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RAPPORTEUR'S REPORT

ON

ECONOMICS OF RURAL ELECTRIFICATION

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In all 20 papers, relating to one or other aspect of the economics of rural electrification in India, have been submitted for discussion. The papers may, for convenience, be grouped under the following heads, depending on the aspect of the problem to which attention has been devoted in them :

(1) Papers relating to the general problem of rural electrification and the performance in this field in various States of India.

(2) Policy in regard to rural electrification followed by the State Electricity Boards, and the economic merits of alternative policies in terms of their profitability to the Board.

(3) General impact of rural electrification on the extent of irrigation, cropping pattern including extension of high-yielding varieties of crops, and greater use of fertilizers and other inputs.

(4) Comparative cost of irrigation with the help of electric and diesel engine operated pumps, and traditional water lifting devices.

(5) The price of electricity for agricultural purposes, and an examination of benefit-cost ratio of electrically operated lift irrigation systems from this point of view.

(6) Estimate of future demand for electricity in rural India.

(7) Methods and problems of financing rural electrification, with particular reference to the problem of small farmers.

Not all topics have attracted the same attention. By far the largest number of papers relate to the question of relative cost of different methods of lifting water, though even on this rather straightforward question, the handling of data leaves much to be desired. On most other topics the treatment tends to be rather general, so much so that even with specific micro studies the questions that should have appropriately been raised at that level have gone unnoticed. We shall summarise below the basic contention of the various papers under the heads noted above.

I

The general problems of rural electrification are discussed in quite a few papers, like those of B. N. Sahu and Narayan Sugayya who touch on most aspects of the problem, but do not discuss any aspect in particular at length. Usha Dar in her paper presents the available official statistics giving an overall picture of growth of rural electrification in India during the last two decades. The paper refers to the

significant increase in the number of villages in India served with electric power, the number of wells fitted with electrically operated pumps for irrigation, electrically operated tube-wells, etc. It shows that while a very large per cent of the bigger villages has been electrified the proportion of the smaller villages served with electric power is very small. These proportions also vary considerably from State to State: Madras and Kerala show the most significant extension of electric power into rural areas with more than two-thirds of the villages electrified, while Assam and Orissa have hardly one per cent served with electricity. Extension of electricity to rural areas is a rather expensive proposition and naturally the larger villages have been greater beneficiaries than the smaller ones.

In this connection, a point raised by Sahu in his paper may be noted. He refers to the finding of an earlier survey by the Programme Evaluation Organisation of the Planning Commission, that in different States'electrification of a village' means different things. This presumably introduces an element of non-comparability into the data on the extent of rural electrification in different States; but the point has not been clarified in either Usha Dar's or the other papers that refer to such data.

II

In the matter of extension of electricity to rural areas, there has been a shift of policy or emphasis sometime back. As K. V. Patel points out in his paper, till 1965 the general approach was to supply electricity to villages for domestic use as well as for use in farms and small industrial establishments. After 1965 the policy was changed to emphasis on motive power for agriculture. Patel's paper argues that this change has been for the better in Gujarat, because compared to the revenue that the Eelectricity Board could get from motive load connections, the investment was smaller than was the case with non-motive load connections. The resources for investment being limited, the changed policy decision saved the Board from incurring losses, and at the same time enabled a greater expansion of electric power supply for agricultural purposes in Gujarat. The paper shows that net revenue to the Board as percentage of investment in power connections for agriculture as well as industry was much higher in both the sets of villages studied (the ones electrified under the old policy and the ones under the new) than in the case of non-motive connections. This is particularly so in the case of villages electrified under the old scheme. However, it is interesting to note that the ratio of net revenue to investment in the case of agricultural connections in the villages under the new scheme is not very different from that for non-motive connections in the villages under the old scheme. Similarly, the ratio of net returns to investment in the case of agricultural connections in the new scheme villages was a little over half that in the old scheme ones. The author explains these differences by saying that in the new scheme, villages were smaller. No indication, however, is given about the smallness of these villages, nor is it quite clear how that is very relevant, when the number of load connections in each of these villages is not very different from that in the old scheme villages. There may be a number of circumstances responsible for this, but the point has been left without adequate examination.

Gujarat is one of the States in India where use of electric power for irrigation has made the most headway, and the State Electricity Board appears to have finally

turned the corner recently in regard to its income position. In this context, it would have been interesting to have some studies relating to the States of Madras and Kerala where unlike in Gujarat, electricity has gone to most of the villages.

One of the major difficulties of rural electrification is the cost of transmitting power from the source to the well-head or the village street. The cost of power to the rural consumer can be kept low and the revenue to the Board can be kept high if this cost of transmission can be brought down or/and the demand for power in the village can be increased. R. C. Agrawal and S. C. Jain in their paper give hypothetical examples of the cost of getting power at the well-head, depending upon whether the transmission line is high tension or low, the distance over which the transmission line has to be drawn, the number of consumers, and the amount of power consumed. And they make the obvious point that given the distance and the nature of the main transmission line, it is only the increased consumption of power that can bring down the per unit cost of transmission. Sahu in his paper quotes the data supplied in the Report on the Evaluation of the Rural Electrification Programme by the Programme Evaluation Organisation of the Planning Commission to show the wide divergences in various items of this cost of extending power to consumers in rural areas in different States. While this is partly due to accounting practices, it appears it is also partly technical. Unfortunately, none of the papers discusses either the technical or the accounting and economic aspects of this cost. Usha Dar refers to the lack of uniformity in the allocation of capital costs between rural and non-rural electrification, as well as the ununiform rates of interest and the unstandardized service charges that the State Electricity Boards have to bear.

The other way of reducing the transmission cost per unit of power, and thereby increasing the revenue to the Electricity Board is to see that use of power increases. S. M. Patel and K. V. Patel in their paper argue that the factors affecting revenue are the price of electricity, the size of electric motor (horse power), and the number of hours the motor is worked. They say since the price cannot be raised (why, they do not state) and the consumption per hour of operation per horse power is technically fixed, the other two factors matter. But increasing the horse power of the motor will mean lesser hours of work, unless the requirement of water on farm can be raised at the same time. While it may be possible to charge lower rates for higher slabs of consumption (here the earlier assumption of no change in price of power is being abandoned!) and thereby induce farmers to use more power, the ultimate limit will be set by the amount of water in the well. From this the authors proceed to suggest that it is best that power connections are given on a priority basis to users who have wells of proved capacity. A statistical enquiry of two sets of electric pumps—one with prior testing (in the sense that the pumps on these wells were being operated with diesel engines before electrification) and one without—show that the revenue yield to the Board was higher with the former. This amounts to saying that priority should be given to electrifying those wells where lifts are being worked with diesel engines. Any other kind of lift will not provide the necessary test for the potentiality of the well with an electrically operated lift, as, for example, is seen from R. M. Mohan Rao's paper.

Besides the total utilization of power, there are other factors that also affect the cost of electricity supply to the consumer. The seasonality of demand for

electricity is one of these. Sahu refers to this point in a general way, but it would have been more useful to find out how far fluctuations in load factor in agriculture affect the cost of power generation and supply, and the way this can be reduced, in any specific situation.

III

Once electricity is made available for agriculture, the impact of it is seen in the changes in area under irrigation, changes in cropping pattern, and the other concomitants of timely and adequate water supply. Quite a few papers seek to illustrate this point with specific enquiries in different parts of the country. S. P. Dhondyal and G. N. Singh studying two groups of villages in Uttar Pradesh, one where electricity is available and another where it is not, try to show that as a result of electrification the area under irrigation and intensity of cropping have increased, and there has been a greater shift in area in favour of the high-yielding varieties of crops and sugarcane. Naturally, application of fertilizers and insecticides has increased and so have per acre yield and marketed surplus of many crops; investment in fixed capital assets like pumping sets is greater, and value of land has also gone up. While it is interesting to note that electrification has brought about an increase in area under irrigation and crops, it would have been useful to know how the commanded area of particular wells has changed due to electrification, whether electrification has accelerated the pace of switch over to new high-yielding varieties and vice versa, and whether the small as well as large farmers were using electricity economically. The data presented do not throw light on any of these questions.

Similar findings are reported in the paper by J. S. Garg and M. S. Bhatia. They show that the aggregate irrigated area in the village in Kanpur district which was electrified had increased much more than in the village without electricity, because of the large number of electrically operated tube-wells in the former. Naturally, this has led to extension of area under high-yielding varieties of crops and greater use of fertilizers in the electrified villages.

Mohan Rao shows in his paper that area irrigated per well was more if the water lift was operated electrically or with diesel engines, than if the lift was only a *mohte*. While this would partly depend upon the supply of water in the wells, it also has to do with the speed with which water can be lifted. Adequate and timely water supply makes a great difference to the cropping pattern : Mohan Rao shows that the area under paddy, sugarcane and vegetables is more under wells with electric or diesel pumps than under those with *mohtes*.

T. Y. Patil and B. J. Hinge also say in their paper that irrigated area and area under sugarcane, wheat and paddy increased in the farms covered by the selected lift irrigation societies in Sangli district. They, however, do not present any data to this effect. The emphasis in the paper is on the extent of increase in labour input on various crops and the extent of use of fertilizer and credit. The only crop that shows increased use of human and bullock labour was wheat; the other two crops, sugarcane and paddy, were not being grown before irrigation.

IV

The aspect of the problem of rural electrification that has invited the widest attention is the comparative cost of electric and diesel engine operated pumps and

traditional lifts. Seven papers are almost entirely devoted to this; besides, some others contain references to this aspect as well. The point is rather straightforward, and it is easily demonstrated by most that it costs less per hour of operation or per acre-inch of water lifted if the lift is operated with electric motors than with diesel engines, particularly if the total area to be irrigated is the same and the total horse power of the two types of engines is not very different. Different authors have chosen different ways of examining this.

S. M. Patel in his paper compares the cost of lifting water with electric and diesel operated pumps in certain talukas of Gujarat. Considering pump sets of the same characteristics he shows that the average cost as well as marginal costs per hour of operation and per acre-inch of water are significantly more in the case of dieselised pumps than in the case of electrically operated ones. Indeed, he goes forward to show that those farmers who had already put up diesel pumps will still be able to save significantly in operating expenses, while the capital cost of the change over will be practically nil. It is, however, not quite clear why the author includes the cost of sinking well in the capital cost, while comparing the two alternate methods of lifting water for irrigation.

Similar evidence is provided by S. L. Shah and L. R. Singh for diesel and electric lifts in north-western Uttar Pradesh. They also illustrate with a synthetic crop plan that the electric lift will become even more economical with greater use of water from the well.

D. P. Bore, T. Y. Patil and D. K. Sohoni illustrate the advantages of electric pumps in the banana growing farms of East Khandesh. They, however, unnecessarily present detailed itemwise cost of production data for various crops, instead of concentrating attention on various aspects of the electric water lift.

S. M. Patil presents figures for total and average cost of irrigating summer and winter paddy separately, to show that electric lift costs less than diesel engine lift in Ratnagiri district.

Comparison of traditional water lifts, like *mohtes*, *Rahats* and persian wheels with diesel or electric pumps is a little more difficult, because the capacity of any of these traditional lifts is more limited and the capital cost is much less than that of the electric or diesel pumps. Consequently, light irrigation over smaller area will mean less cost per acre with traditional lifts. But timely heavy irrigation for larger area will mean higher cost with traditional lifts. While these are rather obvious propositions, the papers examining this question do not quite often care to keep them in mind.

Mohan Rao shows that the farmers in Visakhapatnam district who had *mohtes* were doing only light irrigation of crops like *ragi* and chillies, while irrigation with electric or diesel pumps meant very significant area under paddy, sugarcane and vegetables, all of which require both heavy and timely watering. No wonder, cost per acre irrigated was less with *mohtes* than with electric or diesel pumps. The paper shows that irrigation cost per acre was more with electric pump than with diesel ones, because of the fixed minimum charge of electricity which in the case of the farmers studied was more than the value of actual energy

consumed. Otherwise, irrigation with electric pumps costs less. But at the same time it has to be remembered that while the diesel engines were being hired out, the entire cost of operating the engine has been charged to the owner's farm (*i.e.*, the return from renting has not been taken into account), and hence the higher cost of diesel pumps.

R. C. Agrawal and R. C. Kashive examine the relative economics of electrically operated pumps, *Rahats* and *mohtes*, the latter two bullock operated. For this purpose, a sample of farmers is chosen, apparently purposively, for study. "On each of these holdings, observations were recorded in respect of human, bullock and electric power consumed in the process of irrigating a certain piece of land earmarked for study. These observations were taken for the same number of irrigations and the same acre-inches of water applied to the selected plots." It is not clear what the approach indicated by the second sentence means. With the help of these data for 60 farms irrigation cost functions were fitted separately for electric lifts, *mohtes* and *Rahats*. The cost of irrigation was expressed as a function of acres irrigated. With the help of these functions the marginal costs of irrigating an acre were estimated. Now, from the lines quoted above it is not clear what costs were taken into account and how capital costs were treated in estimating the total cost of irrigating a particular crop on the particular plot of land under observation. A brief statement of all these would have made matters clear. In the absence of such clear statements about the method and data used, one is left wondering how a farm irrigating only one acre of sugarcane with electric lift can do so with only about Rs. 114, and an acre of wheat with about Rs. 59! Similarly, in the context of the method described above, one wonders why the marginal cost of irrigating sugarcane should be less than double the marginal cost of irrigating wheat with electric pumps, and almost five times so with *mohtes* and 8 times so with *Rahats*!

K. K. S. Chauhan and N. L. Agarwal in their paper estimate the comparative cost of irrigating an acre of wheat with the help of electric pumps, diesel pumps, *charsas* and persian wheels. They have selected a few farmers for each of these four types of water lifting devices. They calculate the average costs per irrigation (presumably meaning the same acre-inch of water) with each of these devices separately, from the data collected from these farmers. These average costs per irrigation on the farms are used to estimate the cost of irrigating an acre of wheat. The figures show the cost with electric pumps to be the lowest. But this holds true for only the farms studied. It should be remembered that the fixed cost in the case of electric or diesel pumps is much higher than for *Rahats* and *mohtes*, and the variable cost per hour is much less in the case of the former than the latter. Since the fixed cost per irrigation per acre will vary inversely with the total number of irrigations for which the lift will be used during a year, it should be clear that the averages worked out in the paper would not hold if the number of irrigations to be provided during the year were to be different from those observed. Due note of this elementary proposition would have resulted in different analysis of the available data and possibly somewhat different conclusions.

V

The cost of irrigation with the help of these alternative powers for lifting water raises the question of price of electricity for agricultural purposes. In a number of

States electricity is supplied to rural areas at subsidized rates. S. M. Patel in his paper raises the question of subsidized electric power and highly taxed crude oil. Since lifting water with electric pumps is shown to be much cheaper than with diesel engines, it is necessary, he says, to examine the possibility of either removing the subsidy on electricity to rural areas, or lowering the tax on crude oil for the diesel engines.

The question of subsidy has been discussed in a paper by C. C. Maji and A. S. Sirohi. The authors estimate the benefit-cost ratio of irrigation with an electrically operated deep tube-well owned and operated by the State, in West Bengal. The paper shows that the total annual cost of irrigation from the tube-well, at the subsidized rate of electricity, is less than half the net benefit received by the farmers from the use of the water. Indeed, the benefit-cost ratio would still be greater than 2, even if the subsidy is removed. On the basis of this benefit-cost ratio, they consider the project financially feasible. But, they at the same time advocate a development charge on the farmers to cover the extra cost of electricity, if the subsidy is to be removed. This charge, according to them, should not be linked to the irrigation charge that the farmers now pay on a per acre basis for supply of water from the tube-well. In the first place, it is difficult to see why a variable cost like electricity charge should be recovered through a development charge. Moreover, since this has to be an annul impost, it is not clear why it has to be kept separate from the irrigation charge. But more important of all, since the authors have not cared to ascertain if the Irrigation Department is recovering at present the total annual cost of irrigation through water rates, it is difficult to understand their anxiety to see the increased electricity charge recovered from the farmers. If the benefit-cost ratio is the best measure of financial feasiblity, then what is the logical necessity of considering a new charge? It would have been useful for the authors to discuss these questions in the context of their problem.

A similar benefit-cost calculation for another electrified tube-well in West Bengal is presented by Alok Kumar Giri and Arunendu Mukhopadhyaya, but they do not take into consideration the question of the electricity charge, which Maji and Sirohi suggest, is hampering expansion of tube-wells in West Bengal.

VI

Two other aspects of rural electrification in India have drawn the cursory attention of a few paper-writers. One relates to the estimation of demand for electricity in rural India, and the other to the problems of financing electrification at the farm level.

In estimating the potential demand for electricity in rural areas one has to take into consideration the change in policy of the Governments about the use which will have priority, the possibilities of lift irrigation in various parts of the country, the economics of lift irrigation as affected by the new varieties of crops, the possibility of using electric powered equipments for certain other farm operations in areas that are witnessing rising and diversified farm production, and finally the rising

income in rural areas leading to greater domestic use of electric power. No wonder in view of the many changes in policy, finance and other economic forces, the trends based on past data have already been proved unhelpful in predicting the situation in 1968-69.

VII

Two papers devote their attention specifically to the financing of rural electrification schemes. The high costs of rural electrification is a difficulty faced both by the consumers and the producers of electric power. Various schemes have been devised to help farmers with finance for taking electric power to their farms, and provide the necessary capital to the State Electricity Boards at the same time.

D. Jha and S. D. Salunke in their paper give a summary account of the role of the Agricultural Refinance Corporation and the State Land Mortgage Bank in Maharashtra in providing finance to cultivators for electrification of pump sets. It refers to the plan for financing of a compact area of 7 villages in Poona district, but it does not refer to the potential economy of this 'area approach' as against the current method of extending electricity to rural areas. The rest of the paper gives some details about the lift irrigation schemes in the district and the loans sanctioned by the State Government for buying electric motors and pumps.

M. N. Upadhyay in his paper gives a brief account of the procedural difficulties and delays faced by farmers in obtaining loans from co-operative financial institutions.

A related aspect to which some papers have made passing reference is the place of small farmers in the scheme of rural electrification. A number of papers, *e.g.*, those by Chauhan and Agarwal, Mohan Rao and Usha Dar show that the use of electric (and possibly also diesel) pumps is confined to medium and large farmers. Upadhyay in his paper suggests that small farmers should come together to provide security so that one of them can get loan to buy pumps and sell water to others. Usha Dar suggests that commercial banks may come forward, with Government guarantee, to advance loans to farmers for making the necessary deposits with the State Electricity Board. The village panchayats may also be enabled to buy pumps and rent them out to small farmers, who should be free to sell water to other farmers. Indeed, in some States there is a restriction on farmers selling water to others, if they buy electricity at a subsidized rate. This might hamper the use of electric power by small farmers. These and other related questions, however, have not received adequate attention in any paper.

VIII

In the light of the problems summarised above to which the paper-writers have directed attention, the group discussion in this Conference may be organized around the following points.

(1) While, generally speaking, the usefulness of rural electrification is not questioned, the relevance from the economic point of view, of emphasizing the need

for power for productive purposes of agriculture has of late been emphasized. Several questions arise in this context:

(*a*) Is it necessarily correct that extension of electric power to farms for irrigation will be more productive and economical from the point of view of the power supply agencies, as some papers suggest? How does the performance of rural electrification in States like Madras and Kerala where most villages are electrified, compare with those in, say, Gujarat and Punjab? Will this policy, for example, mean non-priority for domestic, and other non-agricultural use of power in villages which are perennially irrigated from canals?

(*b*) Will this policy mean in effect priority to bigger villages, a phenomenon which has been noticed in the past ? What is wrong if this happens?

(*c*) Will a cluster approach to rural electrification that is being tried out now be more productive and remunerative, and consequently, will the exclusive emphasis on agricultural use need to be revised under those circumstances?

(2) Some of the above questions also relate to the problem of lowering the cost of rural electrification? This may be discussed under a number of subheads:

(*a*) A part of the cost of bringing electric power to the village is the cost of transmission from tap off point on the main high tension line. But the other part will be the share, if any, in the cost of this high tension line itself. How should this overhead capital cost be distributed between rural and non-rural consumers, and between big and small villages?

(*b*) Is there any possibility of reducing the cost of transmission by improving techniques and/or substituting cheaper materials?

(*c*) Are there any reasonable bases for improving the accounting practices in changing the cost of material and depreciation for transmission lines? States like Madras had somewhat different practices in this regard.

(*d*) Should the interest charge for capital used in rural electrification be lowered?

(*e*) What role can rural electric co-operatives, if tried in this country, play in reducing the cost of power to the consumer?

(*f*) How significant is likely to be the reduction in capital cost of transmitting power to villages in the light of the above?

(3) Should electricity be subsidized for the rural consumer, particularly in view of the relative cost of irrigation with diesel pumps? How relevant is the

benefit-cost ratio in deciding on the economic usefulness of a lift irrigation project, if the cost of supplying water cannot be recovered from the farmers?

(4) From the farmer's point of view, what are the circumstances that make use of electricity for lifting water more economical than either diesel engines or bullock operated lifts? How are the prospects of rural electrification likely to be affected by the introduction of technical improvements in agriculture, like high-yielding variety seeds, etc.?

(5) What are the circumstances that prevent the use of electricity by the small farmers in particular, and the measures that may enable them to do so?

(6) Is the slow pace of rural electrification due to lack of adequate capital with farmers as well as the Boards? Will provision of credit for electrical installations be all that is necessary to meet the situation? The various schemes of extending co-operative credit to farmers and indirectly to the Electricity Boards may be discussed from this point of view.