PROJECT FORMULATION—NEED FOR A DATA BASE*

BY

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Mr. Chairman,

I am grateful to the Indian Society of Agricultural Statistics for the invitation extended to me to deliver this year's Panse memorial lecture. I deem it an honour and privilege since I shall be in the happy company of many distinguished scholars who have preceded me in this pleasant task.

I thank the Society, however, for giving me this opportunity to pay my regards to the memory of Dr. V. G. Panse with whom I had the privilege of association for more than a decade. Many of you present here today are well aware of Dr. Panse's significant contribution in the broad field of development of statistical methodology and in applied research covering many fields. Above all, his devotion to the cause of statistics and its application to the problems of agricultural research and development is well-known to all.

Those who have personal experience of working with Dr. Panse at one time or another and are present today will bear with me when I state that the best way to commemorate his contribution to the development of statistical science and applied economic research is to dwell on a subject matter which was, perhaps, the dearest in his heart. I had learnt one important and useful lesson from my association with him in quite a few agro-economic investigations and research projects: namely to accord due attention to the essential requirements of statistical data, non-statistical information and assumptions which reflect the real situation. Dr. Panse, as you may know, was quite rigorous and, at times, used to be a great stickler on statistical procedures and analysis. In the beginning, I held the view that it would be difficult to undertake any worthwhile and time-bound study if we become too penchant for details and too demanding on the requirements of data for a scientific statistical

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analysis of a problem. Dr. Panse used to tell me that for the sake of expediency, there could be no fundamental objection to the need for short-circuiting, at times, the collection of voluminous data and base one's findings on a limited data base that might be available. However, it was important to highlight the fact that such "data" are used for a limited purpose for which these might be alright and, in no case, would these form the basis of an extended and sophisticated analytical exercise. Unfortunately, according to him, these limitations are easily and conveniently forgotten and far-reaching conclusions and policy decisions are arrived at. My experiences have more than convinced me about these hard truths propounded by Dr. Panse.

I

The subject of my talk today is—project formulation, need for a data base. I have chosen this particular topic for the memorial lecture mainly for two reasons. First, the subject is of topical importance due to the fact that the World Bank has lately stepped up its assistance for agricultural development projects in general and for the India programme in particular. The current level of concessional credit from the International Development Association (IDA) of the World Bank to India is of the order of Rs. 700/800 crores for agriculture and irrigation projects every year. In addition, a new international financing agency, the International Fund for Agricultural Development (IFAD) has agreed to extend concessional credit to the extent of Rs. 150 crores in a period of two to three years. Further, a number of other multilateral and bilateral donor agencies have shown interest in financing agricultural development programmes. With a view to preparing well-conceived and bankable project reports in the agriculture and irrigation sectors and thus absorb effectively the increased volume of external assistance, a Project Preparation and Monitoring Cell (PPMC) has been set up in the Ministry of Agriculture and Irrigation. Similar cells are being set up in the States as well.

Secondly, the work of project formulation being multidisciplinary in nature with components in various project disciplines to be spelt out in quantitative terms, one of the basic tasks is of a statistical nature comprising:

(*i*) collection and collation of available information and data,

(*ii*) generation of new types of data required in the process of project preparation, (*iii*) matching of different types of data generated by the multi-disciplinary team engaged in project formulation,

(*iv*) processing and analysing all types of data—both quantitative and qualitative.

Therefore, the need for a fuller data base. Though the need and the substance of this task is fairly well-known, the practical implications thereof are not fully understood with the result that one comes across a lot of wasteful effort in putting out a large number of project reports of indifferent quality.

My past experience of a little more than three decades in the field of socio-economic (more especially, agro-economic) research in the context of the Indian situation, leads me to one fundamental realisation, namely, the importance and seriousness with which some task needs to be done is very difficult to get across to research workers if it is of a somewhat familiar nature. There is a tendency to take it for granted. However, the tasks which are not generally known or are known to a lesser degree attract immediately the serious attention of researchers. An apt illustration of the former type is the building up of a sound data and information base and of the latter the application of sophisticated analytical techniques. The proverbial quote—"to cut the pigs tail with a fine razor" fully describes this situation.

It is worth repeating that analysts should probe and interpret the basic statistical data, non-statistical information and assumptions with a questioning mind to be certain that they truly reflect the real situation. If this is not done, the final results may well be misleading and faulty regardless of any sophisticated techniques used in the analysis.

Before I illustrate the import of what I have tried to state about the requirements of a sound and well conceived data base for any scientific analytical work with reference to the topic of this talk, *i. e.* project formulation work, permit me to make a little digression. I shall cite one or two additional examples in the context of economic and statistical advisory work in the Government, of which I have personal experience in my career. Just after Independence, those responsible for tendering advice on the price and trade (export and import) policies in the then Ministry of Food & Agriculture were using data related to area, production, yield, prices and perhaps, possible estimation of internal demand. I understand that no significant changes have occurred either in the set of data required or the mode of analysis of such data even though the context in which these policies are being formulated now has changed to a significant extent.

Almost similar is the situation in the field of price policy formulation done in the Agricultural Prices Commission. We have yot to take into account the significant changes that have occurred in the Indian economic scene today. I shall cite only two such changes. The first one is related to the state of surplus production that we have reached in the case of a few agricultural commodities, *e.g.* cereals, sugarcane and cotton and the second one is a trend towards larger diversification of both our export and import trades. I wonder whether such issues as relative physical productivities and economic profitabilities of the main competing crops and those relating to the question of higher agricultural prices *vis-a-vis* lower input costs are being taken into consideration in the analytical framework for deciding on trade and price policies for agricultural commodities.

I hope that I have been able to adduce some evidence, even though briefly, to justify the building up of a sound and adequate data base for economic policy work. Let me now turn to the specific subject of data requirements in project formulation.

II

Let us examine the complex nature of data requirements in the field of project preparation with the help of an illustrative project, say in the field of irrigation-cum-CAD. I have selected this particular project because of the practical experience gained in the PPM Cell in formulating such projects in Gujarat State which are currently being appraised by the World Bank.

The various project components which have to be supported by adequate data base relate to creation of irrigation infrastructure, existing and projected cropping patterns, assessment of credit requirements, devising institutional and organisational arrangements for implementing the project and, finally, ascertaining economic and financial rates of return. Though each of these components have data requirements of their own, a large proportion of such data have to be interlinked and matched with one another. For instance, the total availability of water in the reservoir and in the main canals is conditioned by annual precipitation, spread of the catchment area and its topography. However, the utilisation of the irrigation waters in crop production will depend on several factors, *e.g.* whether irrigation requirements are of a "protective" nature during the monsoon season or for supporting irrigated crops in winter and summer months ; whether the cropping pattern would be conditioned by considerations of water availability and crop water requirements or whether high valued crops have to be given priority, and finally, whether in order to cover small and marginal holdings in the command of the project, it is proposed to sacrifice some of the agronomic and technical considerations in the total scheme of water utilisation.

The main physical components of an irrigation-cum-CAD project are a storage structure across the river, canal system upto outlet (main, branch, distributary, minor) and main drainage system (all constructed and maintained by the Government) and water courses, field channels and field drains, constructed and maintained by the beneficiary farmers.

It has been the usual experience in irrigation projects in India that geological investigations for the dam are done first and in great detail. Not surprisingly dam designs in India have attained international standards. Hydrological studies to assess yields likely to be available over a span of time and designing an economical but safe surplussing arrangement given limited run-off data also follow practices followed in other advanced countries. But the data base for designing and implementing efficient water distribution and drainage system is very poor and enough attention is not paid to this during investigation stage. It is suggested that data base on the following aspects should also be built up during investigation stage :

(*i*) Rainfall data—weekly for at least 30 years for as many raingauge stations as possible in the command area (recommended density for irrigation projects one for 10,000 ha.) to derive expected weekly rainfall with different probabilities (90%, 75%, 50% and 25%).

(*ii*) Agro-climatic data : Temperature, relative humidity, wind velocity, sun-shine hours for 10 years observed at IMD stations within command area.

(*iii*) Soil surveys : Test to determine texture, permeability, specific gravity, infiltration, pH, electrical conductivity, moisture holding capacity, field capacity, wilting point, sodium absorption ratio, catioh exchange capacity, preparation of soil maps and irrigability class maps based on test results. Usually only reconnaissance survey is done and important soil properties have to be assumed.

(*iv*) Survey maps for the command area 1 : 2500 scale with 30 cm contour intervals.

With the above data base, it is possible to recommend an ideal cropping pattern and design an efficient water carriage and drainage system including development of lands based on sound engineering principles.

Building up a data base in on-going irrigation projects is as important as building up one during investigation so that remedial measures can be taken to rectify defects in time. The results of monitoring studies would also help in designing other contiguous irrigation projects. These studies, among other things, relate to :

(*i*) observation of groundwater levels (monthly or biennial in the command areas to plot hydro isobath contour maps and ground water flow maps and identify areas where ground water is rising.

(*ii*) measurement of water released in the canal system and wasted in the drainage system at various points to compare with actual water demand based on agro-climatic data. This would also help in computing actual efficiencies as obtaining in field against assumed design efficiency. The need and extent of lining of the irrigation system would depend on the results of above studies.

Estimating costs of a project involves a two stage preparation namely :

(*i*) formulation of tentative cost estimates after completion of investigations on the basis of local P.W.D. schedules and rates applicable to the area. To these are added estimated costs on account of contingencies and price escalation on the basis of stated assumptions. Works are put to tender after getting technical and financial sanctions ;

(*ii*) during actual construction, cost estimates are revised on the basis of (*a*) actual tender rates, and (*b*) site conditions encountered—*e.g.* blasting required where not envisaged earlier.

Cost estimates have to be continually reviewed and revised as the construction progresses to get fresh financial sanctions where necessary.

However, if at the preliminary stage, costing is done on a realistic basis, using correct factors in regard to contingencies and price escalations, a drastic revision in the original project cost estimate, which leads sometimes to serious difficulties of project implementation, could be avoided. The data on cost estimates (as per original project report and actuals incurred) of completed projects of a similar nature could provide useful guidance in estimating the costs on a project. It needs to be stated that from the point of view of economic analysis of a project not merely the total cost estimate but also its yearwise phasing have an equal importance.

After the construction phase of the project, the annual operation and maintenance costs will have to be set off against the project benefits for estimating economic/financial returns. The O & M charges are usually sanctioned on per hectare (irrigated area) basis. This allocation is usually insufficient to keep the irrigation system in top operating conditions. Realistic estimates of O & M costs needs to be formulated on the basis of data on actual maintenance costs in other similar projects including their itemwise breakdown, *e.g.* maintenance of canals, maintenance of drainage systems, maintenance of other structures etc.

Costs on Irrigation-cum-CAD projects (alongwith several other types of projects in agriculture sector aimed at either specifically increasing production of individual crops or augmenting agricultural productivity in general on an area basis ; soil conservation, land development, or creation of marketing facilities) have to be justified in terms of the net incremental production which could be ascribed to them.

Again, increment in production in its totality alone is not enough to justify the financial viability of a project. It is important to have information on the manner in which increase in production will accrue under different holding sizes. Thus, it is not merely enough to have an idea of the magnitude of increase in total production but also the pattern of this increase under different farm sizes.

The increase in production has to be estimated by comparing the data in regard to the present cropping intensities, cropping patterns and levels of yields and the projected cropping intensities, patterns and yield levels. Projection exercises in this regard have to be based on the analysis of trends supplemented by judgement of experts in the field of agronomy, water use, agricultural economics and other allied disciplines.

For purposes of evaluating the increased production, data on prices is required both for the principal crops and their by-products, A view has also to be taken on the price norms which should be used for this exercise—whether these have to be farm harvest prices or wholesale market prices, what should be the base year and whether pricing should be done on the basis of constant or projected prices.

The returns from a project have, of course, not to be measured in terms of the gross value of the additional production but on its net value—net of additional investment made by individual farmers on agricultural inputs, land preparation and shaping as also longer term investments on improved implements, machinery, irrigation infrastructure etc. This involves preparation of farm budgets and crop enterprise budgets both in the pre-project situation and in the post-project situation—the existing situation and the desired situation as it were. In so far as the post-project situation is concerned, this again has to be a statistical exercise based on adequate data supplemented by informed judgements and foresight of experts in the fields of farm management, agricultural economics and agronomy.

The proportion of agricultural produce marketed by farmer (both the main crop and its by-products) sensitively responds to the level of his farming income. This in turn has an important bearing on the income accruing to him from the farm. The part of the produce consumed on the farm household cannot perhaps be valued at the same rate at which the marketed produce is valued. It becomes, therefore, necessary to build up and analyse data on the possible changes in the proportions of marketed surpluses arising from increased agricultural production levels under a project.

Thus, ascertaining the returns of a project in the agricultural sector in terms of increased crop production involves the building up of a data base consisting of the following components:

(*i*) Present and future cropping intensities and cropping pattern ;

(*ii*) Yield levels, present and projected;

(*iii*) Productionof various crops inthe project area a preesent and projected ;

(*iv*) Incremental production of various crops on account of the project;

(*v*) Prices of farm products;

(*vi*) Gross and net value of incremental crop production ;

(*vii*) Present consumption patterns and possible changes in the proportion of marketed surplus of various agricultural commodities;

(*viii*) Distribution of holdings according to size;

(*ix*) Representative farm budget sizes in the project area;

(*x*) Crop enterprise and Farm budgets;

(*xi*) Net increase in farm incomes under different farm budget sizes;

(*xii*) Qualitative/quantitative information on changes in farm technology, input use, improved crop varieties likely to be evolved and their yield levels.

In addition to measuring the benefits accruing from a project in terms of increased agricultural production and the resultant increase in the income of the various strata of farmers in the area, it is also necessary to measure it in terms of additional employment the project generates both directly in terms of employment in the creation of various project works which is relatively a simple exercise but also indirectly as a result of more intensive agricultural effort which results on account of the project. To measure the indirect employment generation in farming activity as a result of the project, one has to collect data on monthly labour requirement per unit of area under various crops (and crop combinations) both in the present situation and in the possible post-project situation. These norms have then to be applied to the area coverage under various crops under the project to arrive at the total employment generation picture. Thus, for measuring these benefits one has to collect information on the present working pattern of agricultural labour households, the norms of labour requirement for individual crops, both under 'with' and 'without' project situations. This analysis would also reveal whether the project would lead to full employment situation or even to a labour shortage situation. Data on opportunity cost of labour would also be necessary to value the additional employment generated by the project.

Thus, even for the limited purpose of ascertaining the benefits accruing from the project the data has to be quite broad based covering a large complex of items. These data have then to be related to the cost components of the project, to arrive at estimates of economic/financial returns-cost-benefit ratio or internal rate of return. It is also usual to ascertain the impact of uncertainty in certaain key factors on the possible returns through a sensitivity analysis *e. g.* stretch out in the implementation period, fall in price, increase in construction costs, non-attainment of yield levels projected, etc.

For purposes of measuring the total impact of a project on the agricultural economy in general, it is necessary to start with a comprehensive bench-mark survey to identify the socio-economic profile prevailing in the project area prior to the project and compare this with the situation obtaining after its implementation.

In the economic field, it must be recognised that all costs and benefits are not easily measured. In fact, in almost every project analysis, there are costs and benefits which can be quantified, those which are difficult to quantify and finally those which cannot be quantified but still need be described in the project report.

An example of costs which cannot be quantified can be taken from the construction of an irrigation dam. With the completion of dam, the permanent flooding entails removal of people from their homes and villages. While monetary compensation may be paid to those who are uprooted and adequate arrangements may be made for their resettlement in a new environment and these costs can be quantified, but such costs do not fully compensate the individuals concerned. Estimating the "non-economic" costs to an individual stemming from the denied right to use their erstwhile lands is extremely difficult. However, it is not wise to ignore such considerations.

As an illustration of the complex nature of the actual data compilation necessary on some selected engineering and agro-economic aspects of a project, I am appending four tables lifted from the project report on the Gujarat Composite Irrigation-cum-CAD (Karjan) prepared by us.

These tables are:

(*i*) *Projected Cropping Pattern in the Project Area:* Data on area, yield and production of crops grown during the course of an agricultural year with reference to three situatiohs *viz.* 'present', 'future without project' and 'future with project'.

(*ii*) *Crop Enterprise Budget :* Giving for the same three situations cropwise input-output data both in physical and value terms on per hectare basis.

(*iii*) *Model Farm Budget :* For a two-hectare farm giving crop-wise disposition of the net area during the different crop seasons in the same three situations with the consequential net income to the farmer to which an estimate of the non-farming income is also added.

(*iv*) *Estimated Project Costs:* Giving itemwise cost of a project posed to the World Bank. Let me explain briefly the nature of the data that go into these four tables so as to give an idea of the time, effort and judgement required in putting them together.

As regards the projected cropping pattern, it might be noted that both in the columns relating 'future without project' and 'future with project', we have taken two years as reference points *viz.* 1983-84 as the terminal year of funding by the World Bank and 1986-87 when full benefits on the investments made under the project will begin to be realised. As a corollary, this implies that there will be spill over investment expenditure during the intervening years (1984-85 to 1985-86) which the Government of Gujarat has committed to incur.

The areas under different crops have been derived from another statement which gives the present and projected cropping patterns and cropping intensities as per cent of cultivable area.

It would be noticed that the intensity of cropping is expected to rise from 94. 1% in the 'present' situation to 95. 1% in the 'future without project' situation on the basis of an assumed trend of growth rate. But in the situation 'with project' it would rise to 138%. The projected cropping intensity under the 'with project' situation (*e.g.* 138%) has been arrived at on the basis of several factors such as availability of water from the project, crop water requirements, intensifying cultivation of existing crops, introduction of new crops both on agronomic (*e.g.* soil conditons, farmers' acceptance) and economic (*e.g.* high value crops, marketability of such crops) considerations.

The yield levels of different crops have been projected to rise gradually over the years based on estimates in respect of availability and spread of high yielding seed varieties, utilisation of higher doses of modern inputs, improvement in cultivation practices, better water management and improved extension support.

It sometimes becomes difficult to project specific yield level for a particular crop in case experimental results are not readily available either in the same area or with reference to similar areas. In such a situation the project analyst has either to be conservative in estimating increased yield levels or better still work with more than one alterative estimate of the projected increase in yield rates.

Even under the 'future with project' the entire command area does not get covered under the irrigation infrastructure. In the project area which does not receive irrigation, the benefits of demonstration and extension advisory services under the project however still tend to flow leading to use of improved input packages (compared to the 'without project' situation). The yield levels would, therefore, be somewhat higher than in the 'without project' situation while being still substantially lower than in the areas served by the irrigation infrastructure. This situation is reflected by the figures in parenthesis in this table.

The crop enterprise budget takes off from the present and projected yield levels of the crop being given in the above three situations and presents data relating to input, labour and overhead financial costs per unit of area involved in its cultivation both in the present and projected situations. This budget has to be carefully prepared taking into account doses of individual inputs required for the crop (*e.g.* fertilizers, agro-chemicals, seeds) the doses of each of these inputs being determined separately under the current situation and the future 'with' project situation.

Basically, this is a job for trained agronomists and farm management specialists. It has been found from experience that the matching of input doses with the projected yield levels of different crops is not a simple mathematical exercise but has to be based on sufficient research and experimental results.

To the input costs one has to add estimated overhead costs on account of depreciation of capital assets, interest on production credit, contingencies and possible price escalation. Finally, the labour input (both family and hired) which goes into the crop enterprise has to be costed and added to the production costs. The final row in this table relates to the gross value of the yield. The value of the by-product also has to be added to the value of the principal crop.

The farm budget is the next link in the exercise. The budget presents the economics of a two-hectare farm on the basis of per unit area production costs derived from the crop enterprise budgets. In both these statements the valuation procedure to convert the physical units of various inputs into financial terms is based on data on prices both under the present and future situations. Whereas the pricing of the output could be done with a fair degree of preciseness the pricing of some of the inputs (*e. g.* labour in a future situation) is rather a complex task.

The summary statement giving estimates of the project cost itemwise and their annual phasing over the period of project implementation have been built up from the details of cost estimate of each item both in physical and financial terms. The Central Water Commission (CWC), which is the technical agency in the Government of India to approve the technical design of the project, has vetted the physical details of the different components of the project proposed by the State, for instance, completion of 52 km long left bank main (LBM) canal and 12.6 km long right bank main (RBM) canal including earthwork, structure and lining and 5.9 km LBM branch canals, providing a distribution network for 56,200 ha culturable command area (CCA) etc. Suitable physical contingencies (10, 15, 20%) have been calculated for all the engineering items. Provision for price escalation during the project period has been made at the rate of 8% per year.

We might round off the discussion on the data and information requirements of a project by a brief reference to some other important aspects *viz.* institutional, organisation and managerial aspects of project implementation.

A wide variety of institutions in the field of research, extension and credit, to name only a few, exist in a given situation. Whether such institutions in their present form will subserve an effective and quick implementation of a project or whether some renovations of these existing institutions or further still, whether the setting up of new institutions is required—all these need to be examined in great details and depth so that correct policy decisions could be taken. Secondly, one of the basic in-built assumptions in all project formulations is that adequate management will be available, yet often this vital component is not provided for. There is a lot of truth in the statement that a good manager can make a mediocre project successful, and a poor manager a failure of a good project. Special problems arise in the Indian context where most projects are handled either by Government Departments or public sector undertakings.

Thirdly, the question as to what type of organisation would be the most suitable, is rarely given sufficient attention in project formulation. The exact character of the organization will vary from project to project, but in all instances, the organisational structure should facilitate the achievement of project objectives, provide those who are responsible for results with the authority to act, and provide internal controls so that management can effectively evaluate performances in the key areas and institute corrective actions where necessary. One vital organisational aspect is training. Provisions for money and time for such training need to be made.

All projects require timely and adequate flow of funds for implementation according to schedules laid down. The sources of these funds could be wholly from the development budgetary resources of the State and the Central Governments or entirely from the financial institutions or a mixture of both. In many projects, the capital investment involved is not recoverable and it is entirely a charge on the exchequer—especially the so-called infrastructure projects *e. g.* irrigation, extension, research etc. In some of these projects, however the operation and maintenance costs are partly or wholly recovered from charges or cess levied on the beneficiaries for the use of the final product. In other projects, especially on farm development programmes short-term needs of production credit are met from institutional finance sources. While other projects of a commercial nature meet their requirement of funds, both capital and operational, wholly from the special types of financial institutions whose basic objective is to support developmental activities in the context of plan programmes.

The final phase of the financial analysis is to identify the sources of investment funds. The mix of private equity, government equity and debt capital from internal and or foreign sources is a major influence on the rate of return realized on equity and on total capital. In addition, the earnings of the project need to be appraised to assure that the debt burden is not soheavy as to cast a wearisome shadow on the project.

III

I had three objectives in mind while discussing the need for a data base in project formulation work. In the first place, I wanted to impress about the need and impact of a comprehensive data and information base on the quality of a project feasibility report. I had deliberately chosen to present with a broad sweep on a wide canvas the substance of my talk today in order to illustrate the enormity of the task of data collection and collation.

Secondly, I have made an attempt to show that, project formulation exercise being basically of a multi-disciplinary nature, there is a great need to understand and establish the linkages of the voluminous data and information at various levels, especially between the engineering and the agronomic aspects at the technical level as also between all technical, economic, organisational and management aspects for the successful completion of the project and to have a satisfactory economic return from it. Unless sufficient care is taken to link properly the technical/engineering details of a project, it would lead to cost escalation in future when such linkages are discovered in course of actual implementation. It would also invariably lead to a tardy implementation of the project.

Flnally, and perhaps, the most important to bring home to all of us the need for inducting project discipline through the building up of a sound data-base for the formulation of all agricultural development programmes.

Till very recently, the word 'project' had been very rarely used in the field of agricultural planning and development. The concept of a 'project' as distinguished from that of a 'scheme' or a 'programme' had been rarely used in preparing the details of the agricultural sector in the Five-Year Plans or for that matter, even in the Annual Plans. It was only when some major 'schemes' having large dimensions were in the process of being posed to external agencies for financial assistance, that nomenclature of a 'scheme' was very conveniently and quickly elevated to that of a 'project' without injecting the discipline needed in the preparation of such a project.

It is my earnest hope and desire that the project formulation activities that have been just initiated in the agriculture and irrigation sectors in the limited context of absorbing the increased flow of external financial assistance will gradually help in inducting the much needed project discipline in the formulation of all agricultural development programmes.

The best way to commemorate the tradition built up by Dr. Panse and his crusade and the zeal in sustaining it is to contribute our individual mite in our respective spheres of activity to hasten this induction process.

Thank you.

A. Area Hectares
Y. Yield kg/ha.
P. Production Tonnes

TABLE I
Projected Cropping Pattern

Sr. No.	Crops	*Present situation*			*Future without project 1983-84**			*Future without project 1986-87†*			*Future with project 1983-84**			*Future with project 1986-87†*		
		A	*Y*	*P*	*A*	*Y*	*P*	*A*	*Y*	*P*	*A*	*Y*	*P*	*A*	*Y*	*P*
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	A. Kharif															
1.	Paddy	2,360	750	1,770	2,810	850	2,388	2,810	950	2,670	3,092 (1,265)(a)	2,000 (900)	6,184 (1,139)	5,621	3,000	16,863
2.	Sorghum	956	600	574	1,124	740	832	1,124	800	899	1,855 (506)	1,200 (800)	2,226 (405)	3,373	2,000	6,746
3.	Maize	225	740	166	281	950	267	281	1,000	281	1,855 (127)	2,000 (1,000)	3,710 (127)	3,373	3,000	10,119
4.	Bajra	2,361	500	1,180	2,473	600	1,484	2,473	700	1,731	1,855 (1,113)	1,250 (700)	2,319 (779)	3,373	2,000	6,746
5.	Misc. (Kodra)	281	720	202	281	800	225	281	850	239	— (127)	— (850)	— (108)	—	—	—
6.	Groundnut	1,293	700	905	1,686	800	1,349	1,686	850	1,433	1,256 (759)	1,250 (850)	6,570 (645)	9,554	1,500	14,331
7.	Pulses	3,429	425	1,457	3,373	500	1,687	3,373	550	1,855	1,855 (1,518)	750 (500)	1,391 (759)	3,373	1,000	3,373
8.	Vegetables										309 (—)	3,500 (—)	1,081 (—)	562	5,000	2,810
	B. Rabi															
9.	Wheat	787	1,740	1,369	1,124	2,000	2,247	1,124	2,100	2,360	4,637 (506)	2,500 (2,100)	11,592 (1,063)	8,431	2,500	21,078
10.	Sorghum	9,612	600	5,767	10,118	740	7,487	10,118	800	8,094	4,637 (4,553)	1,000 (740)	4,637 (3,360)	8,431	2,000	16,862

11.	Ratoon Sorghum										618 / (—)	1,200 / (—)	742 / (—)	1,124	2,200	2,473
12.	Groundnut (late)										3,092 / (—)	1,250 / (—)	3,865 / (—)	5,621	1,500	8,431
13.	Rape & Mustard										927 / (—)	1,250 / (—)	1,159 / (—)	1,686	1,500	2,529
14.	Gram										1,237 / (—)	700 / (—)	866 / (—)	2,249	850	1,912
15.	Vegetables	281	6000	1686	337	6500	2190	337	7,500	2,528	309 / (162)	10,000 / (6500)	3,090 / (988)	562	13,000	7,306
	C. Two Seasonal															
16.	Cotton	30,185	340	10,263	28,667	400	11,467	28,667	450	12,900	9,274 / (14,418)	1,000 / (450)	9,274 / (6,488)	16,863	2,000	33,726
17.	Tobacco	168	580	97	169	600	101	169	650	110	— / (76)	— / (650)	— / (49)	—	—	—
18.	Vegetables										618 / (—)	4,000 / (—)	2,472 / (—)	1,124	5,000	5,620
	D. Hot Weather															
19.	Fodder (Green)	731	22,500	16,448	731	22,500	16,448	731	23,000	16,813	— / (329)	— / (23,000)	— / (7,567)	—	—	—
	E-Perennials															
20.	Orchards (Guava)	229	5,000	1,145	225	5,500	1,237	225	6,000	1,350	1,237 / (101)	12,000 / (8,000)	14,844 / (808)	2,2249	25,000	56,225
	Total	52,898	—	—	53,399	—	—	53,399	—	—	42,663 / (25,550)	—	—	77,570	—	—

(*a*) Figures in parenthesis relate to the command area not covered under canal irrigation.
* Terminal Year.
† Full benefit year.
Source : Irrigation-CAD Composite Project (Karjan)—Gujarat.

TABLE II

Crop Enterprise Budget (Financial)

S. No.	Item	Paddy			Sorghum (Rabi)			Wheat			Cotton			Groundnut		
		P	W	W_1	P	W	W_1	P	W	W_1	P	W	W_1	P	W	W_1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.	Yields (Tonnes/ha)	0.75	0.85	3.00	0.6	0.74	2.00	1.74	2.00	2.5	0.34	0.40	2.0	0.70	0.80	1.5
	Income (Rs./ha) including by-product	1,057	1,198	4,230	900	1,110	3,000	2,610	3,000	3,750	1,190	1,400	10,000	1,440	1,760	3,300
2.	Labour requirement (Mandays/ha.)	94	100	220	115	125	150	100	110	120	90	100	300	100	110	125
	(Rs./ha.)	352	375	825	431	469	562	375	412	450	337	375	1,125	375	412	469
3.	Fertilizers :															
	(i) N : (Kg./ha.)	25	25	100	—	10	100	80	90	100	25	25	100	10	10	20
	(Rs./ha.)	87	87	350	—	35	350	280	315	350	87	87	350	35	35	70
	(ii) P_2O_5 (Kg/ha.)	12	12	50	—	5	50	40	45	50	12	12	50	20	20	40
	(Rs./ha)	42	42	175	—	17	175	140	158	175	42	42	175	70	70	140
	(iii) K_2O : (Kg/ha.)	6	6	25	—	—	25	25	25	25	—	—	25	—	—	—
	(Rs./ha.)	12	12	50	—	—	50	50	50	50	—	—	50	—	—	—

4.	Agro-chemical : (Rs./ha.)	—	—	100	—	—	50	—	50	75	—	—	1,750	—	—	100
5.	Seeds (Kg./ha.)	30	30	20	20	20	20	100	100	125	10	10	2.5	87	87	100
	(Rs./ha.)	45	45	40	20	20	50	200	200	312	25	25	200	251	251	300
6.	Contingencies (including depreciation on bullocks & machinery) at 10% of total of items 2-5)	54	56	144	45	54	123	104	118	145	49	52	365	73	76	107
7.	Interest on production credit at 5% of total of items 2-5)	27	28	72	22	27	62	52	59	72	24	26	182	36	38	53
8.	Total expenditure (Rs./ha.)	619	645	1,756	518	622	1,421	1,101	1,362	1,629	564	607	4,197	840	882	1,239
9.	Net income (Rs./ha.)	438	553	2,474	382	488	1,579	1,509	1,638	2,121	626	793	5,803	600	878	2,061

P—Present,

W—Future without Project.

W_1—Future with Project.

Source : Irrigation—CAD Composite Project (Karjan)—Gujarat.

TABLE III

Farm Budget for 2 Hectares

Sr. No.	Crops	*Present situation*				*Future without project*				*Future with project*			
		area (ha.)	*Yield (tonnes/ ha.)*	*Production (tonnes)*	*Value (Rs.)*	*area (ha.)*	*Yield (tonnes/ ha.)*	*Production (tonnes/ ha)*	*Value (Rs.)*	*area (ha.)*	*Yield (tonnes/ ha.)*	*Production (tonnes/ ha.)*	*Value (Rs.)*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*
	Kharif :												
1.	Paddy	0.10	0.75	0.075	105.00	0.15	0.85	0.1275	177.80	0.40	3.00	1.200	1,692.00
2.	Groundnut	0.10	0.70	0.070	154.00	0.15	0.80	0.1200	264.00	0.25	1.50	0.375	825.00
3.	Sorghum, Maize and Bajra	0.10	0.60	0.060	90.00	0.10	0.65	0.065	97.50	0.25	2.00	0.500	750.00
4.	Pulses	0.10	0.425	0.0425	85.00	0.10	0.60	0.050	100.00	0.10	1.00	0.100	200.00
5.	Vegetables									0.10	5.00	0.500	300.00
	Rabi												
6.	Wheat					0.10	2.00	0.200	300.00	0.40	2.50	1.00	1,500.00
7.	Sorghum	0.50	0.60	0.30	450.00	0.50	0.74	0.370	555.00	0.40	2.00	0.800	1,200.00
8.	Oilseeds and pulses									0.10	0.85	0.085	170.00

9.	Vegetables	0.10	6.00	0.600	360.00	0.10	6.50	0.650	390.00	0.10	13.00	1.30	780.00
10.	Groundnut two Seasonal									0.20	1.6	0.32	704.00
11.	Cotton	1.10	0.34	0.374	1,309.00	1.00	0.40	0.40	1,400.00	0.50	2.00	1.00	5,000.00
12.	Vegetables Perennials									0.10	5.00	0.500	300.00
13.	Orchards (Guava)	0 10	5.50	0.550	275.00	0.10	6.00	0.600	300.00	0.10	25.00	2.500	1,250.00
	Total	2.20			2,828.00	2.30			3,586.30	3.00			14,671.00
1.	Net Cultivable area	2.00	...	...	...	2.00	...	...	...	2.00	...	...	...
2.	Production cost (Rs.)				1,578				2079				5,892
3.	Net income in (Rs.)				1,250				1507				8,779
4.	Increase over present situation (Rs.)								257				7,529
5.	Increase over future without Project situation (Rs.)												7,272
6.	Non-farm income (Rs.)												1,000

Source : Irrigation CAD Composite Project (Karjan)—Gujarat

TABLE IV

Estimated Project Costs

(Million Rupees)

Item	Total cost posed to World Bank	Yearwise expenditure planned				
		1979-80 3	1980-81 4	1981-82 5	1982-83 6	1983-84 7
A. *Irrigation :*						
1. Dam	193.10	56.31	77.77	40.22	18.80	...
2. LBM Canal net-work	103.06	16.73	29.60	32.17	24.56	...
3. RBM Canal net work	16.39	3.20	5.70	6.12	1.37	...
4. Temporary buildings	19.83	10.84	8.99	...	...	...
B. *CAD*						
5. (*a*) Field Channels, field drains and land grading	43.66	—	7.00	14.00	15.40	7.26
(*b*) Complete package of land development	24.20	—	—	2.20	8.80	13.20
6. Drainage	8.60	—	1.08	5.37	2.15	—
7. Extension services	5.00	—	—	1.00	2.00	2.00
8. Roads	23.85	—	7.02	8.33	8.50	—
9. Markets	4.50	—	—	1.00	1.50	2.00
C. *Equipment :*						
10. Dam and spillway	28.70	14.70	14.00	—	—	—
11. Canals	3.26	1.66	1.60	—	—	—
12. Laboratory	4.50	2.25	2.25	—	—	—
13. Roads	4.03	2.00	2.03	—	—	—
D. *Monitoring*	10.00	—	—	3.00	3.00	4.00
Sub-total	492.68	107.69	157.04	113.41	86.08	28.46
Physical contingencies	74.93	17.66	24.60	17.38	11.95	3.34
Engineering Supervision and administration	85.85	19.90	28.05	20.16	14.10	3.64
Price contingencies (8% per year)	76.64	—	17.12	24.62	25.86	9.04
Total	730.10	145.25	226.81	175.57	137.99	44.48

Source : Irrigation—CAD Composite Project (Karjan)—Gujarat