Economic Investigation as Related to Drainage with Special Reference to Khairpur

By
P. E. NAYLOR

This paper attempts to set forth some of the problems that we have encountered in the economic investigations we have carried out in connection with WAPDA's drainage projects in Sind. The paper does not pretend to present any final answers to these problems, rather to set them out as clearly as possible, to explain the ways in which we have tried to overcome them in our earlier economic analyses and to hope that a discussion of alternative solutions may clear the way to improving their treatment in future project reports.

The paper deals first of all with the assessment of the physical changes which result from the impact of drainage on agriculture and explains the assumptions we have made about what can be expected to occur. It then deals with the financial assessment of these physical changes and with the ways of determining the financial profitability of a project. Finally, the paper deals with the question of the financing of the project and in particular with ways of assessing the cultivator's capacity to bear the costs incurred in drainage.

Throughout this paper our work in the Khairpur region of Sind is used to give examples. The Khairpur region covers the commands of the two Khairpur canals, the Khairpur Feeder East and the Khairpur Feeder West, which take off from the Indus on the left bank of the Sukkur Barrage. Their total GCA is about 800,000 acres. Within this area there are approximately 355,000 acres with a water table within 7 feet of the surface. A tubewell drainage scheme has been prepared for this area, for which W.A.P.D.A. has obtained a loan from the World Bank for the construction of some 570 tubewells.

I. ASSESSING THE PHYSICAL CHANGES THAT ACCOMPANY DRAINAGE

The main aim of agricultural economic investigations in drainage projects is to evaluate the impact which drainage is expected to have upon the system of farming in general and upon the value of agricultural output in particular and to consider the accompanying changes in the agricultural environment, taking this in its broadest sense.

Drainage will lower the water table and allow the salinity of the soil to be reduced. This will lead to changes both in the area under crops and in the yield of those crops. Minor changes in the actual crops grown can also be

expected. The effect of drainage is assessed by comparing the position both in terms of area and yields to be expected without drainage with the position expected with drainage. Area and yield effects can be considered separately.

First of all the effect of drainage upon the area under crop. For this we need to establish to start with the past trend of cropped area, then to discover the present position and finally to project the future trend. As far as the past trend goes Pakistan is well supplied with data. When discussed in Pakistan, the standard Punjab thesis that 100,000 acres of land is being lost annually through salinity and waterlogging is usually put forward as sufficient evidence of the need for drainage. For Sind in general and Khairpur in particular the statistics just do not bear this out. The total area under crop on the two Khairpur feeders has risen at a rate of over 8 per cent per year for over twenty years. Such an increase does not necessarily imply that more and more land is not being abandoned as a result of rising water tables but it is a strong argument against it. This then is the past trend.

To establish the present position we carried out a detailed study of land use in the Khairpur Project area in the spring of 1962. This revealed that 3 per cent of the CCA had never been brought under cultivation, that 19 per cent had been abandoned and the total cropping was concentrated upon the remaining 78 per cent. Much of the abandoned land has been abandoned for many years and nothing indicated an increasing annual rate of abandonment.

If we dismiss the possibility, in Khairpur anyway, that the total cultural area is declining the projection of the future trend without drainage depends on whether the factors causing the increase in the cultivated area will continue in the future at the same rate as in the past. The main factor in this increase is water supplies. These have in general risen since 1947 and are in most cases at or above design discharges. Any increases must be limited by the capacity of the canals to take more water. For the purpose of computing benefits, we have assumed that the expansion in the cultivable area resulting from the continued increase in water supplies will cease.

Increases in the cropped area can still come through better use of available supplies. The rather unreliable data available on actual crop deltas are not encouraging to prospects of better use. They indicate no general improvement in water use over the past 15 to 20 years. This is not to say that no room for improvement exists. We have calculated the expected water requirements of the existing crops using the Blaney Criddle method to give the basic consumptive use figures and by making broad assumption for canal and farm losses. This calculation indicates that present supplies and the cropped area are approximately in balance only on the East Feeder in kharif; supplies may be as much as 25 per cent too large at peak on the West Feeder in kharif and some 50 per cent too large on both feeders in rabi. The cropped area could, therefore,

increase if irrigation efficiency is improved. Since there is no indication that it is at present improving we have assumed that without drainage it will not improve in the future. Indeed the present areas are probably only maintained because ample water is being used. Area changes without drainage are, therefore, assumed to be negligible.

The prospects for increases, in the cultivated area once drainage is installed, are more promising because first, reclamation will increase the cultivable area, secondly, tubewells will increase water supplies and, thirdly, generally improved conditions should bring about an increase in irrigation efficiency and, fourthly, water supplies may be increased by increasing canal capacities.

Drainage will make possible the reclamation of the 19 per cent of the CCA which is presently abandoned and the cultivable area will increase as a result. Even if existing land remains cultivated at only existing intensities this newly reclaimed area cannot be cultivated in Kharif unless water supplies increase. The tubewells themselves will provide some additional water which is of a suitable quality for direct or mixed re-use for irrigation but a fair proportion of the pumped water is expected to be too saline for re-use. Cropping of all the reclaimed areas will be impossible, therefore, without additional canal supplies or improved use of existing supplies, or both. We are convinced that it is necessary to raise the intensity of cultivation throughout the whole area, on already used land and newly reclaimed land alike, both in order to prevent an upward movement of salts in the soil and also because the extremely high cost of drainage makes it necessary to use the land as intensively as possible once it is drained. We have proposed that enough water be made available to raise the intensity to 60 per cent in kharif and 75 per cent in rabi. The present design intensities are 32 and 48 per cent respectively; they are low because of the need to spread the benefits of the Sukkur Barrage over as wide an area as possible. In practice only 78 per cent of the CCA is now being used and actual intensities on this land are far higher than design, being 45 to 50 per cent in kharif and 55 to 70 per cent in rabi, on the average of minor commands. Even higher intensities are achieved on smaller areas and our recommendation is that these be adopted everywhere. Such an increase will make the difference between a profitable and an unprofitable project.

To realise this increased cropping intensity more water is needed. In the West Feeder command the tubewells can themselves provide the necessary supplies, if combined with a limited improvement in the efficiency of water use, which we assume will occur after drainage. In the East Feeder command, however, the additional supplies will have to come in the canal, involving expensive remodelling and because the kharif supplies are already fully utilised.

We now come to the second part of our assessment, the effect on crop yield, of the physical changes accompanying drainage. Here no reliable data at all on the past trend of yields was available. Data on the present situation is also unreliable and though we are not carrying out yield sampling on some crops our basic data has had to come from official statistics. In so far as these are used for the comparison both of the situation with drainage and without drainage the unreliability is of lesser importance.

As a working assumption we doubted, if drainage alone would result in very large increases in yield, because there are two main influences restricting yields. One of these is the Productive Capacity of the land as reduced by salinity and waterlogging. This can be controlled by drainage. The other is the low standard of farming. Large increases in yields can only come as a result of a combined attack on both restricting influences at once, not through drainage alone.

At present the Government is attempting to remove the second of these restrictive influences by undertaking a campaign to improve the standard of farming and provide farmers with better seed, fertilisers, pesticides, etc., and to teach them the need for better cultivation and planned rotations. We consider that this campaign on its own can have a marked effect but, so long as the restricting influences of high water-tables and saline soils remain the full productive potential of the land cannot be realised.

Studying the results of experimental farms and the yields achieved by better farmers in the area led us to conclude that the combined effect of the removal of both sets of restricting influences together would be the doubling of most crop yields. Cotton would go up for instance from 6 to 12 maunds per acre, wheat from 10 to 20 maunds per acre, rice from 12 to 25 maunds and so on. This was our basic assumption. In order to obtain the benefits resulting from drainage alone it was necessary to decide how much improvement would result from drainage alone and how much from better farming alone. Our assumptions about this were that drainage alone would raise yields about 25 per cent, better farming would raise them 50 per cent, and that the inter-action effect would account of the full 100 per cent from both together. These are crude guesses but were the best we could make with the information available. In other more saline areas like Gaja we have made entirely different projections.

An extremely important consideration, affecting the extent to which improved farming and the use of scientific aids will be efficiently used, is the social and institutional framework within which agriculture is carried on. Sind agriculture suffers under a number of restraints other than low soil fertility and until these are removed only a very slow improvement in farming method can be expected. Among these are the conditions of land tenure, particularly the share-cropping system, the lack of credit, the inadequate communications

and marketing facilities, the low standard of rural education and so on. While these may be tolerable in an extensive farming system, the introduction of high-cost drainage implies a shift towards a much more intensive cash-crop type of farming. Drainage is bound to speed the shift from age-old to modern methods and Governmental assistance will be needed to change the customary structure which ties the present farming to low production. We doubt whether even the 50 per cent yield increase, we have assumed without drainage, can be achieved unless there is a change in these conditions; and we are certain that the 100 per cent increase with drainage can never come about without such change. How to induce this change is something we have not yet studied.

To sum up this assessment of the physical impact of drainage, the important questions to which the investigation must provide answers are:

(*i*) **The trend in the area cropped**

If drainage is not installed will the cultivated area increase, decrease or remain static? Our answer is that 'it remains static'. If it is installed, will this enable the area cropped to increase? Our answer is 'yes'.

(*ii*) **The trend in crop yields**

If drainage is not installed, would the restrictive effects of low soil fertility be outweighed by better farming? Our answer is 'no'. If it is installed, how much will this increase yields? Our answer is that 'drainage alone will increase yields by about 25 per cent'.

In the particular area studied it was decided that two major changes must accompany drainage, if this was to be worthwhile; first the standard of farming must be improved and all factors restricting such improvement must be eliminated; second more water must be made available to enable higher cropping intensities to be realised. The economic analysis was based on the assumption that these changes would be made.

II. ASSESSING THE FINANCIAL IMPLICATIONS OF DRAINAGE

The conversion of the physical changes, accompanying drainage to monetary terms, involves assessing the value of the increased physical products. It is customary in this type of analysis to use farm prices, not wholesale or retail prices, since one is concerned with changes in the value of farm output. But what farm prices to use in Pakistan? There is no data available on farm price levels and if there were, it is doubtful if this would be useful, for two reasons: (*i*) they would be largely influenced by factors unrelated to the real national price level, for example by indebtedness causing farmers to sell at artificially reduced prices. (*ii*) They would reflect only what had happened in the past, not the future level of prices. This second criticism is, of course, valid for any series of past price statistics. What is required for project planning

is a forecast of future levels, assuming no change in the general price level. In our own projects we now use wholesale prices, put out by the Co-operation and Marketing Adviser as a guide to past trends, adjusting to farm level by taking the average of the three lowest monthly prices less 10 per cent. Where the crop is one which is virtually insulated from world markets, like gram; past trends must be used for forecasting. Where the crop price is largely influenced by world market conditions, either like cotton, the price of which is dominated by exports, or like wheat, the price of which is influenced by large imports, world conditions must be considered. The Pakistan price may of course be entirely unrepresentative of world conditions because of distortions—PL480 wheat for instance distorts the wheat price structure, and foreign exchange scarcity distorts sugar prices. The latter case of sugar is very important in one of our project areas. The present Pakistan price is about three times the world level, and if one uses this for forecasting, drainage is highly profitable. If one uses the world price, drainage is not profitable. Yet the world price is not appropriate since Pakistan cannot earn enough foreign exchange to buy sugar from abroad and she must grow it at home, at a higher price. In practice, therefore, some judgment must be exercised in deciding on the most appropriate price level to use. On this judgment the apparent profitability or non-profitability of the project may turn.

Once the farm prices are decided it is a simple matter to convert the physical production estimates, already made to financial terms. The value of output without drainage is deduced from the value with drainage to give the gross financial benefit.

Before we can compare benefits and costs, various other elements must be considered. We have so far estimated the gross value of production from the project area with and without drainage, the difference being the gross benefit. In addition the value of associated costs must be considered as well as the project costs themselves.

The project costs include :

(*a*) the capital cost of the project, being the engineer's estimate of the total capital outlay required, including interest during construction. This can be expressed as a lump-sum or as an annual amortization charge including annual interest.

(*b*) the sinking fund required to finance the replacement of equipment which has a limited life, such as tubewells or pumps.

(*c*) the annual costs of operation and maintenance, such as staff salaries, transport, fuel, repairs and so on.

Associated costs are all the costs of production other than project costs. They mainly consist of the farm costs of production such as seeds, fertilisers, machinery, depreciation, taxation and hired labour. Family labour is not

usually included as a cost. The effect of this is to raise the value of the net benefit of increased production by a larger proportion in a peasant economy such as Sind than it would in a developed cash economy, since in the one the use of partially employed family labour has no cost while in the other the additional labour would be paid for and thus form an associated cost. Associated costs also include any other costs required to raise production, and might cover the costs of extension services, improved farm roads or marketing facilities or other Government expenditures, for instance on the provision of credit or co-operatives or land consolidation measures. The estimation of these costs is difficult and for this reason we have attempted to arrive at the benefits of drainage alone excluding the benefits from the other expenditures. Furthermore the return on money invested in Government services is very variable—extension services showing usually a high ratio of benefit to cost, infrastructure expenditure such as that on roads, etc., showing a low ratio. Their inclusion might thus swing the benefit cost ratio in either directions by a large amount. In one area we estimated that an extension service would raise the annual costs by 22 per cent but that this would approximately double the benefits, and raise the benefit cost ratio from 2: 1 to 3.2 :1. In our early Khairpur treatment we have isolated the costs and benefits of drainage from those of other changes which will be required. The validity of this procedure is debatable, but it does provide a means of assessing whether drainage alone is justified, if it were ever considered to be reasonable to carry out drainage without any extension services.

A further element sometimes used in benefit cost comparisons is the indirect benefit of the project. Indirect benefits are the increases in the net incomes of persons, other than the farm population directly concerned, resulting from either the increased flow of agricultural products out of the project or the increased expenditure of the direct beneficiaries. Considerable controversy has arisen as to whether or not these indirect benefits should be taken into account. American practice appears now generally to ignore them or take into account only the benefits stemming from the increased flow of produce but not benefits induced by the higher expenditure of the direct beneficiaries. The principle reason for this appears to be that in America most resources tend to the fully employed and any single project competes with other projects or investments for resources. The latter type of indirect benefits would tend to exist, therefore, with or without the project. In an economy such as that of Pakistan, however, there exist large under-employed resources, particularly of labour, and a project will bring into use resources which otherwise would have remained idle. The indirect benefits may thus be large. The matter needs more detailed consideration than we can give it here. For the present we do not use indirect benefits in our calculations.

The actual figures which were calculated in our Khairpur Project Planning Report for each of these items are shown in the Table below. In the table the whole area is considered as a single unit. There are considerable variations within the area. This is the project as it was recommended in the final form.

Annual Benefits	**Lakh Rupees**
Value of gross output with improved farm practice but without drainage	644.5
Value of gross output with improved farm practice and drainage	1,197.6
Difference or gross benefit of drainage ..	553.1
Value of associated costs with improved farm practice but without drainage	217.5
Value of associated costs with improved farm practice and drainage	388.8
Difference, increase in associated costs	171.3
Net Annual Benefit	381.8
Costs	
Annual Amortization Charge	57.6
Sinking Fund	17.7
Annual Operation and Maintenance Costs	78.0
Total Annual Costs	153.3

The net benefit must be adjusted to account for the time lag that will occur between the start of development and the achievement of full output. In this case the average annual value is taken over the expected 40-year project life, assuming a straight line increase to 15 years, when full production is achieved, with constant output after that. The adjusted net benefit then becomes 310 lakh rupees.

We are now in a position to assess the project. The assessment is required to compare this project with other projects. Where investment funds are available within a country the assessment is needed to guide the Government in its allocation of limited available funds. Where, as in this case, the investment is supplied from an international loan, the assessment is needed to guide the lender on the merits of this project as compared with other projects it is considering elsewhere, besides showing the general viability of the project itself.

The standard procedure for such an assessment is to compare the average annual net benefits resulting from the project with the average annual costs. These were calculated for Khairpur as 310 and 153 lakh rupees respectively, giving a ratio of 2 : 1. All this indicates, however, is that some net return can be expected, but it gives little guidance for the Government to

decide, whether this project is more profitable than other projects; this is because of the varying importance of fixed and operating capital in relation to benefits of different projects. It is useful in the comparison of projects with similar capital intensity but not otherwise.[1]

A more accurate benefit cost ratio can be obtained by comparing the present value of the benefit spread over the life of the project with the present value of the costs. For Khairpur this gives a benefit cost ratio of 1.8: 1, if the same 4 per cent interest rate and 40 year life are used. This figure is, however, sensitive to changes in interest rates and with an interest rate of 8 per cent the ratio drops to 1.2:1. The effect of changes in the interest rate on the benefit cost ratio will be different on different projects and since there is no "right" interest rate, the ratio is even less reliable as an indicator of relative worth.

One alternative indicator of relative worth is the rate of return on the project investment. This can be expressed simply as the ratio of gross annual benefit or of adjusted net benefit to project investment. For Khairpur these rates of return are 36 per cent and 20 per cent respectively.

These two measures are used by the World Bank for comparing projects on which they are considering making loans and no doubt as indications of the profitability of a laon as an investment they are useful, particularly when they can be compared with similar measures for other widely different projects. Their drawback is that they do not reveal anything about the relative ratios of annual benefits and annual costs. A project with annual costs in excess of annual benefits could conceivably have a high return on capital, if operation and maintenance costs formed a high proportion of annual costs.

To cover this, the rate of return can be calculated by deducting the operation and maintenance costs from the adjusted net benefits and expressing the remainder as a ratio on the fixed capital. This gives a rate for Khairpur of 15 per cent. Or this can be refined still further and the rate can be calculated from the difference in the adjusted net benefits and the total annual costs. The rate of return by this method falls to 10 per cent.

None of these four measures gives quite the same information about a project as a benefit cost ratio and they are thus complementary measures of project worth rather than mutually exclusive. The difficulty of finding any single measure of profitability arises from the nature of the benefits. They are not the same as the earnings or turnover of a commercial firm; nor is the value of project capital of a commercial firm since operation and maintenance costs are met directly out of Government revenue. They may derive from project earnings but the connection is often devious. If one imagined the project as a self-financing body, capable of extracting all direct benefits out of beneficiaries and paying annual costs out of these receipts, then the return on capital would

have a full meaning since there would be a rate of turnover. In the case of Khairpur actually annual costs are only 10 per cent of project capital costs and the additional capital required to finance them would thus be small. In practice of course benefits are not extracted from beneficiaries and payments for project services rarely cover project costs. The effect of failure to cover costs is shown later greatly to reduce the chances of ever repaying the original capital.

Another alternative that has been put forward by McKean is to rank projects on their present worth[2] (present value of benefits less present value of costs) over a varying range of discount rates. For instance the present worth of Khairpur on the basis is 2340 lakhs at 4 per cent, but only 434 lakhs at 8 per cent. The rate of discount at which the present worth becomes zero is termed the "internal rate of return" and this is the second measure which McKean suggests should be used for ranking projects. For Khairpur this is 10 per cent.

This discussion may seem slightly unrealistic in Pakistan conditions, since so few projects which could be constructed actually exist in a form which could be compared in this way. At present so long as any gain over costs appears likely and the necessary finance can be found the project will be constructed. This, however, is a passing phase and with the increasing effort going into investigation the number of potential projects will, within the immediate future, exceed the finance available to construct them and some means of ranking projects in order of value will be required. The main purpose of this discussion is to indicate that total reliance on the benefit cost ratio is unwise. None of the other measures discussed appear entirely satisfactory either. A great deal more work is still required in improving the analysis and presentation of the financial aspects of water and power development projects, if this is to be of real use to those who have to allocate resources between alternative projects.

When all this has been said, the worth of these various measures is no greater than the realiability of the figures on which they are based. Our task in Sind in the agricultural economic field is to concentrate on improving this reliability and on presenting as clearly as possible the basic physical relationships, which will determine the financial pattern with and without drainage.

III. THE CALCULATION OF PAYMENT CAPACITY

A benefit cost ratio greater than one to one indicates that the project has a surplus of benefits after paying the full costs of the project. This surplus indicates that the direct project beneficiaries should be capable of paying the costs of installing and running the project: the direct beneficiaries in this case being the farming community since other beneficiaries are not taken into account. The calculation of this capacity to pay is our next concern.

Payment capacity is formally calculated by comparing the output and expenses of typical farm units with and without the project. In Khairpur we started our investigations with absolutely no economic data concerning typical farm units. We had, therefore, to try to construct them using such information as was available from censuses and crop returns, supplemented by field surveys of our own. This limited data did not reveal sufficient differences between types of farming to justify calculating payment capacities for more than one such farm type.

The typical farm which emerged from our study of local data was 11 acres gross area with 9.2 acres under cultivation, cropped at 105 per cent intensity, 4.4 acres in kharif and 5.5 acres in rabi. The summarised financial position under present conditions is shown below :

	Tenant	Land-owner	Owner Operator
	Rs.	Rs.	Rs.
Gross Farm Output ..	1,020	474	1,494
Total Farm Expenses ..	487	152	639
Net Income ..	533	322	855
Interest on Capital ..	104	514	618
Return to Family Labour and Management.	429	—192	237

The gross farm output includes both cash sales off the farm and the value of home consumed farm produce. Farm expenses include only actual cash outgoings. The difference between the two gives the net farm income. Interest on capital is deducted from this at 4 per cent to give the net amount available to reward the family labour of the tenant and the management of the land-owner. The first two columns in the table indicate how the output and expenses would be divided between share-cropper and land-owner if the land was tenant farmed; the last column gives the total, indicating the position of an owner-operator. The crop output is divided equally between tenant and owner while the livestock produce goes to the tenant. The two alternatives are given here since in Khairpur the land is farmed in equal proportions by tenants and owner-operators.

This budget immediately reveals the unsatisfactory state of Khairpur farming :

(1) The tenant farmer ought to have an income of at least Rs. 1,200 if he is to live at a satisfactory standard. This is the amount proposed by the Land Reforms Commission. In fact the farm unit provides him with only about one third of this amount, after allowing a return on capital. Clearly

the tenant would be better off, if alternative outside employment were available even at low rates of wages.

(2) The land-owner is not obtaining an adequate return on his capital and although he may remain a land-owner for security or prestige reasons, he cannot be expected to invest the additional capital in his land that improved farming methods would require unless the return on capital is higher.

(3) The figures also indicate that the project will have difficulty in collecting all or even part of the first fruits of improvements due to project works.

We now consider the situation when improvements in farming practices have taken place, first without drainage and then when drainage has been installed, for it is the difference between these two situations that indicates the capacity of the cultivators to pay for drainage. No allowance is made in the with drainage situation for any additional water that may become available from tubewells or remodelled canals.

	Without Drainage			With Drainage		
	Tenant	Land-owner	Owner-Operator	Tenant	Land-owner	Owner Operator
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Gross Farm Output ..	1,464	647	2,111	2,295	914	3,209
Total Farm Expenses ..	751	140	891	1,190	153	1,343
Net Income ..	713	507	1,220	1,105	761	1,866
Interest on capital ..	116	514	630	139	514	653
Return to Family Labour and Management.	597	—7	590	966	247	1,213

It is evident that if one took merely the gross increases resulting from drainage the payment capacity would be considerable. The return to the tenant's family labour rises from Rs. 597 to Rs. 966 or by Rs. 369. The land-owner's management earnings rise from Rs. —7 to Rs. 247 or by Rs. 254. The total increase is Rs. 623 or Rs. 57 per acre, more than adequate to cover the cost of drainage at Rs. 48 per acre. This, of course, accords with a favourable benefit cost ratio. But if the whole of the improvement resulting from drainage was taken in taxes by the Government to pay drainage costs there would be no incentive for the cultivators to work harder or the land-owners to increase investment and the improvements would not occur. The amount which it is possible to deduct must be less than the full increase resulting from drainage.

The tenant's increased family labour earnings are the result both of the additional effort expended in production and of drainage. The additional

effort as well as the drainage must receive a fair payment if they are to continue. The value of the labour payment would be the additional hours spent on farm work times the wage rate. But as we lacked data on labour requirements, we calculated this value instead from the increased share of crop output, leaving aside the animal products accruing to the tenant as a result of drainage. This is Rs. 267. (The landowner's share is the same since the crop output is shared equally, Rs. 914-647). The proportion of the tenant's benefit from drainage that could be taken to cover drainage costs is thus Rs. 102 (Rs. 369-267).

We considered that, although the tenant could be made to pay this amount, it would be undesirable to do so since one of the purposes of the project is the raising of living standards. The tenant's income will be raised by drainage from Rs. 597 to Rs. 966 but as this will still leave him Rs. 234 below a desirable minimum: we felt that no part of the increase should be touched. The non-payment of this amount is the measure of the welfare element of the project.

The land-owner's full benefit from drainage was calculated at Rs. 255. Some case could be made for taking all this but since an incentive to increased investment is needed, we assumed that only 50 per cent of this increase of Rs. 127 was available for payment capacity. The 50 per cent incentive bonus is equivalent to allowing the land-owner a management earning of 4 per cent on the gross output. American standards usually permit 5 per cent on the gross or 10 per cent on the net output, whichever is less. Thus we doubt if more can be extracted from the land-owner than Rs. 127. The amount will be same for an owner operated farm as for tenant operated one.

The total available payment capacity of this 11 acre holding is thus only Rs. 127, or Rs. 11.5 per acre. This is less than a quarter of the full cost of drainage.

These budgets take no account of additional water being made available either from the tubewells themselves or from an enlarged canal supply. As explained earlier the provision of extra water raises drainage from a marginally profitable undertaking to a fairly profitable one. It does the same for the payment capacity. With additional water the return to labour and management of the tenant rises by Rs. 210, that of the land-owner by Rs. 200, all of which would be potentially available to cover drainage costs. If the whole of this were taken, the Government could just about cover the total annual costs of the project from payments by beneficiaries. Using the same arguments as before we do not think that the increase should be taken and even with additional water we see little prospect of drainage costs being fully covered by payments from direct beneficiaries.

Although the Khairpur tubewell drainage project will provide some

additional water, we have used only the lower estimate of payment capacity without additional water, since it will be necessary to charge an equal drainage rate throughout the project area. Only when canal remodelling is completed, would it be possible to charge the higher rate. In the mean time it will be necessary to capture the additional benefit from those who do receive tubewell supplies by means of a water rate.

We would be the first to admit that the above approach is open to many criticisms but it is a first attempt to try and estimate for Pakistan the impact of modern scientific farming and adequate drainage upon the individual farmer in sufficient detail to allow policy to be formulated upon it.

The question of, who pays for the project is one of vital importance to the whole national development policy. If the financing of the annual costs of all drainage projects in Pakistan is thrown upon Government resources, even though the projects have a high benefit cost ratio, the number of projects that can be undertaken will be severely restricted. If, however, the cost can be covered by a drainage rate levied on the beneficiaries the only national strain will be on foreign exchange for repayment of loans, not a permanent drain on current Government revenues. Even the deferment of repayment will place a considerable strain on current revenue. Take for example the situation where no change is levied on beneficiaries, for say the first five years of the project in order to encourage them to use the project services. In Khairpur annual costs represent about 10 per cent of the original capital investment. If these are covered by the Government for five years the Government has in effect invested an additional 50 per cent over and above the original investment in the construction of the project.

Our study of the repayment position in Khairpur is not optimistic about the possibility of achieving repayment of the loan and more attention to repayment is obviously required. What we have outlined here is no more than one possible approach and we hope that constructive criticism can produce a more refined approach which will be better guide to policy-making than the present one.

(1) For further discussion of these criteria see :

Eckstein, Otto. Water Resources Development, Cambridge, Harvard University Press 1958.

McKean, Roland N. Efficiency in Government through Systems Analysis. Rand Corporation. John Wiley 1958.

(2) Mckean *op. cit.*