Research

THE KOSI PROJECT

by Martin Hoskins*

The Kosi Area

The Kosi Area Development Region covers eighty miles square of Purnea and Saharsa districts in North-East Bihar in India. This area was chosen because it provided an ideal opportunity to study the effects of a new crop technology on a backward agriculture.

Until recently the Kosi region was probably one of the most hazardous in India. The river Kosi, which flows through the region, draining the Himalayas before joining the Ganges, flooded the area regularly as it moved seventy miles westwards in two hundred years, leaving swamps, dry fertile river beds and higher sandy waste land. Malaria was endemic until the early nineteen sixties and the two districts were often used as punishment posts for recalcitrant civil servants by the British colonialists.

The uncertainty of cultivation resulting from the frequent flooding and movement of the Kosi river offered little prospect of any economic development in the region. But a very bad flood in the early 1950's convinced Mr. Nehru that the various plans for flood control, which had been proposed occasionally, should be finalised and executed. The final plan, involving the construction of a barrage at Hanumanagar, just inside the Nepalese frontier, and a long series of embankments to contain the river Kosi, was implemented in 1955.

Having accepted the plan for flood control, it was quickly realized that the additional cost of supplementing this with a canal irrigation network would be minimal compared to the additional benefits. It was decided to construct a large canal running West to East across the northern border of the region from the barrage, and a series of branch canals, distributaries and minor canals running southwards. This canal system began operation in 1963-64 and it is from the gradual extension of the canal irri gation system that the subsequent developments in Kosi stem.

The provision of irrigation coincided with the developments which collectively have become known as the "Green Revolution".

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This consists of the use of new high-yielding varieties of crops, combined with the fertilizers and water which are necessary for their full potential to be realised, and the administrative expansion necessary for the organisation of credit, input distribution and marketing services which are indispensable for the widespread adoption of the new crop technology.

In the Kosi region the most noticeable impact of the "Green Revolution" has been in the dry and cooler winter season. Previous to the introduction of irrigation the Rabi, or winter season, had been used for the cultivation of low yielding pulse crops, mustard and small areas of poor vegetables and tobacco. The introduction of water in this season together with the provision of high-yielding varieties of wheat and fertilizer, to which the new varieties are particularly responsive, has virtually resulted in a completely new cropping season. Although the new varieties of paddy have had some impact on rice cultivation, which has always been the principal source of food, this has not been so notable as that of wheat. This is largely due to siltation and other difficulties of the canal system, which has required its frequent closure, and the risks associated with these new varieties of paddy. They are more susceptible to pest attacks than the local paddies and because they are dwarf varieties their cultivation is restricted to those plots of land on which there is not too much waterlogging. Consequently the land area cultivable with high-yielding varieties of paddy will be restricted unless extensive drainage and land levelling policies, requiring large and continuing investments, are adopted in the region.

The need for substantial amounts of credit, certain specific disadvantages, such as inferior grain quality and poor storage characteristics, as well as the limited land area suited to the cultivation of the new varieties, all militate against their hoped for widespread adoption. Nevertheless the "Green Revolution" has made an undeniable impact in the Kosi region and will continue to do so even though the local varieties of paddy and other traditional crops of the area, notably jute, will be cultivated with the new crops.

The general picture so far given has been one of qualified optimism. This, however, is not uniformly applicable to all types of farmers and workers. So far, the benefits of the irrigation scheme and the "Green Revolution" have largely accrued

to the larger farmers - those owning above twenty acres of land. This has largely resulted from the attempt by the Indian government to achieve a very rapid increase in food production to redress the damage caused by the agricultural neglect of the early plans. This policy seems to have left those responsible for policies in the Kosi area with a felt obligation to justify the project by showing quick results, and has led to an emphasis being placed on the larger farmers whom, it is thought, can respond most quickly to development policies. This view, although not frequently articulated by the local administration, has worked itself out in fact, partly because it is the larger landowners who, because they have traditionally been the most powerful, have most ready access to the government and commercial bodies through which development policies are implemented, and partly because they are the group which has sufficient wealth (and land is the most important component of wealth in the Kosi area) to finance the investments and take the risks which the new agricultural practices require. For these new practices require seeds, fertilisers and pesticides and also involve additional expenditures on crop cultivation.

There are other difficulties associated with the cultivation of the new crops. Being of shorter duration than traditional varieties, they allow three crops to be taken each year, or at least five in two years. This makes it difficult for farmers relying on a non-ready supply of bullock power to complete land preparation in the short intervals between crops, hence placing a high premium on tractor possession or a ready supply of bullocks. The new varieties also hold out the prospect of potentially high returns to the installation of tube-well irrigation in those areas not irrigated by the canal, and to proper storage and marketing investments. All of these require credit which is, understandably, largely channelled to those farmers who own sufficient land to give security to the credit they require and who have traditionally had access to the agencies dispensing it.

Even if some of the claims made for the success of this policy are exaggerated, it is certainly true that many crop yields have doubled and tripled and that the Kosi area is expected to move into a definite food surplus in the coming year. The price paid for this quick success, however, is the concentration of its benefits in the hands of larger farmers and a consequent strengthening of their economic position. The "Green Revolution" has

made it profitable for farmers to cultivate land themselves rather than rent it out and provided them with an incentive to use the returns to invest more and acquire more land. This process will, no doubt, often involve the displacement of the smaller tenant farmers who often cultivate the land of very big landowners.

Although developments in the Kosi area have not yet been occurring for a sufficiently long time to obtain any clear idea of the pattern of land purchases, we might expect the farmers who are benefitting from these developments to consolidate and expand their farms. At the moment the smaller farmers do not seem to have started selling their land. They have experienced a rapid increase in its value and anticipate further increases. The important question is how long they can be excluded from the benefits of the "Green Revolution" before being unable to resist the pressures to sell and join the landless. We can also expect to see large money-lenders, usually big landowners themselves, who now see the profitability of cultivation, foreclosing more frequently on the land which is often taken as security for their loans.

Although the smaller farmers seem to have resisted pressures to sell land so far, share croppers have been much less fortunate. This class cultivates farm land on a tenancy basis, usually paying 50% of the produce of the land to the landowner. Although there is legislation to protect their rights (just as there is legislation putting a ceiling on land holdings designed to prevent bigger farmers monopolizing agriculture), this has so far proved to be almost totally ineffective. Most pieces of land reform legislation contain sufficient escape clauses to vitiate them. Just as the Ceilings on land-holdings Act has largely been evaded by a provision for registration of land in the names of many members of a family, so too, attempts at recording the rights of tenant share-croppers have been vitiated by directives from the State Government of Bihar not to do so. Thus, there is a large area of land in the Kosi area, estimated at 23% of the total, cultivated by share-croppers who have little security and where landlords are now finding it profitable to cultivate the land themselves and now have the resources, such as tractors, to do so. We can expect a growing number of displaced share-croppers to swell the numbers of landless and semi-landless labourers unless something is done quickly to guarantee their rights.

The landless labourers so far appear to have benefitted in an absolute sense from the Kosi development. The extension of a three-crop farming system and the greater intensity of agricultural operations associated with the new technology, have provided them with more consistent employment throughout the year. There is some evidence that wage rates are rising, but the apparent absence of any critical labour shortage at the times of peak labour demand, suggest that wage rates will not rise substantially unless much larger areas are brought under cultivation and the new crops adopted more extensively. It is not yet clear how these groups will be affected in the longer term even though there is every indication that they will not benefit as much as the farmers who own land. Living on the land of big landowners who have first claim to their services and often pay them less than the market wage, their relative poverty is almost certain to increase.

The Kosi Research Project

It is the above developments which the Kosi project aims to analyse. It is attempting to predict the potential effects of different agricultural policies on the different types of farm situation in a quantitatively precise way that will be useful for the design of further policies. There are several stages to this analysis. The first stage involves the construction of a model, and a linear programming model has been decided on, to explain the farming activities of the area and show the ways these relate to each other. A "universal matrix" has been constructed which is intended to cover all the important farming activities which could be chosen by farmers in the area and reveal the resource requirements of the different sets of activities which could be chosen. The next stage of the research is to determine, by parametric linear programming, which components of the matrix are the crucial determinants of different farming situations. Having determined the important categories of farmers, the "universal matrix" will be split into parts, each part representing the farming situation of a different class of farmer. These parts will then be used to show the way in which the different classes of farmer will be affected by different agricultural policies. A later stage of the research, and a much more difficult stage technically, is to develop an analytical technique which will show the ways in which the various farming situations interact, and the ways in

which the reactions to policies of farmers in one situation will affect farmers in other situations. This latter stage is essential if, for example, the effects on share-croppers of mechanization by larger farmers are to be explained adequately.

Each of these stages presents formidable difficulties.

The construction of the universal matrix required the collection of information on all the major crops grown in the Kosi area, the different ways in which they could be cultivated, the different resource requirements of these different ways of cultivation, the different rotations in which the crops could be cultivated and the effects on yields of these different practices.

The complexities of farming in Kosi can be judged when we consider that there are at least seven main categories of paddy cultivable in the monsoon season, all of them observed to be important. Within each category there are many varieties, each of which have special characteristics, can be cultivated in different ways. Although it has been necessary to simplify all these possibilities in order to make the problem manageable, it is undesirable to carry this procedure too far if excessive distortions are not to be introduced into the model. At the moment the model allows for 400 real farming activities and includes 800 other activities necessary for its efficient working.

In addition to the farming activities, the resources available to farmers also have to be included. These, of course, will vary between different groups of farmers e.g. big farmers have more of the land resource than smaller farmers and we expect that the levels at which resources are available will be one of the principal criteria for delimiting the different farming situations. The inclusion of these resources in the model presents as many difficulties as the crop activities. There are, for example, nine different types of land provided for in the model, and because the availability of some resources varies throughout the year (e.g. labour and bullock ploughing power), these resources have to be specified in relation to the different periods of the farming year. There are 600 resource constraints at present included in the model.

It has been assumed that farmers maximize the net revenue of their activities, subject to minimum cash and consumption requirements, and constraints imposed by the resources at their command. It is recognised that these assumptions are only a first approximation, and attempts will be made to take account of constraints on behaviour of different types of farmer imposed by the social structure of the area, though it may be impossible to quantify the effects of these.

The information from which the model was constructed was largely collected from the farmers of the Kosi area. Farmers were interviewed intensively sometimes in three-hour sessions and their operations observed in the fields. A survey of thirty-six farmers was also conducted.

At the moment the matrix is based on a one year planning horizon, is static, and riskless. It is hoped that methods will be found for extending the planning horizon beyond one year - a prerequisite for any effective evaluation of potential response to the long-term investments in such things as tractors, tube-wells, and land improvements - and for allowing some sort of sequential decision-making behaviour by farmers and of incorporating the important aspects of risk-taking involved in Kosi farming. This last problem appears to be important for a full understanding of the rate of adoption of the new varieties of crops and rates of fertilizer application.

The treatment of this last group of topics will require an extensive elaboration of the basic matrix. There is no theoretical reason why linear programming should not be able to deal with them. The cost of doing so, however, might result in a model much too complicated to be of use in the practical formation of policies and a further stage of the research will investigate ways of simplifying the model to make it usable without making it useless.

When the model has been formulated satisfactorily, its parameters will be altered to identify the variables and their values which are critical determinants of different farming situations. The results of this exercise will then be used to determine the criteria for stratification of a much larger survey of farmers which it is intended to start in the Autumn of this year.

Members of the Kosi project feel that agricultural planning has, for the most part, leaned excessively on macro-economic models, and that its weaknesses derive mainly from the distortions implicit in aggregating information about farmer behaviour. The central problem of the approach adopted in the present study is to develop a manageable micro-model which is applicable to a wide variety of situations. Consequently, an important aspect of the Kosi project is to test the effective adaptability of its linear programming model.

The core of the project, outlined above, is supplemented by a series of studies on the interactions of the various farming situations using a regional model, on the employment effects of the Kosi development project, on the implications of the tube-well programme which is being adopted to supplement the canal irrigation system, and on the origin and nature of the poverty in the region, and the problems of those living at subsistence level.

It is misleading to study economic aspects of the Kosi area without devoting some attention to modes of access to resources where these deviate from the formal rhetoric of egalitarian allocation. The articulation of interests by groups and categories at the village level produces conflict and a type of political activity which has implications not only for the accuracy of the formal rhetoric but also for the models of change subscribed to by the administrative actors in the process. Consequently, a study is also being conducted of the political activity generated by the development of the Kosi area.

There are, of course, difficulties in the development of useful theoretical models and in the collection of adequate data to estimate them. Nevertheless it seems essential that these problems be tackled if the ways in which development affects different classes of people are to be understood clearly. There is a clear appreciation in the Kosi area that the unequal distribution of the benefits of the new technology is leading to the breakdown of traditional social and economic classes and is resulting in the formation of new and different classes. We hope that the Kosi study, based as it is, on a detailed micro study of farming behaviour rather than on aggregative study which treats all farmers as being basically the same, can help in the understanding of this process.