on the normal utilisation of pump supported by past performance, groundwater potential, etc., a model[2] is built up, stipulating minimum number of agricultural connections required for financial viability of the cost of network (taluka-wise) under the scheme. These minimum number of agricultural connections so derived for financial viability of the scheme is found to be far in excess of additional wells proposed for energization under the scheme, by the Board. In other words, therefore, the number of wells proposed under the scheme is found to be insufficient for break even of investment in view of the normal utilization of pumpset in the district.

As electricity is producer's input as far as its agricultural use is concerned, an attempt is made in the study to gauge the impact of electricity at the farm level for a few important irrigated crops.

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1 Ibid, See Chapter V, p.60.

2 Ibid, pp.64-66.

Using secondary data on farm economics from various sources, the benefits (net returns) have been compared with annual costs for acre-feet of water lifted in different selected talukas of the district. Unfortunately, the benefits have not been precisely defined in relation to costs of irrigation through alternative sources (such as oil engine, bullock lift) of irrigation as attempted in the study conducted by M.S. University of Baroda. Hence the net benefits are found to be inversely varying with the cost of digging the well which depends on topographical conditions. The study has, therefore, not compared the costs of irrigation through alternate sources with a view to stipulating required levels of operation for promoting use of electricity for irrigational purposes. However, the following observation from the study is relevant for our work. "What is technically and economically feasible may not be workable at the field level due to fragmentation of holdings in certain areas. This would impose a further limitation on the growth of load. In-depth analysis of the farm economies of different sizes of holdings is, therefore, very much necessary to judge the overall viability of rural electrification of new problems such as sharing of well waters among the small holders... etc."[1] Our study tries to focus attention on such problems relevant for growth of use of electricity for irrigational purposes.

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1 Ibid, p.72.

Another study conducted by the NIBM on rural electrification in Maharashtra focuses its attention on the financial stresses and strains arising out of the programme undertaken by Maharashtra State Electricity Board (MSEB) between 1970-75[1]. The Board, as mentioned earlier, carries out its rural electrification programme with the loan assistance available from nationalised banks and other financial institutions like Agricultural Finance Corporation, Rural Electrification Corporation, Agricultural Refinance and Development Corporation and the State Government.

As rural electrification, by its very nature, is the least remunerative activity of Electricity Boards, the loans-advances to them have to be on liberal terms.[2] While on the one hand commercial bank finance could be said to be the costliest as the rate of interest is tied with the Bank Rate, State Government loans on the other hand could be termed as the cheapest inasmuch as this finance is available at a low rate and maturity period is also quite flexible.

The study has traced the origin of the financial strains and stresses caused to the Rural Electrification (RE) Schemes. Normally, the strains arise from two sources : (a) cost escalation of the inputs during implementation of the schemes, and (b) deviations of realised benefits from projected ones, adding to the burden of interest payable and the stipulated instalments.[3]

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1 National Institute of Bank Management, Financial Aspects of Rural Electrification (Mimeographed), 1977.

2 Ibid, page I-3.

3 Ibid, see Page I-4.

The method used in the study, especially to analyse the effect of cost escalation, is based on cost data and on the schemes as designed in the project reports. The analysis has been done in respect of 44 RE Schemes and 10 Intensive Electrification (IE) Schemes, but the data are presented together by groups of schemes for reasons of brevity.[1] While estimating the effects of cost escalation for completing the schemes, prices of inputs, as prevalent in March 1975 have been used.

The second source of financial stress, viz., deviations from the projected benefits have been discussed in Chapter IV of the study.[2] Scheme-wise, the revenue realisable and the annual working expenses have been estimated. The revenue estimates have been worked out on two alternatives: (i) working hours and physical targets are taken as assumed in the original project reports, with change in time-phasing, necessitated by deviations from the original time pattern, and (ii) realisable revenues are estimated on the basis of working hours, load development patterns observed in the past and physical targets, modified on the basis of recent achievements. The net surplus on or deficit under both these situations have also been calculated for each of the schemes.

The analysis shows that the MSEB would be incurring a consolidated loss of about Rs.12 crores on the 44 RE Scheme till 1981.[3] This loss would be marginally increasing till 1985. However, it

1 Ibid, see Page III-1 and IV-3.
2 Ibid, see Page IV 1-4.
3 Ibid, see Page IV-6.

has been estimated that the Board will have to find cash only to the tune of Rs.6.5 crores till 1981 to honour the interest commitments to RE and other working expenses exclusive of depreciation.

The cumulative loss on the 10 IE Schemes in expected to be Rs.17 crores by 1979. Some of the reasons cited for these staggering losses are : (i) high interest rates charged by commercial banks; (ii) optimistic assessment of realisable revenues; and (iii) capital cost escalation.[1] IE Schemes are likely to constitute a big drag on the Board's financial position for years to come.

Another interesting point made out in the study is that apart from rural programmes, the financial situation of all the State Electricity Boards is quite unsatisfactory.[2] Quoting from the Fifth Plan document, the study states that despite further tariff revision, 12 Boards are expected to incur a loss of Rs.106 crores in the current year.[3] This aspect cannot be lost sight of in assessing the financial resources that could be made available for rural electrification programmes in the country.

Suggesting possible alternative policies that the Board should follow, the study has pleaded for a revision in the rate for rural electric supply. The Board further should go in search of sources of relatively low interest finance. One such source is the Agricultural Refinance and Development Corporation (ARDC).

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1 Ibid, see Page IV 7-8.

2 Ibid, see Page V-1.

3 Govt. of India, Planning Commission : Fifth Five Year Plan, Oct. 1976, p.37.

Another method to raise low cost finance is the issuance of debentures and/or deposits from beneficiaries.[1] While this is being done presently, it has to be added that it is done in an irrigational manner. The farmers are asked for deposits, debentures, etc. before the benefits of electric supply start flowing. A system has to be developed whereby additional capital funds from beneficiaries are sought, when they are in a position to pay.[2]

In contrast to studies undertaken by the NIBM, the Report of the Planning Department of Government of Maharashtra has attempted to analyse the programme implemented by MSEB from entirely different angle.[3] A brochure - like Report of the planning Department attempts to assess the performance of the MSEB as an aid to the programme of agricultural development. Towards this end, spot enquiries were conducted in 5 to 6 villages each, having more than 3 years of electrification from 8 districts of Maharashtra State. However, the emphasis of the enquiry appears more on the administrative matters, i.e., to find out the extent of co-ordination among different agencies in charge of agricultural development in the implementation of rural electrification programme. As such, the officials of various agencies such as Zilla Parishad, District Land Development Bank, District Collectorate were associated along with the Officials of the MSEB with the survey.

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1 'Financial Aspects of Fural Electrification', op.cit.

2 Ibid, see Page VI-6.

3 Government of Maharashtra, Planning Department, Report of an Evaluation Enquiry of Rural Electrification Scheme, (Mimeographed), 1966.

The Report contains good commentary on the factors accounted in planning the programme of rural electrification by the MSEB and on the criteria of selection of villages for implementing the programme. The choice of sample villages has been evaluated in the light of prospects of development of agricultural (irrigational) load. Further, an attempt has been made to look into the shortfall in realisation of estimates of agricultural load in the selected villages and to ascertain its causes from Sarapanchas,[1] Land Development Banks, Block Development Offices and the MSEB. Unfortunately, despite involvement of so many agencies, no field survey of beneficiaries (pump set users) and non-beneficiaries was carried out with a view to obtaining further corrobarative evidence on causes of shortfall gathered from above-mentioned agencies or for finding out the factors influencing the use of electricity for agricultural purposes.

Summary of Approaches of Past Studies :

As could be seen from the above review of literature on the subject, 3 distinct approaches have been adopted in analysing the problems pertaining to rural electrification programme, as under :

As revealed by the studies of M.S. University of Baroda and the NCAER, 'Cost-benefit' technique has been applied to rural electrification programme with a view to finding out the justification for investment on the programme and ranking the projects within the programme inter se. On the other hand, the studies undertaken by the NIBM have mainly analysed the financial aspects

1 Elected head of village body known as 'Grampanchayat'.

of the programme, testing the validity of assumptions underlying forecasts of revenue and costs and identifying factors responsible for stresses and strains in Board's financial position. While certain other studies, mainly conducted by the Government agencies/departments, have blended both the above mentioned approaches in analysing the implementation of programme by State Electricity Boards, but with less rigour. These latter type of studies have also highlighted administrative aspect of implementation of the programme, thus reviewing the government policy, emphasizing inter-agency co-ordination and enumerating the Board's organisational and procedural matters related to rural electrification programme.

However, there is one common feature discernible in the analysis of data in all the above-mentioned studies on rural electrification, which is the importance attached to agricultural (irrigational) use of electricity. Though these studies accorded importance to agricultural use of electricity in rural areas, they had not addressed themselves to analysis of mechanics of development of agricultural load in the background of socio-economic conditions obtaining in these areas and the inherent weakness of agrarian structure. Despite the laudable efforts of the studies relating to 'cost-benefit' analysis of electrification of rural areas to further the cause of their electrification, these studies appear to have assumed away the development of load of electricity. On the other hand, the other studies (PEO Report, NIBM studies and Report of Government of Maharashtra) though had

undertaken the analysis of development of agricultural use of electricity, it was only confined to physical factors like ground-water availability, depth of wells, water columns or administrative aspects like sanctioning powers for the load, procedural delays, inter-agency co-ordination, etc. Thus it could be seen that analysis of development of use of electricity in terms of socio-economic conditions obtaining in rural areas was to a large extent not attempted in the past. The present study, therefore, attempts to bridge this gap in the existing literature by concerning itself to analysis of factors influencing the use of electricity for irrigational purposes, highlighting the role of gamut of socio-economic conditions.

Statement of Problem :

In the context of scanty development of agricultural use of electricity and non-realisation of its anticipated growth, we set up a hypothesis that adoption of electricity as a source of motive power for lift irrigation by farming community is not basically related to the cost considerations. In other words, socio-economic conditions obtaining in rural areas and the present agrarian structure override cost considerations in adopting electric motor, though relatively cheaper among alternate modes of irrigation.

Approach to the Study :

As the testing of hypothesis necessarily involved field

survey of farmers in electrified villages employing electric motors and other alternate modes of irrigation, the study undertook the same in one of the administrative units (Division) of Maharashtra State Electricity Board (MSEB). The study was undertaken in 1965-66 and the results of field survey relate to the period 1965-66. However, it may be observed that the findings of the survey are even valid to-day, particularly in the light of the fact that agrarian structure has not undergone substantial change and State Electricity Boards have still not been able to tap large number of consumers for irrigational use of electricity. Further, though the factors observed to be influencing the use of electricity in the analysis essentially pertain to conditions obtaining in the selected Division of MSEB, they are not specific to local conditions and, therefore, would also be traced in other parts of the country.

In the context of emphasis on irrigational use of electricity among its different uses in the study, a resume of Policy prescriptions on rural electrification programme from Five Year Plan Documents and the working of MSEB over the years is also given to serve as background for gauging the importance accorded to this use of electricity in rural areas.

Objectives of Study :

Since electricity is one of the alternate sources of motive power for lift irrigation purposes, it was necessary for testing

the above-mentioned hypothesis, to compare and contrast situation obtaining for farmers employing electricity with those of farmers deploying alternate sources of irrigation. The mode of irrigation using electricity as source of power being electric motor, while the modes of irrigation using alternate sources of power were (a) oil engine (b) bullock operated lift in the areas covered by the study.

Further, the choice of any one of the modes of irrigation by a farmer being, among other things, related to costs of irrigation by that mode, as a pre-requisite of the analysis of factors influencing irrigational use of electricity, the study attempts to estimate costs of irrigation by different modes.

Although, ideally speaking, one would have liked to compare and contrast situations of distinct group of farmers employing different modes of irrigation, in reality it was not possible to classify farmers into such groups due to the following reason. On account of fragmentation of holdings, the farmers' irrigated holdings were divided and scattered into number of irrigated plots, each having different source of irrigation. In certain cases, farmers having number of irrigated plots coming under the command of different wells, had employed different types of modes to irrigate them. Hence, analysis of factors influencing the use of electricity for irrigational purposes boiled down to -

(i) analysis of choice of techniques (modes of irrigation) of the same farmer on his different irrigated plots in certain cases; and

(ii) Wherever possible, comparing and contrasting the socio-economic conditions of farmers using electric motor vis-a-vis those using oil engines or bullock-operated lifts.

Area for the Study:

As stated earlier, one Division of MSEB was selected for the purpose of study and the field survey was conducted for the period 1965-66. The field survey as also the preliminary work of the study were financed through a fellowship sponsored by the Gokhale Institute of Politics and Economics, Poona. Since the survey had to be conducted single handed, to keep the work-load in manageable proportion and to minimise time spent on travelling, a Division of the MSEB was selected whose offices were in proximity of place of work, so that the information from records of MSEB for purposes of field survey could easily be obtained. The office of Poona Rural Division of MSEB was located in Poona city itself and hence this Division was selected.

Outline of the Study :

The major part of this study is based on the results of field investigation conducted in sample villages selected for fulfilling the objectives of study.

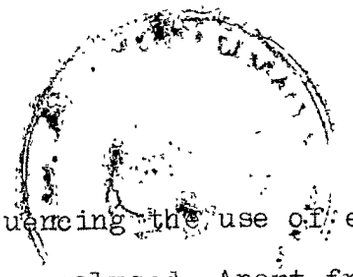
In Chapter II, we have presented historical perspective to rural electrification programme as implemented during the Plan periods, as also the working of MSEB, since the study related to its jurisdictional areas. The review of electrification

policy is intended to serve as backdrop in understanding the emphasis on irrigational use of electricity in the study.

In Chapter III, we have presented survey methodology, spelling out, inter alia, sample-design, sources of data, method of collection of data, etc.

In subsequent 3 chapters (Chapters IV, V and VI), an attempt is made to analyse costs of irrigation by electric motor, oil engine and bullock-operated lift, respectively. Having analysed major components (fixed and variable) of costs of irrigation by the respective modes of irrigation, an attempt is made to establish relationship between the costs of irrigation by a mode and its level of operation.

In Chapter VII, an attempt is made to compare costs of irrigation by different types of modes. Since discharge capacities of 3 types of modes are different, the costs of irrigation for various levels of operations worked out for respective modes in earlier chapters are not directly comparable. To facilitate their comparison, an attempt is made in the chapter to evolve a norm for expressing the levels of operation of 3 types of modes. Further, since the costs of irrigation by these modes were worked out for the year 1965-66 based on then prevalent prices of equipment, fuel, electricity, etc., an attempt is also made in this chapter to update the costs of irrigation, considering the current prices.



In Chapter VIII, factors influencing the use of electricity for irrigational purposes have been analysed. Apart from costs of irrigation influencing the choice of mode, the important role played by other factors like the ownership right in source of irrigation, the composition of irrigated holding, disposability of mode prior to electrification, socio-economic status of the farmer, local leadership, etc. in the development of use of electricity is highlighted.

Chapter IX summarises the findings of the study.