ORISSA ECONOMIC JOURNAL

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ORISSA ECONOMICS ASSOCIATION
BHUBANESWAR

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ADDRESS OF WELCOME

G. N. ACHARYA,
Secretary, Reception Committee
Principal
Kendrapara College

Mr. President, Hon'ble Akbar Ali Khan, Governor of Orissa, fellow members of the Reception Committee, other office-bearers of the Orissa Economics Association, Delegates to the 8th Conference of the All Orissa Economics Association, Ladies and Gentlemen,

I, on behalf of the reception committee, extend you all a very cordial welcome and ovation. I hail the 8th Annual Conference of the Orissa Economics Association. It is a rare opportunity and privilege for us to play host to an important conference of a learned Association like yours.

We feel proud that the Hon'ble Governor of Orissa, Sri Akbar Ali Khan, in spite of his multifarious engagements could spare a part of his valuable time to be with us this evening. From the time of your assumption of this great office, Sir, you have been taking keen interest in the upliftment of the people of this economically underdeveloped and poverty-striken State and it is your love and affection for the common man of this state that you have been undertaking extensive tours throughout the state. We feel proud that a personality of your stature is here to inaugurate this conference which is taking place at a very crucial time in the Economic life of the Nation.

To you Mr. President and learned delegates, some of whom are my own teachers, and others, friends and colleagues, I owe a deep sense of gratitude. You have not only honoured us by your kind presence this evening but have shown a great

favour to us in selecting this College as the venue of your Conference.

I am aware of our limitations in not being able to make your stay here as comfortable as it could be because of the lack of adequate amenities of modern life at Kendrapara. But I am sure, you will not mind these deficiencies on our part due to your magnanimity.

Kendrapara is a small town being the Sub-divisional headquarters of Kendrapara sub-division in the district of Cuttack. It is situated at a distance of 20 miles from the Bay of Bengal with a rich cultural heritage. The town of Kendrapara is famous for the deity of Baladevji throughout the State. The name of Kendrapara is associated with the legend relating to the Demon Kandara Sura who was slain by the Lord Baladevji. Lord Baladevji married the daughter of the Demon, named Tulasi and that is why Kendrapara is known as Tulasi Khetra in Orissa. It has become a blessed sanctuary.

The town has an area of 10.88 sq. Kms. with a population of 20,079 which consists of Hindu and Mohammedans in the ratio of 65 to 35. The Hindus and Muslims have been residing as brethren in perfect harmony with each other.

The Kendrapara Municipality is one of the oldest Municipalities of Orissa. It came into existence as far back as 1869. In the days of yore, when there was no Railway connection between Cuttack and Calcutta, trade and commerce with Calcutta was carried through the Kendrapara Canal.

It has once been a centre of maritime trade and commerce through its port False Point. It is one of the prosperous agricultural areas of Orissa, famous for the production of rice, jute, fish, milk and milk products. This can be described as the granary of Orissa because of large-scale production of rice in the area.

But the area is frequently hit by natural calamities like flood and cyclone which has shaken the economic back-bone of the people of this area.

Kendrapara has contributed a great deal to the development of music and dance in Orissa.

The present conference is meeting at a very crucial stage in the National Economy when in spite of four five-year plans, 40 per cent of the people of the country live below the poverty line or the minimum consumption level. The country still has to fight against poverty, backwardness, exploitation and social injustice. The learned delegates assembled here in this conference will deliberate on two important subjects of topical interest. "The cost-benefit analysis of development projects in Orissa" and "The development strategy of weaker sections in Orissa". An assessment of the functioning of the development projects in Orissa and their impact on national economy needs careful study, otherwise the loss from these projects may outweigh the gain.

More than one third of the population of Orissa belong to the scheduled caste and scheduled tribe community who are proverblally backward. It is the duty of the National Government to bring these communities on an equal par with other communities of the state by special efforts. The learned delegates of the Conference, I trust, will arrive at significant decisions on these vital economic issues.

Before I conclude, I convey my sincere apologies to the Chief Guest, the Hon'ble Governor of Orissa, to the distinguished delegates and other guests for the inconveniences that might have been caused to them on account of deficiencies in our arrangements. With a deep sense of gratitude to you, Hon'ble Chief Guest, Mr. President, and learned members of the Association, I once again welcome you all with cordiality and affection.

Hope, you will carry sweet memories of this place and blessings of Lord Baladevji.

REPORT OF THE SECRETARY, ORISSA ECONOMICS ASSOCIATION

P. K. DAS

Your Excellency, the Governor of Orissa
Mr. President,
Dean Dr. Misra,
Hon'ble Vice.Chairman, Reception Committee,
Principal Mr. Acharya,
Fellow Delegates,
Ladies and Gentlemen.

I have great pleasure in presenting this report of the Association before the august gathering.

Annual conference

The seventh Annual conference of the Association was held at Bhubaneswar on 6th and 7th April, 1974 under the auspices of Orissa University of Agriculture and Technology. It was inaugurated by Srimati Nandini Satapathy, Chief Minister of Orissa. Dr. S. P. Gupta, Prof. and Head of Deptt. of Economics, Sambalpur University presided over the conference. Sri Jagannath Das, Vice-Chancellor of Orissa University of Agriculture and Technology welcomed the delegates. Mr. Ram Saran, Economic and Statistical Advisor of the Ministry of Agriculture delivered a technical address on Price policy for agricultural commodities. Dr. Baidyanath Misra, Dean, College of Agriculture proposed a vote of thanks. The following topics were discussed :

(1) State Finances, and
(2) Regional disparities and Balanced Growth.

Symposium

The Association organised a symposium on "Inflation in India". Dr. Sadasiva Misra, Ex-Vice-Chancellor of Utkal University initiated the discussion and some of the distinguished members of the Association took part in the deliberations.

Orissa economic journal

During the year the Association continued with the publication of the Orissa Economic Journal and brought out two issues. Some of the papers read in the conference have appeared in the Vol. VII of the Journal.

Publication

It has been proposed to undertake the collection of outstanding published research articles on various topics in economics and reproduce them in book form under the auspices of the Orissa Economics Association.

High light of this 8th conference

This 8th All Orissa Economics conference which is held here is going to be inaugurated by our most esteemed and learned Governor of the State, Sri Akbar Ali Khan. He is not only an eminent jurist and a talented administrator but also a great educationist. We offer our deep sense of gratitude to him for having consented to inaugurate the conference.

In this conference two important topics namely (1) Cost-Benefit studies of the Development Projects and (2) Strategy for Development of Weaker Sections will be discussed. Moreover there will be a seminar on Improvement of Teaching of Economics in Colleges and Universities of Orissa. Dr. Debendra Chandra Misra, D. P. I. (H.E.) Orissa and one of our past Presidents will be in the chair.

I take this opportunity of placing on record the services of the members of the Executive Committee, and other members

of the Association who have cooperated whole-heartedly in the affairs of the Association. I would like to express my deep sense of gratitude to Dr. Baidyanath Misra and Dr. Bidyadhar Misra for their valuable guidance and advice which enable me to carry on the activities of the Association.

On behalf of the Association and on my own behalf I wish to thank the members of the Reception committee, the Principal, Staff and Students of Kendrapara College for kindly inviting us to hold the conference at Kendrapara. I also thank the delegates and all those present here for their kind presence and for making this conference a grand success.

VIII ANNUAL CONFERENCE OF THE
ORISSA ECONOMICS ASSOCIATION

PRESIDENTIAL ADDRESS

SHRI H. K. MISRA,
Professor of Economics

Hon'ble Rajyapal, Chairman Reception Committee,
Members of the All Orissa Economics Association,
Ladies and Gentlemen,

I am grateful to the members of the Orissa Economics Association for inviting me to preside over this year's Conference. Had I not been a little free after my being relieved of my duties as the Registrar of the Utkal University, it would not have been that easy for me to accept this assignment so generously offered to me by my esteemed colleagues. I am fully aware of my limitations to discharge the responsibilities of the President of this august body. Having lost touch with my subject for some time past, I am afraid, this address may lack the academic approach of a person seriously devoted to the study of economic problems.

The object of this address is to highlight the present state of Orissa's agricultural economy and some of its major problems. The agricultural sector of our economy has been given paramount importance in the draft Fifth Five Year Plan of Orissa. (The final plan is not yet available for public use). The predominance of the agricultural sector has remained an established fact and will continue to remain so as 92 per cent of the people of Orissa live in villages tied to agriculture directly or indirectly and seventysix per cent of her working population depend on agriculture for their livelihood as against 69 per cent at the All India level. Concentration of labour

force in agriculture has increased from 70 per cent in 1951 to 76 per cent in 1971. In Orissa 55 per cent of the State's Income comes from agriculture as against 30 per cent in West Bengal, 45.80 per cent in Bihar and 44.70 per cent in Assam. Agriculture which is still at the subsistence level accounts for major share of the State's income with more than 90 per cent of her people living in villages depending on agriculture which is itself at a subsistence stage. Orissa is rightly described as epitome of India's poverty.

The twin basic objectives of our country's planning are removal of poverty and attainment of economic self reliance. The first of these two objectives is popularly described as 'Garibi Hattao'. Poverty level has been defined by the Approach Document in terms of per capita minimum level of consumption per month. The minimum level of consumption expenditure which should be ensured for each individual has been estimated to be Rs. 20/- per month at 1960-61 prices and at current prices it may be approximately Rs. 50/-. An individual who has not the capacity to incur this expenditure to meet his consumption requirements is certainly living below the poverty line. It has been estimated that 64 per cent of Orissa's population of 220 millions were living below this poverty line on the eve of the Fifth Five Year Plan as against the All India percentage of 41.20. Orissa has the highest percentage of people below the poverty line. It is further revealed that 79.88 per cent of Orissa's rural population are living below the poverty line which is also the highest in India. If the large bulk of our people are to be lifted above the poverty line so as to keep pace with the All India level an all out effort has to be made to strengthen the agricultural sector which constitutes the basic foundation of our economy.

When it is said that agricultural sector has to be given the topmost priority, it does not mean that the other sectors are to be ignored. As a matter of fact no one sector of the economy can be considered in isolation as all the sectors are interdependent. Any measures to strengthen one sector of the economy will have impact on the other sectors. If yield from agriculture increases, if agriculture is diversified by produ-

cing both food and non-food crops and if land remains utilised as far as possible all the year round the secondary and tertiary sectors of the economy will be benefited and the sectoral imbalance which is at present a conspicuous feature of our economy will be largely corrected.

The objectives of the Fifth Five Year Plan of Orissa as given in the approach paper are—

(*a*) Doubling of the State's income at current prices.

(*b*) Provision of the minimum consumption needs of the people.

(*c*) Improvement in the status of the relatively backward tribal population.

(*d*) Removal of imbalance in the development of various regions within the State.

With regard to the first objective which is considered to be the main objective it is said 'a key to this approach is that the main emphasis should be on development of the agricultural sector including the development of irrigation facilities in the State and rural electrification.....The Fifth Plan's main thrust is to be agricultural development'.

The cropping pattern in Orissa has essentially remained the same after more than two decades of planning with slight variations here and there. 74.3 % of the cultivated area is still under the food crops out of which rice alone accounts for 56.9 % of the total cultivated area. Though there has been some switch over to the production of cash or commercial crops the impact is not that significant to affect the economy of the State. In most of the non-irrigated areas there is mostly one crop cultivation and agricultural production has been to all intents and purposes been identified with rice production. It is natural that yield from rice production will considerably influence the contribution of the agricultural sector to the total income of the State.

Growth rate of agricultural production during the decade 1960-61 to 1970-71 does not appear to be satisfactory. During this period production has increased by 44.3 per cent against the area increase under cultivation by 31.2 per cent. Agricultural productivity as a whole seems to have increased by 10 per cent only i. e. at the rate of 1 per cent per annum. But as between the food crops and non-food crops, the growth rate of the former has been less than 2 per cent as against a little more than 10 per cent for the non-food crops. Taking the growth of area under cultivation into account, agricultural productivity in respect of food crops showed a negative trend.

Though under the First Five Year Plan agriculture received the highest priority, the same degree of importance was not attached to it during the subsequent two plans. It is of course true that a good deal of emphasis was given to irrigation and power which constitute the principal infrastructure for agriculture and industry. With agricultural economy at the subsistence level it should have been given topmost priority for at least three consecutive five year plans.

The basic malady of agricultural production has been low yield from land—low yield per acre as well as low yield per unit of labour force employed in it. In almost all the developing countries like India, this is a general feature. The scope for increasing area under cultivation with a view to increasing total yield from land is absolutely limited. The land utilisation statistics for 1970-71 reveal that in Orissa out of the total geographical area of 384,00,000 acres cultivated area is 166,59,000 acres, forests account for 122,89,000 acres and pastures and grazing land for 17,91,000 acres. Thus cultivated area, forests and pastures account for 43 per cent, 32 per cent and 4.7 per cent respectively. The balance of 20 per cent is accounted for by orchards, cultivable wastes and lands not fit for cultivation. The question of increasing land area for further cultivation is not possible unless the limited cultivable waste land is reclaimed at fairly high cost or there is an encroachment on for forests and pastures, but such an encroachment will ultimately be detrimental to the interest of agricultural economy. With land area under cultivation remaining almost fixed and the labour force engaged in it increasing with

rise in population, yield per unit of labour force dependent on land is anything but satisfactory. In 1971 the population of the State was 219.4 millions showing a decennial increase of 25.4 per cent. The projected population by 1981 is expected to exceed 286 millions and the land under cultivation remaining almost constant we can easily imagine further dependence on land by the end of the Fifth Five Year Plan when the projected population figure will be in the neighbourhood of 260 millions.

With all the emphasis given to irrigation in the second and the subsequent plans, Orissa does not compare favourably with many of the States in India. With the exception of Gujrat, Madhya Pradesh, Karnatak and Rajstan the percentage of net irrigated area to the net area sown is the lowest in Orissa. The major irrigation projects have not gone a long way in providing water facilities to the large bulk of the cultivated areas. Even the Hirakud canal system does not provide water for more than 15 per cent of the net area shown in the Sambalpur district which has been brought under the I. A. D. P (Intensive Agricultural District Programme). More than 85 per cent of our cultivated land comes within the rain-fed areas without any specific irrigation facilities and success or failure of crops in these areas depends to a very great extent on favourable or unfavourable weather conditions.

The cultivator is now fully aware of the fact that the yield from his land will improve if he is assured of well-timed water supply, manures and fertilisers, pesticides etc. The scope for improving yield from land still exists and the pessimistic concept of the operation of the Law of Diminishing Returns need not be advanced to justify any low productivity from land. I quote a leading economist who has observed as follows. 'Differences of yield are noticeable not merely as between different areas but also between different groups of farmers. In the same area, the best farmers are known to have produced yields several times higher than those produced by the average farmers. In fact the difference between the best and the average is much wider in India than in the technically advanced countries. This is both an Index of the backward character of Indian agriculture and a measure of its potentiality for development'. This state

of affairs is also true in the case of our state. There is ample justification for allocating a little more investible resources to enhance the yield from land. In agriculture yield can improve better than elsewhere with low capital/output ratio. The need for foreign exchange and scarce skills is less in agriculture. With a little more capital investment in terms of inputs like irrigation, fertilisers etc. production in the agricultural front is likely to increase substantially.

The average farmer in our state is the small farmer. The statistical data relating to the percentage of operational holdings operated individually indicate that 76 per cent of the rural households operate up to 2 hectares of land i.e. 5 acres land. Only 2. 45 per cent of the households operate 10 hectares or 25 acres of land and above. The Government as a part of their policy have started redistribution of land holdings. Surplus lands wherever available are being placed at the disposal of the landless workers. The difference in possession of land as between big and small holders definitely poses a problem for serious consideration. How far the average farmer will be capable of increasing the inputs in his land so as to increase the yield still continues to be a debatable issue. The Government have accepted as a policy measure to go ahead wtth consolidation of holdings. A question that naturally arises if consolidation of holdings can be effected through legislation. The merits of consolidation of holdings cannot be questioned as this will facilitate the use of requisite inputs in land. Even when a family is partitioned the inheritors do not agree to partition the lands in such a manner so that each inheritor will have a compact block of land in his possession. Cultivated lands can be divided into good, indifferent and bad varieties. The inheritor will certainly insist on having a share in each of these varieties of land. The sentimental attachment to land is so very great that only those who possess land know how strong that attachment is. Fixation of land ceilings and consolidation of holdings are theoretically sound. But unless the persons affected are psychologically prepared to accept these measures no amount of legislation will deliver the goods. These measures may be responsible for creating a certain degree of uncertainty in the minds of the landholders regarding the future of tenure and occupancy rights. Any steps in this direction are to be taken with due caution and circumspection

so that agricultural production may not be adversely affected. Hasty dislocation of existing distribution of land holdings may be avoided as far as possible. Consolidation of holdings may be attempted on a selective basis by provision of suitable incentives from the side of the government. The government may consider whether the process of consolidation of holdings due recognition will be given to the ownership of land. Distribution of land holdings compatible with increase in agricultural production should be treated as one of our basic goals, otherwise the remedy may prove to be worse than the disease itself.

In the Fifth Five Year Plan production of foodgrains is to be increased from 60 lakh tonnes to 80 lakh tonnes with greater emphasis on Rabi crops. Production of jute is to be increased from 3.9 lakh bales to 5.2 lakh bales, sugarcane, from 2. 50 lakh tonnes to 3 lakh tonnes, and oil seeds from 2.97 lakh tonnes to 4.86 lakh tonnes. Thus increased emphasis on Rabi crops and commercial corps is the main strategy on the agricultural front.

It is doubtful as to what extent these targets are realistic. In the first place we are not yet aware of the actual production of the crops referred to above at the end of the Fourth Five Year Plan i. e. by the end of 1973-74. Secondly the increase of crops from 1967-68 to 1971-72 has not been that significant to justify the anticipated increase by the end of the Fifth Five Year Plan. The total quantity of food grains was 41.35 lakh tonnes in 1967-68, 47.2 lakh tonnes in 1968-69, 47.2 lakh tonnes in 1969-70, 48.5 lakh tonnes in 1970-71 and 43.53 lakh tonnes in 1971-72. It is difficult to conceive if in another two years' time production would have increased by 16 to 17 lakh tonnes. The considerable fall in quantity in 1971-72 cannot be lost sight of. Putting the target of production at such a high pitch will belie the expectations of both the government and the people. With regard to production of jute, the volume of production in 1971-72 is slightly higher than in 1967-68 with definite fall in the intermediate three years. As regards oil seeds there is seen to be positive improvement. Production of oil seeds increased from 1.91 lakh tonnes in 1967-68 to 2.43 lakh tonnes in 1971-72. The 30% increase in production of oil seeds during this period justifies putting the Fifth Plan target at about 4.9 lakh tonnes, although it

will need sustained efforts to reach the target. Production of Sugarcane from 1967-68 to 1971-72 has been fluctuating. Against the production of 1.81 lakh tonnes in 1967-68 production is 1.91 lakh tonne in 1971-72 and it is difficult to accept a production figure of 2.50 lakh tonnes within the next two years so as to justify fixation of the production target at 3 lakh tonnes. But apart from the apparent statistical improbabilities pointed out above we may say that the approach is in the right direction. A change in the pattern of cropping as indicated above appears to be reasonable.

The Intensive Agricultural District Programme (IADP), popularly known as the package programme operating in the Sambalpur District since 1962-63, has played an effective role in increasing agricultural production. The package programme is really a package of improved farm techniques which include farm planning, supply of improved seeds improved agricultural implements, soil testing, credit and marketing facilities and field demonstrations in improved technology. With regulated assured water supply the programme is bound to increase yield beyond the farmer's expectation and in fact paddy yield has substantially improved with the use of fertilisers and high yielding variety of paddy. But cropping pattern does not seem to have changed. Paddy continues to be the important crop of the district and cash crops cover only 7 per cent of the total cropped area.

Even with all steps taken to improve the yield from land the outlook of the people has to change so that ultimately they may be encouraged to grow cash crops. But this change in outlook will come only when food crops more than necessary continue to be produced over a period of years. The farmer has however to be provided with water facilities at the appropriate time. If in rain-fed areas the government without being involved in statistical cities takes up life irrigation works and covers all the drought affected pockets over a decade's time the problems relating to agricultural production will be substantially solved. No amount of package practices will be helpful in the absence of assured irrigational facilities. It may be considered if package programme of the I. A. D. P. model can be extended to other districts in phased manner particularly having already experimented it for more than twelve years in a particular district.

Agriculture will continue to be the biggest employment generating sector for all the people living in rural areas. With improved techniques of cultivation labour force engaged in land will be properly utilised and more persons may also be kept employed. But what is equally important is that agrobased industries should be developed in as many rural centres as possible. Small townships will naturally grow with development of agriculture and industries directly linked with agriculture. Exodus of people from rural areas to industrialised urban centres like cities has created and will create more complications. Neither the city dwellers nor the migrants from rural areas will stand to gain. The country side should hum with industrial activities side by side with agricultural development. For purpose of agricultural growth there is a need for a network of market towns and agro-industrial townships linked with villages below and cities/metropolies above. Village industries cannot be saved by subsidies only. Unemployment in rural areas cannot be solved by adhoc programmes or by setting up agro-industries unless market is created to absorb the products of such industries at profitable prices. Outlay on infrastructure like development of village roads and rural electrification will certainly give necessary impetus to agricultural development and facilitate creation of adequate creation of adequate employment opportunities in the rural sector.

It will not be a mistake to state that implementation of a plan is more important than making a plan itself. A plan may have some shortcomings and as a matter of fact no plan will be free from shortcomings. The objectives and ideals behind a plan can seldom be challenged though there may be difference of opinion regarding the right ordering of priorities. Persons kept in charge of developmental projects at different levels must be conscious of the objectives and ideals of a plan because it is they who are to make the benefits of the plan available at the door steps of the common man. Implementation of agricultural programme stands or falls to the extent the block level officers at the lowest level function effectively or otherwise. They constitute the agency through which cooperation from voluntary organisations among the rural masses can be enlisted. A plan or a programme cannot be

thrust down the throats of the people unless they are associated with it. The government may consider grant of special facilities to those officers and officials who take sincere and keen interest in the promotion of agricultural programmes. Certain schemes already implemented during the fourth plan period to help the small and marginal farmers may be extended to as many areas as possible. But here a caution is necessary. It is too early to make any assessment of the success of these schemes. There is the apprehension that funds given may not be properly utilised for the purpose for which such funds are given. Diversion of such funds to nonproductive uses cannot be ruled out and if assistance given goes down the drain nothing will be more disappointing than this. A plan can be successful or otherwise with the sincerity or the lack of sincerity with which it is implemented.

Note : Source of statistical date used in this address is the Bureau of Statistics and Economics, Orissa.

SOURCES OF GROWTH IN INDIA AND ABROAD

Dr. BAIDYANATH MISRA

Factors in growth

Economic growth of a country depends on several factors. For the sake of simplification, three main factors can be identified for the purpose of our analysis. First is, physical increase in factor inputs permitting a higher level of production. However, in this case, if only one factor increases and other factors remain constant or a few factor inputs increase while other factors do not show any signs of change, the movement to a higher production function will involve a change in the combination of factors, and output will not be able to increase for ever because ultimately the marginal product of the variable factor/factors will fall to zero. This may be prevented for sometime because the combination of different factors may improve efficiency, In every kind of business, there is usually a minimum size of establishment below which it is impossible to operate competitively because one of the factors would not be present in large enough quantity to allow certain technical efficiencies to be realized. This fact in turn arises because factors are not infinitely divisible for all uses and there is always a minimum amount of one factor that must be applied if a certain output is to be secured. But ultimately since the variable factor cannot replace the fixed factor the elasticity of substitution between different factors being in most cases less than one, total output will increase less than proportionately.

Secondly, when all the factors increase in supply, total output may increase more than proportionately due to economies of scale. This means that as we simultaneously increase all the factor units, the total mix of these units forms an increasingly

efficient technical combination giving rise to Increasing Returns. Thirdly, technical progress may increase the productivity of factors other than increasing returns. This is irrespective of increase in factor supplies : the same amount of factors may produce more due to qualitative change in the factors.

Role of capital in economic growth

Assuming that these are three sources of growth, in fact, all the factors of growth can be subsumed under these three heads, let us see which of these three sources of growth have become important in increasing the rate of growth in developed countries. A number of studies has been initatied to make a quantitative measurement of the contribution of different factors to economic growth particularly in developed countries. Some of the findings are revealing. E. Denison who has made a comprehensive study of the sources of growth of nine western countries (including America) for the period 1950-62, pointed out that capital stock including changes in its composition contributed approximately 25 percent in the U. S. and just under 20 percent in North-West Europe towards economic growth. Abramovitz and Solow studies (1956 and 1957) showed that capital accumulation did not play a crucial role in the growth process, about 80 to 90 per cent of the growth of output per head in the American economy over the century could not be accounted for by increases in capital per head. This implies that if a country is already developed, the importance of capital as a source of growth is not significant. But in a developing country, capital has greater importance. For example, A. Maddison has recently made a study of less developing countries, 22 countries over the period 1950-65. His results show that capital's contribution is 55 percent, labour's 35 percent leaving a residual contribution of 10 percent attributable to increased efficiency in resource allocation. In case of Israel, Gaathon finds out that the growth of capital per head accounted for 60 percent of the annual average growth per head over the period 1950-59. That is why Hicks in his 'Capital and Growth' says : 'It is very wrong to give the impression to a (developing) country, which is very far from equilibrium even on past technology that capital accumulation is a matter of minor importance.

Role of labour in economic growth

In most of the developed countries, the contribution of labour towards economic growth is quite high. The importance of labour is considerably enhanced if education is taken into account. In America, over the period 1929 58, Denison has estimated that increases in education raised the quality of labour force by the equivalent of a 0.93 per cent per annum increase in the quantity of labour. Weighting by labour's share of the national income gives a contribution of education to measured growth of 0 68 percentage points or 23 per cent. The corresponding contribution of education to the rise in output per person employed is 42 per cent.

Resource shifts from agriculture to industry also contribute towards economic growth. But some of the findings show that there is not much scope for this in case of developed countries. Studies in America showed that approximately 0.1 per cent of growth was due to labour shifts, and 0.8 percentage points to capital shifts. Denison's study showed that resource shifts from agriculture to industry during the period 1950-62 contributed 1.04 percentage points per annum to the growth rate of Italy, 0.7 percentage points in Germany and 0.65 percentage points in France. His study showed that resource shifts were important in Europe, but not in U. S. or U. K. because by about 1950, resource shifts were complete in these two countries.

Dension has made three types of studies. First he quantifies for each country the absolute and relative contribution of each source. Excluding property income from abroad and imputed earnings from residence, the average factor shares of national income in North-West Europe and America for the period 1950-62 were as follows :

	N. W. Europe	U. S.
	%	%
Land	4.0	3.0
Labour	77.6	82.0
Reproducible capital	18.4	15.0

In all countries except America, Denison finds that a higher proportion of growth is attributable to increases in output per unit of total input (resource shifts from agriculture to industry and economies of scale, advances in knowledge and residual productivity) than to increases in inputs themselves. It is also seen that the contribution of labour is more to economic growth than other factors. Having adjusted the employment figures for quality changes, Denison concludes that labour input as a whole contributed 33 per cent to the growth of income in the U. S. A., 18 per cent in North West Europe and 25 per cent in the U. K. The unadjusted growth of employment and education were of major importance in all countries. Education by itself contributed 15 per cent to the growth in the U. S., 5 per cent in North West Europe and 12 per cent in the U. K. and in case of income growth per person employed the relative contribution of education was 22, 6 and 17 per cent respectively. Education in America has a greater stimulus than in Europe, since educational stock per person in Europe is approximately 50 per cent lower than in America.

Denison has shown that residual productivity is the biggest source of difference in levels of income per person employed between America and Europe, and between America and the U. K., while advances in knowledge have been the largest single source of growth in income per person employed in the U. K. and the second largest source, following economies of scale in North West Europe.

Resource allocation in underdeveloped countries

What about under developed countries ? Not much study of this nature has been done in these countries due to shortage of reliable empirical data and difficulty of aggregate production function. Further, in underdeveloped countries factor shares do not measure the relative contribution of labour and capital. In agriculture, for example, when there is subsistence economy, the payment to labour is not in conformity with marginal productivity theory. There is a prevalence of institutional wage which is much lower than the industrial wage. And yet the marginal productivity of labour is lower than the institutional wage. The result is that the contribu-

tion of each labour is less than wage paid to him even though the level of institutional wages is very low and the share of labour in total income almost certainly exceeds its marginal product. This implies that the traditional criterion of resource allocation on the basis of marginal principle is not applicable in developing economies. Galenson and Leibenstein have pointed out that the straight forward application of the marginal principle is limited in backward countries on three grounds : (*a*) it is based on the productivity of capital when the goal of economic development must be to maximise per capita output at some future time; (*b*) the criterion emphasises the rate of output, not the rate of investment which is the determinant of future output; and (*c*) no account is taken of changes other than the increase in the amount of capital i.e. such vital factors as population growth is ignored. It is therefore difficult to make a study of optimal investment pattern so as to measure the contribution of different sources of growth.

Pattern of development in underdeveloped countries : Increased investment

However, the experiences of the development pattern of the developed countries make it clear that we have to initiate action on three fronts. First, we have to make massive investments to break the economy out of its state of poverty, particularly in view of the rapid growth of population. Small efforts to raise income will only induce population growth, which in turn would swamp any improvement of per capita income. Capital accumulation has therefore to play an important part in accelerating the economic growth of underdeveloped countries. In India the rate of investment in relation to national income is round about 11 per cent, out of which foreign capital contributes about one per cent and internal savings 10 per cent. This implies that we are consuming 90 per cent of our income, and saving and investing to the extent of 10 per cent, whereas most of the developed countries which can afford to consume more and save and invest less, are consuming 70 per cent of their national income and saving and investing to the extent of 30 per cent. Unless we increase the rate of our saving and investment to the extent of 20 to 25 per cent, it does not seem that, we can be able to attain the take-off stage. We are still in Rostow's transitional stage of economy.

Infrastructure development

The second question is the pattern of investment. Historical evidence does not support any particular structural sequence of development. In some countries, a necessary condition for take-off has been the existence of one or more rapidly growing sectors whose entrepreneurs (private or public) ploughed back into new capacity a high proportion of profits. In some other countries, rapid expansion in exports has been used to finance the import of capital equipment and to service the foreign debt during the take off. All the same, the need is for emphasising the development of infrastructure which will form the basis for productive investment. Additional investment in any sector will achieve nothing if the rates of return of existing investments continue to remain low. At least private investments will not be forthcoming without a higher rate of return in existing investments. Adler points out that in the process of development, poor countries should emphasise the creation of social overhead capital i.e. high ways, power installations, water works, hospitals, technical training facilities, etc. for creating external economics and accelerating the economic growth. In fact, creation of sccial overheads will not only increase the ratio of net additional output to capital investment (external economics), but it will also provide facility to widen the range of profitable investment opportunities for the private enterprise. Lewis thinks that 'a cheap and extensive network of communicatlons is the greatest blessing which any country can have from the economic point of view.' Because, in addition to generating simple external economies, expansion of communications will facilitate the development of marketing and distribution structure and at the same time, help in spreading skills and changing attitudes which are most conducive to economic progress.

Structural transformation

The third factor which is important for initiating a process of basic change is structural transformation and organizational improvement. In developing countries, the socialized sector plays an important part in investment decisions of the country. This is what it should be. But the socialized sector is often slow,

bureaucratic and sometimes, halting. In our country, with our anxiety for facilitation change, we have established quite a number of institutions for initiating change at different levels of the economy. But these institutions have often delayed the process of change. The Reserve Bank of India which has recently published the results of a number of Surveys (All India Debt and Investment Survey, 1971-72, the 1967-69 study on the 'Specific problems faced by small farmers in their farm business under different agro-economic environmental condition prevailing in the country', and Role of co-operative credit in increasing production for the period 1963-64 to 1965-66) bring out one central fact that planning as practised in the last 25 years has hardly made any basic change in the structure of the rural economy. In fact the relative economic position of the mass of rural population has deteriorated and the major instruments of change evolved over a period of years the Co-operative credit system, the land reform measures, the Intensive Agricultural Areas Programme and High Yielding Varieties Programme—have contributed to the deterioration. You cannot simply park a jet plane over a bullock cart. It is therefore imperative to change the feudalistic structure of the rural economy by completing the agrarian reform measures initiated long ago like fixation of ceiling, fixity of tenure, consolidation of holdings, etc. so that the rural economy can respond to the progressive changes initiated now to help the small farmers, landless labourers and depressed communities.

Further, there is a need for restructuring the socialised sector so as to imbibe it with a sense of urgency and a spirit of social service. Michael Lipton in 'The Crisis of Indian Planning' comments that even rural planning in India has an urban bias. The officers appointed for the purpose of rural development make only casual visits to the rural areas, but spend most of their time in urban areas. Lipton therefore says that Indian planning can build big dams, provide big areas with electricity, establish sophisticated industries i.e. can successfully demonstrate show piece planning, but cannot transform attitudes of the rural people or generate a process of change which is conducive to rural development. There is a saying that it is impossible to force the buffalo to eat meat, it is impossible for the tiger to

eat grass. But now tigers are called upon to live on grass. It is time that we should restructure our social values and bring about a fundamental change in our attitudes and institutions so that our investment can be effective, purposeful and productive.

COST BENEFIT ANALYSIS AND SHADOW WAGE RATE FOR DEVELOPMENT PROJECTS IN ORISSA

D. TRIPATHY, *I.E.S.**

Under perfect competition, the shadow price of labour is equal to the market wage rate. But in the underdeveloped regions, where the labour market is far from competitive in the presence of widespread unemployment, underemployment and disguised unemployment, the choice of market wage for social evaluation of employment is likely to give distorted results.

The Shadow Wage Rate (SWR) constitutes two elements viz. the direct opportunity cost of labour, and the indirect cost which takes into account the disutility of work attached with it and the redistribution that accompanies the new employment due to the development project. The redistribution has three aspects.

(*a*) The immediate gainers (hitherto unemployed workers) have a greater propensity to consume than the immediate losers (the capitalists)

(*b*) The sub-optimality of savings weighs one unit of savings more than one unit of consumption (i.e. consumption is less desirable than savings)

(*c*) Though the weight attached to the savings is higher than the weight attached to the general consumption, the con-

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The views expressed in this paper are entirely those of the author.

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sumpion of the "weaker section" or "weaker region" may be assigned a weight higher than the weight attached to the consumption of their richer counterparts. An attempt is made in the following paragraphs to analyse the above points and derive a Shadow Wage Rate for Orissa.

Direct opportunity cost

It is the marginal product of the marginal worker in the lowest productive sector namely agriculture. Though conceptually it is very easy to understand the opportunity cost of labour, the empirical estimation of it becomes exceedingly difficult. (1, 2, 3, 4, 19, 22) However, the estimation of marginal productivity of the marginal worker by the use of production function can be attempted for particular regions having similar characteristics. It has been argued (22) that, in spite of the difficulties of estimation, the estimated results can provide a good approximation to reach certain broad conclusions.

It is felt that the problem of estimation of marginal productivity of labour in the traditional sector of Orissa may be irrelevant in the face of wide-spread unemployment and under employment, and one may not go for wrong by assuming the marginal productivity of labour in this sector to be zero.

Therefore marginal productivity of labour in agriculture $M_a=0$.

Indirect cost

In a predominantly market economy, where the amount of savings is determined by the market mechanism, the market savings is likely to be non-optimal although the people in general have a general concern for the future generations (6, 7, 8, 9, 10). Again this non-optimal saving is likely to be lower than the optimal (9, 10, 11). This is because though the society, may as a group of individuals like to save and invest more with a concern for the future generation, individually they may not agree to raise their savings to the level required. Everybody will like to see others invest and will invest only if others invest. This is because "the

psychic gain from others investment would outweigh the loss on one's own investment." The above discussion assumes the simple paretion ordering criterion.

Assuming that the utility function is chosen by the planners, the optimality of saving will depend upon the equalisation of *r*, representing the Yield of the transformation possibilities of the present and future consumption and *i*, the social rate of discount, the rate at which society's weight on increment to consumption declines over time. In a private enterprise economy, as discussed earlier, one has to take the inoptimality of savings rate as given in the selection of projects. Even in socialist economics the inoptimality of savings is likely to exist because of the extraordinarily high rates of savings required to achieve the optimality of savings (12, 13, 14). It has been shown that even when the utility function assumed by the planners or political leaders takes into account the interests of the future generations, there is the likelihood of political constraints keeping the saving rate below optimal (6). There is also consensus that in India there is suboptimality of savings and fiscal and monetary policies will not be able to achieve the desired redistribution objectives in the face of constraints. (5)

The shadow Wage Rate reduces to the following.

$$SWR = W^* = M_a + Q\,(S-1)\,W$$

Where Q is the proportion of savings out of profit, S is the accounting price of saving and W is the market wage rate. The above formulation says assuming $M_a = 0$, the SWR will depend upon the weightage placed saving vis-a-vis consumption, and the proportion of savings out of profits. But as the weight to be given to S depends upon the extent of inoptimality of savings assuming $Q = \cdot 75$ $S = 3$ $SWR = W^* = 1.5$, which seems paradoxical in the case of a state having very high unemployment or underemployment. The above paradoxical result is however not unexpected since nothing has so far been said about the effects of a redistribution of income from capitalists to "weaker sections" or the consumers of the weaker regions. The above formulation only took into account the intertemporal redistribution objective.

Redistribution

In the face of suboptionality of savings and the constraints in the fiscal and monetary policy to effect desired redistribution, both inter and intra-regional or intersectional, specific weights have to be attached to the consumption of weaker sections and weaker regions.

Attempts to derive distributional weights in the past concentrated on the past choices of projects or from explicit government action. (15, 16) These methods assumed that past choices were made by some consistent implicit valuation function and the governments always optimise. "If in fact the governments could always optimise and were not constrained from directly legislating the optimal distributional features in their three dimensions then there would be no rationale for taking explicit accounts of distributional effects in project analysis" (17). In such circumstances it is desirable to derive an income distribution weight comprising the three distributional aspects. Deepak Lal derived a set of distributional weights for different states of India which integrated all the three dimensions of income distribution—inter-temporal, inter-regional and intra-regional—based on a constant elasticity of social utility function.

Following gives a brief account of his formulation.* Assuming diminishing marginal utility of income for individuals and society as a whole the general utility function becomes

$$U'c = \frac{1}{C^e} \ldots\ldots\ldots (1)$$

Where U' c is the marginal utility, c is income (consumption assuming all incomes are consumed) and e is a constant parameter (−e is the elasticity of marginal utility). But this only explains the private utility and not social utility.

In order to know about the social value one has to introduce a second factor in the utility function.

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* The Mathematical derivations taken from (17)

So (1) becomes

$$U'c = \frac{K}{C^{\bullet}} \quad \ldots (2)$$

Where K is the social value attached to the utility accruing to particular income groups in a particular region.

If the income of a particular income group in region Z rises to a level CY from a level PCY' that is μ

$$\left(\text{where } \mu = \frac{1-p}{p} \right) \text{ he finds that}$$

$$\Delta R_z = \int_{PCY}^{CY} \frac{\bar{C}_z \, C_z^{*}\,(e-1)}{C\,Y^{\bullet}} \quad \ldots (3)$$

$$= \frac{\bar{C}_z \, C_z^{*}\,(e-1)}{(e-1)\,CY\,(e-1)} \left[\frac{1-P\,(e-1)}{P\,(e-1)} \right] \ldots (4)$$

Where $\bar{C}_z$ is the arithmetic mean regional income in region Z, $C_z^{*}\,(e-1)$ is the harmonic mean income of degree (e—1) in region Z and CY is the new income level of the income group Y in the region and RZ is the regional homogenized unit which converts the incomes accruing to different income groups into the regional unit. Then he uses national homogenized (NH) unit to convert incomes accruing to different regions into national units N.

$$= \Delta N \, \frac{N_z \, \bar{C}_R \, C_R^{*}\,(e-1)}{(e-1)} \; \frac{(\bar{C}_z + \Delta R_z)^{(e-1)}}{C_z^{(e-1)}} \; \frac{-\bar{C}_z^{\,(e-1)}}{(\bar{C}_z + \Delta R_z)^{(e-1)}} \quad \ldots (5)$$

$$= \frac{N_z \, \bar{C}_R \, C_R^{*} \, C_z^{*}\,(1-P)}{\bar{C}_z \, (N_z \, PCY + C_z^{*}(1-P)} \quad \ldots (6)$$

(assuming e=2)

where $\bar{R}_z = R_z / N_z$

N_z is the population (number of incomes) of the region Z, $\bar{C}_R$ is the arithmetic mean of the mean interregional incomes and C^*_R is the harmonic mean of the degree (e—1) given by

$$\frac{1}{CR^{*}\ (e-1)} = 1/Q \int_{0}^{\infty} f\ (\bar{C}_Z)/\bar{C}_Z\ (e-1).d\bar{C}_Z.$$

where $f\ (\bar{C}_Z) = N_Z$, $Q = N_Z$

However, the above formulation has not taken into consideration the intertemporal aspect of the income distribution. Taking the most possible value of e=2, the social welfare of an increase in income becomes,

$$WA = \frac{N_Z\ \bar{C}_R\ C^*_R\ C^*_R\ (1—P)}{S\ C_Z\ (N_Z\ PCY—C^*\ (1—P)}$$

where S is the accounting value of saving. Under different assumptions of S, Dr. Lal found out the value of a 10% increase in income of different income groups in Orissa.

		1	2	3	4	5	6
Income CY		100	200	300	400	500	1000
Nominal increase (1—P) CY in income.		10	20	30	40	50	100
Social value of income	S=1	96.71	48.35	32.22	24.19	19.34	9.67
		(9.67)	(2.42)	(1.07)	(0.60)	(0.39)	(0.0967)
	S=3	30.70	15.35	10.23	7.68	6.14	3.07
		(3.07)	(0.77)	(0.34)	(0.19)	(0.12)	(0.0307)
e=2							
	S=6	16.12	8.06	5.37	4.03	3.22	1.61
		(1.61)	(0.40)	(0.18)	(0.10)	(0.06)	(0.0161)

To me S=3 seem to be a plausible value for India coming to the earlier formulation of SWR, $W^*=M_a+\theta$ (S—1) W, it is found that as the inter and intraregional distribution aspects have not been taken into account W* is higher than what it should be. In order to be complete, $W'=M_a+\theta\left(\frac{S}{\lambda}-1\right)$ W where λ is the parameter which tackles the problem of inter and intraregional distributtion (is the weightage for these two distributional objectives). In Lal's formulation savings is the numeraire whereas in the above formulation consumption is the numeraire (20, 21). In order to convert his values to consumption equivalent, the saving premium equivalent is multiplied and the results for Orissa are given in the table below.

Orissa	1	2	3	4	5	6
Income CY	100	200	300	400	500	1000
Nominal increase in income (1-P) CY	10	20	30	40	50	100
Social value of income	96.72	48.36	32.22	24.18	19.32	9.66
S=3 e=2	9.67	2.42	1.07	0.60	0.39	0.096

We assume that the percapita income of marginal farmers and agricultural labourers in Orissa is in the lowest income group of Rs. 1000/-* and they are employed in some project and the wage rate paid is Rs. 10, then the shadow wage rate for labour according to the above formulation becomes...

$$W^*=M_a+\theta\left(\frac{S}{\lambda}-1\right) W$$

* The average percapita income of the small farmers in Ganjam district of Orissa is about Rs. 146.00 approximately (calculated from Bench Mark Survey Report, SFDA, Ganjam Chatrapur). It is plausible to assume that the percapita income of marginal farmers and agricultural labourers will be less than that of the small farmers and hence Rs. 100 percapita income is assumed for them in Orissa.

$$= 0 + .4\left(\frac{3}{9.67} - 1\right).\ 10^{**}$$

$$= -2.7$$

So the shadow wage rate for agricultural labourers and marginal farmers for development projects, when all the three dimensions of income distribution is taken into account becomes negative.

I have not taken the disutility of effort as a cost because of the reasons explained elsewhere (18).

Conclusion

As all the factors of the equation for W* are known now it is very easy to calculate the SWR for different regions and for different income groups. Sophisticated analysis can be done at the district level or even at the lower level depending upon the availability of reliable data. As the data on the basis of which these calculations were made relate to the sixties, recalculations may be made with the recent data to have better accuracy.

** Q (S in Bayer (4) = .3 to .4, I have assumed it to be .4 here.

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PROJECT EVALUATION UNDER RISK

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Efficient use of resources is the main prerequisite for the development of every economic unit regardless of economic and social system. Different economic methods have been devised to advance efficient use of resources, the most important being the elaboration and evaluation of development projects permitting the selection of the most efficient one. The conventional Benefit-cost ratio or the present value of net benefits estimated from a project give a rank order of the project. These criteria of evaluation do not take into account the social desirability of such projects. As the society attaches different weights to the benefits and costs accruing to different groups, it is but natural to think economically meaningful ways of constructing social orderings of alternative projects. But this work is very complicated as we have to assess aggregate social benefits of public development projects. For simplicity, development projects financed by an individual who bears the risks and gets all the benefits from such projects are considered. This study attempts to evaluate alternative projects measuring individual preference pattern between the projects open to him for implementation.

Attitude towards risk

People differ in their attitude to risk. Hence the same project cannot be optimal for the investors. Different investors will attach differing weights to the cost and return streams and the risk aspects of an investment project. The risk attitude of an individual can be summarized in a utility function which quantify and measure individual's preference pattern between the alternative outcomes

arising from the different courses of action open to him. Utility theory is the most satisfactory and accepted one to explain rational behaviour under conditions of uncertainty. The basic idea behind it was first suggested by Ramsey (1930) and a full exposition, based on axioms of rational behaviour was first achieved by Von Neumann and Morgenstern (1947). Luce and Raiffa (1957), Dillon (1971) give a good description of the axioms. The theory uses the axioms to show that a rational man in a given decision making situation has a preference ordering function U called his utility function with the following properties :

(*i*) U is defined on the set of all possible outcomes;

(*ii*) Outcome A is preferred to outcome B if and only if U (A) > U (B).

(*iii*) A decision giving chances p_i of achieving outcome A_i is preferred to one giving chances q_j of achieving outcome B_j.

$$\sum_{i=1}^{n} p_i = 1, \quad \sum_{j=1}^{m} q_j = 1, \quad (1 \leqq i \leqq n, 1 \leqq j \leqq m)$$

If and only if $\sum_{i=1}^{n} p_i \, U(A_i) > \sum_{j=1}^{m} q_j \, U(B_j)$.

(*iv*) Utility functions are only defined up to a positive linear transformation. Given a utility function U,

$U^* = a + bu$, a, b constants, $b > 0$ is also a utility function (Hadar, 1971).

Property (*ii*) shows that the utility function ranks the outcomes in preference order while, property (*iii*) shows that one set of probabilistic outcome is preferred to another if and only if it has a higher expected utility. Under this theory a rational man should always act, so as to maximize his expected utility instead of expected money income.

Mean–Variance Analysis.

The well known mean–variance analysis (Markowitz, 1959) has been widely used in portfolio problems without explicit recourse to the decision makers' utility function. The method compares the mean and variance of the probability distribution of the risky prospects considered where the variance of a distribution of returns is identified with the degree of riskness. The idea that the risk averse individual has a general aversion to variance is implied. Efficiency frontiers are obtained between the expected values of the random variables (risky prospects) and their variances. Individual tastes and preferences are represented by the choice of points of this frontier.

Using a Taylor's series expansion of the utility function U (x) around E (x) (the expected gain for any action) the expected utility for any action a can be represented as.

$$U(a) = E[U(x)] = U[E(x)] + \frac{1}{2!} m_2 \frac{d^2}{dx^2} U[E(x)]$$

$$+ \frac{1}{3!} m_3 \frac{d^3}{dx^3} U[E(x)] + \ldots$$

Where m_2, m_3 are respectively the second and third moment of the distribution of x. (Halter and Dean, 1971). Since the expected utility is the function of all moments of the distribution the comparison, based on only the mean and variance are valid only for a limited classes of utility function, or for special distributions of the risky prospects.

Quadratic Utility Function

A major assumption underlying the work of Markowitz (1959) relates to the adequacy of quadratic utility function in explaining an individual's utility for money. This assumption was first challenged by Pratt (1964) and Arrow (1965). It follows from the work of Pratt (1964) that most decision makers would subscribe to decreasing global risk aversion, i.e. most utility functions for money will satisfy.

$$U' U''' > (U'')^2$$

where U', U'' and U''' are respectively the first, second and third derivative of U (x). If a quadratic utility function is given by

$$U(x) = q_0 + q_1 x + q_2 x^2, \quad q_1 > 0 \text{ and } q_2 < 0$$

then it is always true that

$$U' U''' < (U'')^2 \text{ as } 0 < 4 q_2^2,$$

showing the quadratic utility function is increasingly risk averse. Also for the quadratic utility function Arrow's Absolute Risk Aversion,

$$R(x) = -U''(x)/U'(x) = \frac{1}{d-x}$$

where $d = -q_1/2 q_2$, which shows that as wealth increase R (x) increases and finally becomes infinite at x=d. This latter property contradicts Arrow's hypothesis of decreasing absolute risk aversion. When $x > d$ we get $U'(x) < 0$ which is interpreted as, "wealth is not desirable". This suggests that quadratic function is only relevant in the rising portion of the curve. These two objections, i. e. that it show (1) increasing risk aversion everywhere, and (2) its relevance in the rising portion of the curve lead to the rejection of the quadratic utility function. Balancing these undesirable aspects of the quadratic utility function here are some advantageous simplifying properties that it presents. As a Taylor's seres approximation to a true utility function about E(x) a quadratic may require only a limited number of parameters. When such an approximation is used, relatedly, the expected utility of any action is completely specified by the mean and variance of the probability distribution of x. In otherwords a decision maker can trade off directly between the mean return and variance about that return from a risky prospect. The computational advantage of the quadratic utility function as compared to decreasingly risk averse functions also led to the use of this function. In com-

paring risky prospects, though its usefulness is limited with regard to risk aversion unless it is viewed as an approximation to a more acceptable utility function.

Empirical study

The focus was on an individual decision maker conducting his own experiment for the purpose of obtaining input recommendation to be applied in the crop production program. Three alternative experimental designs, namely, the complete factorial, central composite and central composite rotatable designs were considered in performing the experiment. An experiment employing one of the above designs in getting the optimal input levels was viewed as an investment project. The objective of the analysis was to determine which design (investment project) gave the maximum expected utility to the risk averse individual decision maker. With the aid of a Monte-Carlo approach the three designs alternatively employed in a corn-fertilizer process were compared. The computor simulation experiments carried out for this purpose were viewed as if they were conducted by the individual. An attempt was made, inasmuch as possible, to make the data used in the computor program resemble the real world situation.

For ranking the three alternative designs in terms of their expected utilities a quadratic utility function was used. Expected utilities of net returns from the experiment was calculated. Designs were ranked on the basis of expected utility. The design was called optimal if it showed highest expected utility. Out of the large number of experiments examined, it was noticed that rotable design or the corresponding project in most cases ranked high in terms of expected utility.

In evaluating alternative projects the method of analysis adopted has not been employed before. This study was not based on posterior anaysis but almost a preposterior analysis. One important limitation in this study was the use of the quadratic utility function which does not satisfy the Arrow-Pratt difinition of risk aversion. Alternative utility functions satisfying

the above criterion might have ranked the alternative projects differently. Productive application of the approach must however await the development of criterion and technical types of functions which realistically portray the potential streams of benefits and costs relating to a project.

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BENEFIT-COST STUDY OF THE HIGH YIELDING VARIETIES OF RICE ADOPTED BY THE SMALL AND MARGINAL FARMERS IN THE COASTAL DISTRICTS OF ORISSA

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This study has been planned to make a rigorous evaluation of benefits and costs that are associated with the production of high yielding varieties of rice by the small and marginal farmers in the coastal districts of Orissa.

Methods and materials

For the purpose of this study, four villages from Puri district namely, Pubasasan, Utarasasan, Patalikuda and Ekahalia were selected. All these villages are enjoying assured irrigation facilities mainly through canal system. The soil condition in these villages is also highly favourable for growing high yielding varieties of rice. The farmers of this locality by and large, have adopted high yielding varieties of rice since 1968.

For selecting the sample farms for the study, the operational holdings of the villages were classified into different size groups and the selection was made from the size group I (below one hectare) size group II (1 to 2 hectares), and size group III (2 to 3 hectares). All other size groups were not taken into consideration since the study relates only to small and marginal farmers. In this case, the farmers who fall under the category of size group I are the marginal farmers, under the category of size group II are the lower class small farmers and under the category of size group III are the upper class small farmers. Five holdings from each of these above three size groups and from each of the four selected villages were selected for the purpose of investigation. The data relate to the year 1972-73.

Estimation of costs of cultivation

Various costs were estimated in this study in the following manner.

Cost A includes : (*i*) wages for hired and permanent labour, (*ii*) expenses for hired and owned bullock labour, (*iii*) the value of seeds, both purchased and farm produced, (*iv*) the value of manures both purchased and home produced, (*v*) the cost of fertilizers, pesticides and other chemicals, (*vi*) irrigation charge and (*vii*) depreciation of dead stock. The interest on operating expenses and rental value of land were added to the cost A for arriving at the Cost B. Similarly, the imputed value of family labour was added up to the cost B in order to compute Cost C.

The concept of cost C is the most comprehensive. It includes all costs, both fixed and variable and similarly both paid out and imputed, and thus it was taken as a basis for comparison of cost under different situations. The rental value of land was taken at 2 per cent of the market value of land as this concept was used by the Directorate of Economics and Statistics, Ministry of Agriculture for the cost of cultivation studies. The depreciation for dead stock is computed at 20 per cent of their purchased value as their useful lives are more or less five years. The interest rate is taken as 10 per cent in this study.

Estimation of gross return

Both main product and by-product values were taken while estimating the gross return in this study. The harvest price of the products prevalent in the local markets was considered for the valuation of the gross return. Here the harvest period was considered as two months following the actual harvest time of the crop, since from six to eight weeks after the harvest the farmers are expected to dispose the major portion of the produce.

Estimation of net return

Net return in this study was the difference between gross return and the total expenses including the interest on operational

expenses, repair of implements and the depreciation of dead stock. The depreciation and repair of dead stock were calculated for the farm as a whole and then apportioned to rice crops as per the extent of use of the dead stock on this enterprise.

Percent return on capital

The percent return on capital represented the rate of earnings produced by the capital invested (both fixed and working capital) in the farm business. For the fixed capital the rental value of land was taken into account. The percent return on capital was obtained by dividing the net return with the sum of fixed and working capital for the particular rice crop.

Benefit/cost ratio

The benefit/cost ratios were estimated by dividing the gross return with the cash expenses including the apportioned value of depreciation of dead stock.

Findings :

Cost of cultivation

Table 1 shows the estimated costs of cultivation per hectare of traditional and high yielding varieties of rice with respect to different sizes of operational holdings.

It can be seen from this table that the cost of cultivation between traditional rice varieties and the high yielding rice varieties varies considerably. Also, it varies from one season to another and similarly from one size group to another. The followings are the estimated cost of cultivation for the agricultural year 1972-73.

(*i*) In case of traditional rice varieties Cost A varies from Rs. 665 to Rs. 733 per hectare. Likewise, cost B varies from Rs. 915 to Rs. 1009 and Cost C varies from Rs. 1209 to Rs. 1246.

TABLE 1

COST OF CULTIVATION OF TRADITIONAL AND HIGH YIELDING VARIETIES OF RICE

(Cost per hectare in Rs.)

Size group	Traditional varieties			H. Y. V. (Kharif)			H. Y. V. (Summer)		
	Cost A	Cost B	Cost C	Cost A	Cost B	Cost C	Cost A	Cost B	Cost C
I	665	915	1246	736	986	1286	834	1114	1484
	(53.37)	(73.43)	(100)	(57.23)	(76.67)	(100)	(56.23)	(75.06)	(100)
II	710	988	1238	809	1084	1309	913	1193	1488
	(57.35)	(79.80)	(100)	(61.80)	(82.81)	(100)	(61.35)	(80.17)	(100)
III	733	1009	1209	827	1102	1277	1007	1287	1495
	(60.62)	(83.45)	(100)	(64.76)	(86.29)	(100)	(67.35)	(86.08)	(100)

(Figures in the parenthesis indicate percentage.)

(*ii*) The Costs of cultivation in case of high yielding varieties grown during kharif season vary in this way :–

Cost A varies from Rs. 736 to Rs. 827, Cost B varies from Rs. 986 to Rs. 1102, and Cost C varies from Rs. 1286 to Rs. 1309.

(*iii*) The estimated costs of cultivation in case of high yielding varieties grown during summer vary still more widely while Cost A varies from Rs. 834 to Rs. 1007, Cost B varies from Rs. 1114 to Rs. 1287 and Cost C varies from Rs. 1484 to Rs. 1495.

(*iv*) In almost all cases Cost A constitutes 55 to 65 percent of Cost C and Cost B constitutes 75 to 85 percent of Cost C.

The following conclusions emerge from the abovementioned estimated costs of cultivation of rice :

The cultivation of high yielding varieties of rice is capital intensive compared to traditional varieties. But the growing of high yielding varieties during summer is much more capital intensive than that of high yielding varieties grown during kharif. So far as direct cost of cultivation (Cost A) is concerned, the cost per hectare increases with the increase in the size of farms. In other words, the upper small class farmers invest more money than the lower small class farmers and similarly the lower small class farmers spend relatively more money than the marginal farmers in the cultivation of rice per unit area irrespective of seasonal and varietal factors.

The percentage increase in the total cost of cultivation (Costs C) of high yielding varieties of rice over the traditional varieties has been shown in table 2.

From this table it can be observed that the Cost C for the high yielding varieties (Kharif) is 3 to 6 percent higher than that of traditional varieties of rice grown during kharif. But the cost C for the high yielding varieties grown during summer is 19 to 24 percent higher than the Cost C for the traditional varieties

TABLE 2

PERCENTAGE INCREASE IN COST OF CULTIVATION OF HIGH YIELDING VARIETIES OVER TRADITIONAL VARIETIES OF RICE (Cost C only)

Size group	Increase in Cost of HYV (Kharif) over TV (Kharif)		Increase in Cost of HYV (Summer) over TV (Kharif)		Increase in Cost of HYV (Summer) over HYV (Kharif)	
	Difference	Percentage	Difference	Percentage	Difference	Percentage
I	40	3.23	238	19.10	198	15.39
II	71	5.70	250	20.19	179	19.09
III	68	5.68	286	23.65	218	17.07

grown during kharif. The comparison between the high yielding varieties grown during summer and the high yielding varieties grown during kharif with respect to Cost C showed that this Cost in case of former is 15 to 19 percent higher than the latter.

Average productivity

Table 3 explains the manner of variation in the yield rate of rice per hectare in relation to varieties, seasons and farm sizes.

TABLE 3

AVERAGE PRODUCTIVITY OF HIGH YIELDING VARIETIES AND TRADITIONAL VARIETIES OF RICE
(Expressed in Quintals per hectare)

Size group	TV (Kharif)	HYV (Kharif)	HYV (Summer)	Percentage Increase of (3) over (2)	Percentage Increase of (4) over (2)	Percentage Increase of (4) over (3)
1	2	3	4	5	6	7
I	23.35	26.85	35.28	14.98	51.09	31.39
II	22.51	27.92	36.56	24.03	62.41	30.94
III	21.53	27.15	37.10	26.10	72.31	36.64

The table reveals the following :

(*i*) The average yield rate of traditional varieties of rice grown in kharif varies from 21.53 quintals to 23.35 quintals per hectare.

(*ii*) In case of high yielding rice varieties grown during kharif months, the average productivity per hectare varies from 26.85 quintals to 28 quintals. However, the same high yielding rice varieties grown during summer give relatively higher yield rate per hectare, which varies from 35.28 quintals to 37 quintals.

From these estimated yield figures it is realised that the high yielding varieties of rice grown during kharif give 15 to 26 percent additional gross return over the traditional varieties grown during the same crop season. But the performance of high yielding varieties raised in summer under the assured water supply condition is more promising. A comparison between the yield rates of high yielding varieties grown in summer and the traditional varieties grown in kharif could show that the former gives 51 to 72 percent of additional gross return than the latter. The high yielding varieties of rice perform much better during summer than in kharif season. These new varieties of rice grown during summer produced 31 to 37 percent additional yield compared to the same varieties grown during kharif.

Cost of production per quintal

Table 4 presents the estimated cost of production per quintal of rice with respect to different varieties, seasons and farm sizes. The table reveals that the cost of production per quintal of rice increases with the increase in farm size in case of traditional rice varieties, whereas in case of high yielding rice varieties, it more or less decreases with the increase in farm size.

While the cost of production varies from Rs. 53 to Rs. 56 in case of traditional varieties, the same varies from Rs. 46 to Rs. 48 in case of high yielding varieties grown during kharif and from Rs. 40 to Rs. 42 for the summer high yielding varieties of rice production. In other words, the cost per unit of production

TABLE 4

AVERAGE COST OF PRODUCTION OF RICE PER QUINTAL IN CASE OF HIGH YIELDING VARIETIES AND TRADITIONAL VARIETIES
(Expressed in Rs.)

Size group	TV (Kharif)	HYV (Kharif)	HYV (Summer)	Percentage decrease of (3) over (2)	Percentage decrease of (4) over (2)	Percentage decrease of (4) over (3)
1	2	3	4	5	6	7
I	53.36	47.89	42.06	10 26	21.18	12.18
II	55.00	46.88	40.70	14.77	26.00	13.19
III	56.15	47.03	40.30	16.25	28.23	14.32

is higher for the traditional varieties than the high yielding varieties even though reverse is the case while we consider the cost of cultivation per unit area. This situation has been created due to relatively much higher productivity of high yielding varieties of rice, which are now widely accepted as one of the capital intensive as well as profit intensive crops. The per unit production cost seems to be 10 to 16 percent less in case of yielding rice (Kharif) than that of traditional varieties of rice (kharif). But the cost of production is still lower in case of high yielding varieties grown during summer and it is to the extent of 21 to 28 percent less than the traditional varieties grown during kharif. As these newly evolved high yielding varieties can be better adopted during summer than in kharif, cost of production per quintal in summer is 12 to 14 percent lower than that of kharif.

Gross and net returns

Table 5 gives the gross and net returns per hectare of rice cultivation with respect to traditional and high yielding varieties grown during kharif and summer seasons by the marginal and small farmers.

TABLE 5

GROSS RETURNS AND NET RETURNS FROM HIGH YIELDING VARIETIES AND TRADITIONAL VARIETIES OF RICE (Expresed in Rupees per Hectare)

Size group	TV (Kharif)		HYV (Kharif)		HYV (Summer)				
	GR	NR	GR	NR	GR	NR	Percentage Increase of (5) over (3)	Percentage increase of (7) over (3)	Percentage increase of (7) over (5)
1	2	3	4	5	6	7	8	9	10
I	1734.50	488.41	1979.50	693.11	2569.60	1085.96	41.91	122.34	56.67
II	1675.70	437.53	2054.40	745.63	2659.20	1171.68	70.41	167.79	57.13
III	1607.10	398.53	2000.50	723.23	2697.00	1202.48	81.40	201.72	66.26

The estimated values of gross return for traditional varieties range from Rs. 1607 to Rs. 1735, for high yielding varieties (kharif) range from Rs. 1980 to Rs. 2055 and for high yielding varieties (Summer) range from Rs. 2570 to Rs. 2700. Similarly, the net returns per hectare of rice in case of traditional varieties range from Rs. 400 to Rs. 490, from Rs. 700 to Rs. 745 for kharif high yielding varieties and from Rs. 1085 to Rs. 1200 for high yielding varieties grown during summer. These estimated figures again confirm our earlier findings that the high yielding varieties are more profitable to grow than traditional varieties and more so when these varieties are grown during summer. While the net profit generated from the kharif high yielding varieties is 40 to 80 percent higher than the traditional varieties grown during the same season, it is 120 to 200 percent higher in case of high yielding varieties (Summer) than the traditional varieties grown during kharif.

Percent return on capital

Table 6 indicates per cent return on capital with respect to rice production, with different varieties, seasons and farm sizes.

TABLE 6

PERCENT RETURN ON CAPITAL IN CASE OF HIGH YIELDING VARIETIES AND TRADITIONAL VARIETIES OF RICE PER HECTARE

Size group	TV (Kharif)	HYV (Kharif)	HYV (Summer)
I	39.20	53.89	73.17
II	35.34	56.96	78.74
III	32.96	56.63	30.43

In this study the assessed percent return on capital for traditional rice varieties varies from 32 to 39. In case of high yielding varieties grown during kharif the percent return on capital varies from 54 to 57, whereas promising varieties give still higher percent return on capital during summer which varies from 73 to 80.

It is evident from this table that the high yielding rice varieties when grown during summer give larger return to investment than the return derived from these new varieties grown during kharif. The supremacy of the newly evolved rice varieties over the traditional rice varieties with respect to return to investment is very much distinct in this study.

Benefit/cost ratio

Finally, the benefit/cost ratios for the rice production under various conditions such as different size of farms, seasons and varieties have been estimated from the analysed data generated through this investigation, and these ratios have been shown in table 7.

TABLE 7

BENEFIT/COST RATIO IN CASE OF HIGH YIELDING VARIETIES AND TRADITIONAL VARIETIES OF RICE

Size group	TV (Kharif)	HYV (Kharif)	HYV (Summer)
I	1.40	1.53	1.72
II	1.35	1.56	1.78
III	1.32	1.56	1.70

As shown in this table, it could be observed that the benefit cost ratios for traditional rice varieties are around 1.35, for the kharif crop of high yielding rice varieties, the ratios are around 1.55 and for the summer crop of high yielding rice varieties, the ratios are around 1.75. It is, however, interesting to observe that while the factors like varieties and seasons have substantial influence on the benefit/cost ratio, the farm size has no significant influence on it. This study therefore corroborates the findings of other studies that the new rice technology is neutral to scale. The study also has been able to make it clear that the newly evolved and adopted rice varieties are economically suitable for growing as kharif corp under irrigated conditions even though these varieties fail to perform as good as summer crop. Though the result was no doubt encouraging,

however, as compared to places like Punjab, Haryana, Tamilnadu the benefit/cost ratios for high yielding rice varieties in this area are on lower side. The lower benefit/cost ratio under our situation may be ascribed to several defects in the managerial, organisational, technical and socio-economic factors. It is of course extremely difficult to indicate the importance of each in reducing the benefit-cost ratios since all are interlinked with one another. However, much attention should be given to (*i*) soil and water management problem, (*ii*) supply of tangible inputs like quality seeds, fertilizers and pesticides (*iii*) supply of institutional credit, (*iv*) farmers' training programme, (*v*) land tenancy reforms, (*vi*) price support programmes, and (*vii*) evolving resistant varieties to suit to different agro-climatic conditions of the region in order to derive much more economic returns from the high yelding rice programmes.

SOME PROBLEMS OF COST BENEFIT EVALUATION IN DEVELOPING ECONOMIES

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Synopsis

Generally the ruling market price is accepted as the medium of cost-benefit evaluation. But it confronts several shortcomings. It should be discounted dynamically to suit the requirements of the development project in a growing economy.

I

The Cost-Benefit Analysis (CBA) is an attempt to devise a formal system of rules whereby the social worth of a public policy or project can be judged. Due to the post-war hike in public expenditures in developed countries and large infrastructural investment in developing countries, C-B techniques are increasingly adopted to reduce the risk of waste.

The decision-maker usually faces three types of choice. (1) Accept-reject. Faced with a set of independent projects without any constraint, he may decide which one is worth undertaking.

(2) Ranking, If due to constraints all 'acceptable' projects cannot be undertaken, they must be ranked objectively.

(3) Choosing between exclusive projects. If projects are not independent of each other and one is undertaken at the cost of another, they are mutually exclusive. Here the decision involves a choice between alternatives.

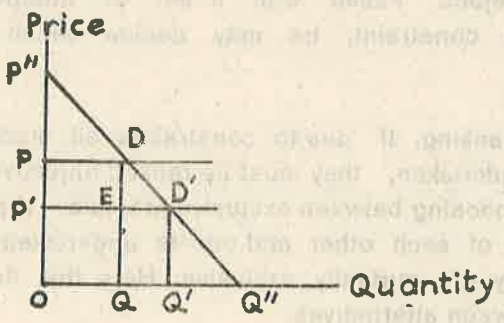
Generally the extent of excess benefits over costs (B—C) is accepted as the criterion of such choice. The following table will explain it.

Project	Cost (C)	Benefits (B)	B—C	B/C
X	100	200	100	2.0
Y	50	110	60	2.2
Z	50	120	70	2.4

Assuming that the society has 100 units of capital to invest, project X would be chosen where the (B—C) return is maximum. But a little introspection would show that a combined operation of Y and Z projects would yield more net benefits. To overcome this problem, projects should be ranked by their benefit-cost ratio i.e. by B/C. Accept a project if B/C >1. In case of rationing, rank them by the ratio B/C. Finally, while choosing between mutually exclusive projects, select the project with the highest ratio. But for simplicity (B - C) is accepted as the objective criterion of CBA.

In the cost-benefit analysis valuation of benefits poses the most formidable problem. Since the community benefits are the combination of individual benefits, we have to evaluate the latter as well. In this case, however, the following relationship is established.

Price=Willingness to Pay (WTP)=Benefit. In other words price of a commodity relates to the willingness to pay and therefore to benefits derived.



P″ Q″ is the conventional demand curve. Suppose the market factors set the price at OP. PO QD is the effective payment. But willingness to pay is P″ O QD which is determined by adding the consumer's surplus P″ PD to PO QD.

Suppose price changes to OP′. The additional increase in willingness to pay amounts to P′ OQ′ D′—P″OQD=DQ Q′D′

Or, $\triangle$ WTP=EQ Q′D′+DED′

$$= \triangle Q.\ P' + \tfrac{1}{2} \triangle Q.\ \triangle P$$

$$= \triangle Q\ (P' + \tfrac{1}{2} \triangle P)$$

$$= \triangle Q \left(\frac{2P' + P - P'}{2}\right)$$

$$= \triangle Q \left(\frac{P + P'}{2}\right)$$

Where, P = Original Price
P′ = Changed Price
Q = Quantity
and symbol $\triangle$ stands for a change.

Under stable prices, assuming that investment alters price only marginally or not at all, for valuation purposes P=P′ and the rule becomes $\triangle$ WTP=$\triangle Q\left(\frac{2P}{2}\right) = \triangle Q.\ P.$

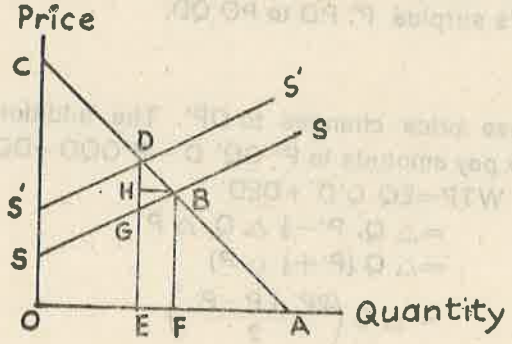
So the ruling market price is an approximate indicator of the WTP and benefits received per unit of output.

Acceptance of market price leads to the following Cost-Benefit equation. A project would be chosen of GPVB > GPVC,
so that NPVB >O,
as NPVB=GPVB—GPVC

where
GPVB = Gross Present Value of Benefits.
GPVC = Gross present Value of Costs.
NPVB = Net Present Value of Benefits.

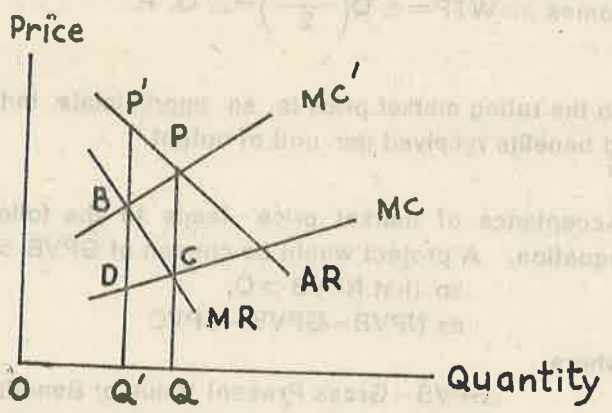
But market price evaluation leads to bias under following circumstances.

(1) Resource prices may rise because of the transfer of resources from one sector to another.



If the effect of the chosen investment is to raise factor prices and shift the product supply curve from SS to S' S', the total loss of WTP = EFBD. But in practice, the use of ruling market price for resources would entail a lower valuation at EFBG. So there is a 'bias' equal to the lost consumers' surplus DBH and the lost producers' surplus BHG. (Dunn and Stober)'.

(2) Resources may have imperfectly competitive product or factor markets.



Division of resources shifts MC to MC' and increases profit-maximising price from P to P'. The loss of actual WTP = P' Q' QP. But according to market price valuation lost WTP = DQ' QC. So the understatement of the true WTP by the area

P' DCP consists of two areas i.e. BDC=the effect of bidding up the resource prices and P'BCP=the effect of withdrawing resources from an imperfectly competitive market. [Dasgupta and Pearce]*

(3) CBA is a sequence analysis. The costs of a definite project are incurred and the respective benefits accrue to the society through different time periods. So the time preference becomes important. It implies that : *(a)* society prefers the present to the future and *(b)* the future generation is likely to have higher level of consumption. If the principle of diminishing mariginal utility operates, the utility gains to future generation out of a given consumption would be less than the utility gains to the present generation.

So the market price evaluation, if not wrong, is limited in its coverage. The future gains should be 'discounted' in real as well as money terms with due allowance for risk and uncertainties. The Cost-Benefit analysis therefore is to be interpreted in the following manner.

$$\text{Net B } (x) = \sum_{t=0}^{n} B_t (x) . d_t - \sum_{t=0}^{n} C_t (x) . d_t$$

$$= \sum_{t=0}^{n} d_t [B_t (x) - C_t (x)]$$

where

Net B (x) = Net benefits of project x.

$\sum_{t=0}^{n} B_t (x)$ = Sum of benefits derived over time period O to n, n being the life of project x.

$\sum_{t=0}^{n} C_t (x)$ = Sum of costs incurred over time period O to n, n being the life of project x.

dt = Social rate of discount.

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* For basis ideas I have referred to A. K. Dasgupta and D. W. Pearce, "Cost-Benefit Analysis : Theory and Practice", Macmillan, 1972.

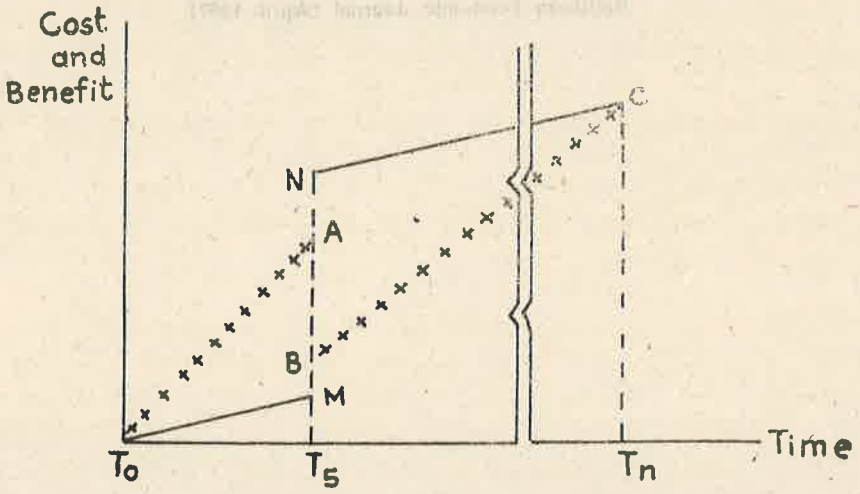
II

Our discussion so far entails that in a hypothetical project having the longevity of five years if marginal benefits derived are 100 units per annum, it will be so discounted that the respective figures would be like 100, 90, 80, 70 and 60 units in successive years. Total benefit units would be 400 instead of 500. Let us assume for simplicity that costs are 60 units per year. While discounted, however, costs are likely to increase as the marginal cost curve generally has a positive slope. In the terminal year the discounted benefits would equal their relative costs. If the latter exceeds the former, production is warranted. So the net benefits of this project are 100 instead of 200 units.

Is this hypothetical example relevant in the context of evaluating the relative costs and benefits of a development project in India (and therefore in Orissa) ? Our analysis has a tacit assumption of constant prices (P=P') over a period of time. In the initial phase of economic development huge costs are incurred in infrastructural activities where benefits are indirect and gestation period is too high. Due to dualistic nature of the economy, production in the traditional sector is price-inelastic. So the incremental money income is accompanied by a reduced marketable surplus which leads to a price rise. Let us evaluate how far the traditional method of discounting can adjust with inflation, which is a built-in-factor in case of economic development.

In case of a development project, actually, real costs are involved and real benefits in terms of goods and services are received even though they are expressed in money terms. Inflation is a period of scarcity. In the successive time periods marginal utility of money may decline either due to enhanced prosperity or because the value of money is decreasing; but the value of real goods and services will never decrease. Therefore the traditional discounting technique which imputes a lower money value to future benefits is a gross fallacy. Instead, we should adopt a dynamic positive discounting method which would slope both the cost and benefit curves upward. However, the slope of the cost curve would be greater than the benefit curve so that both of them will coincide at the n'th time period.

The following diagram explains the behaviour of cost and benefit curves of a development project in a developing economy during inflation.



The horizontal axis represents time period and the vertical axis cost and benefit units. To ABC is the kinked cost curve and T_0 MNC is the kinked benefit curve. T_0 T_5 is the gestation period and T_5 is the completion year of development project. Within T_0 T_5, there is actual construction outlay and the benefits received are only indirect in form of higher wages, more employment etc. After T_5, the high-placed NC benefit curve implies that the project has started producing goods and services directly. But the slope of BC cost curve will be higher because of rising maintenance cost, law of diminishing returns, risks and uncertainties. Net benefits can be calculated by deducting cost from benefits on both sides of T_5. Ultimately the cost and benefit curves coincide in the terminal year T_n when the life of the project is over.

To conclude, the development project should have closer cost and benefit curve during the gestation period which should preferably be small but they should diverge considerably after it over a long period of time.

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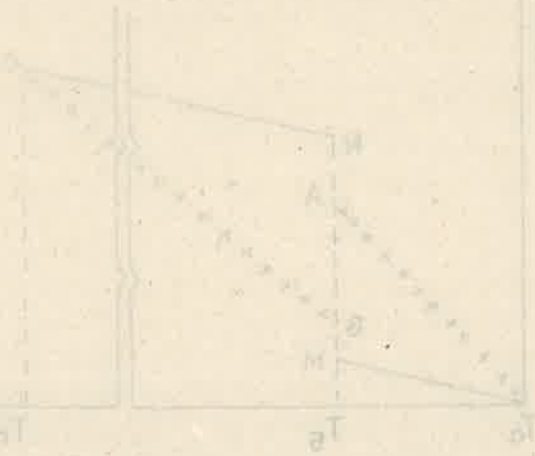

BENEFIT—COST STUDY OF KUSUMITADA TUBEWELL IRRIGATION PROJECT

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Introduction

Modern crop husbandry is distinguished by its dependence on inputs like irrigation, high yielding seeds and fertilizers. It is now realised that the most important single factor determining the domain of the high yielding varieties programme is availability of irrigation. In agriculturally dominated countries like India irrigation projects have greater importance than any other developmental projects. Irrigation projects in general accelerate economic and social development of the regions in which the projects are carried out. Ever since 1951 the planning authorities at various levels have been emphasising on the expansion of irrigation capacity in India. The net area irrigated by means of major and medium types of irrigation projects, principally canal system fed by river sources, increased from 9.7 million hectares in 1950-51 to 21.4 million hectares at the end of fourth plain. Similarly, the net area irrigated by means of minor irrigation projects (excluding ground water schemes) increased from 6.4 million hectares in 1950-51 to 7.5 million hectares at the end of fourth plan. The net area irrigated by means of tubewell and other forms of ground water utilisation schemes increased from 6.5 million hectares to 16.0 million hectares during this period.

In recent years considerable emphasis has been placed upon the irrigation projects in order to save the crops from recurring droughts in the country in general and in the state of Orissa in particular. In a most backward state like ours where capital investment is a major constraint, the desirability

of exploiting ground water resources by means of small capital outlay projects cannot be lost sight of.

From the preliminary geohydrological survey in Orissa, it is now observed that the State is enriched with ground water resources. The survey has been completed in about 48,000 sq. miles covering 194 blocks, and areas suitable for installation of various ground water development structures have been demarcated. A report on Orissa's ground water resources which is prepared by the State-owned Lift Irrigation Corporation reveals that the restorable ground water potential of the State would sustain 5,50,000 open wells, 28,400 filter point and shallow tube wells and 10,000 medium and deep tube wells. Attempts are being made to mobilise resources from various sources including World Bank for investment in the irrigation projects. Under such situation, deriving optimum benefits from irrigation facilities have become imperative.

Objective

The present study aimed to analyse the benefit-cost aspects of a tube well irrigation project located in the state of Orissa.

Methodology

One of the representative tube well points of Khandapara area in the Puri district namely Kusumitada lift irrigation project was selected for the purpose of this study. The selection of this irrigation project was purposive. This project was energised during early part of 1968. However, the present investigation relates to the year 1973-74.

The Benefit-Cost analysis is generally done through two approaches namely (1) "with" and "without" and (2) "before" and "after". The comparison of "before" and "after" the project situations being some what fallacious imposes certain limitations on the project evaluation. Moreover, there was no bench mark survey in this project area before the project was put to operation. "With" and "without" approach

was therefore the only available choice for carrying out such an analysis. Only direct costs and direct benefits have been taken into consideration in order to simplify the analysis. The difference between net benefits 'with' and 'without' the project was defined as the incremental net benefit of the project. Similarly, the difference between net costs "with" and "without" the project was defined as the incremental net cost of the project. In this project evaluation study, two sets of estimates have been made, one for the utilised capacity of the project and the other for the full potential of the project, since it is expected that the project resource will be fully utilised soon.

15 numbers of tube well irrigated farms and another 15 numbers of unirrigated farms located in the neighbourhood of the irrigated farms were selected on the basis of stratified random sampling in order to get unbiased estimates. These randomly selected irrigated and unirrigated farms were distributed equally over three size groups of operational holdings namely (1) below 2.5 acres, (2) 2.5 to 5 acres, and (3) 5 to 10 acres. In other words, from each category of farms (irrigated and unirrigated) and from each size group, five farms were selected at random for the purpose of this study.

Findings

Before embarking on the estimates of Benefit-Cost analysis of the irrigation project it is of absolute necessity to find out precisely the difference between irrigated and unirrigated farms with respect to intensity of cropping and cropping pattern. Because both the costs and returns are largely influenced by the crop intensity, and cropping pattern adopted by the farmers.

Crop intensity

As it is observed the intensity of cropping in the sample irrigated farms located in the Kusumitada tube-well irrigation project varies from 248 to 280. The average intensity in this case comes to 269. However, the crop intensity in case of unirrigated farms located in the neighbourhood of the irrigation project

TABLE 1

ESTIMATED CROP INTENSITY IN DIFFERENT FARM SITUATIONS IN VARIOUS FARM SIZES IN KHANDAPARA AREA DURING 1973-74

Particulars	Unirrigated Farms				Tube well irrigated farms			
	0-2.5	2.5-5.0	5.0-10	Average	0-2.5	2.5-5.0	5.0-10	Average
Net area sown	1.41	4.95	6.31	14.19	1.73	3.30	8.14	13.17
Gross cropped area	2.72	9.20	13.95	26.58	4.47	8.40	22.75	38.40
Intensity of cropping	187.98	184.81	187.87	186.42	247.82	254.54	279.44	269.02

varies from 184 to 188. Table 1 shows the average net sown area, gross cropped area and crop intensity in various farm sizes with respect to unirrigated (control) farms and tube-well irrigated farms.

Cropping pattern

The cropping pattern position which is given in table 2 not only speaks out the difference in the intensity of cropping but also the nature of difference in crop husbandry between unirrigated and tubewell irrigated farms. As it appears in table 2 the summer crops as well as year round crops are conspicuous by their absence in the unirrigated farms whereas the summer crops occupy nearly 30 per cent of the gross cropped area and the year round occupy about 6 percent of the gross cropped area in the irrigated farms under Kusumitada tubewell project. If we analyse the distribution of area according to broad groups of crops, about 97 percent of the total cropped area is devoted to cereals and pulses in the farms going without irrigation facilities. But in case of irrigated farms under the present study, 42 percent of the total cropped area comes under cereal crops, 36 percent comes under the cash crops like sugarcane, potato, tomato, groundnut and soyabean, and the rest 22 percent comes under seasonal vegetables. Less remunerative crops like pulses have been completely replaced by the remunerative crops like wheat and potato in the irrigated farms. Moreover, the unirrigated farms have not adopted the high yielding varieties of paddy under rainfed condition in face of greater degree of risks and uncertainties. But under the assured water situation about one-fourth of the area grown during kharif season is occupied by the high yielding varieties of paddy.

Yeild rates

Table 3 indicates the productivity of different corps per unity area (acre). Productivity is generally considered as one of the important measures of farm efficiency study. In this study, it is not possible to make a comparison between unirrigated and irrigated farms with respect to productivity of different

TABLE 2

CROPPING PATTERN FOLLOWED IN DIFFERENT CONDITIONS OF IRRIGATION AND PERCENTAGE OF AREA UNDER EACH CROP TO THE GROSS CROPPED AREA IN KHANDAPARA DURING 1973-74

	Unirrigated Farm		Tubewell irrigated Farms	
	Crops	Area in percentage	Crops	Area in percentage
Kharif crops	Local paddy	48.91	Local paddy	19.22
	Ragi	2.79	Ragi	0.84
	Jute	2.10	H. Y. V. Paddy	7.40
			Groundnut	3.90
			Vegetables	2.08
	Total	54.80	Total	33.44
Rabi crops	Black gram	12.55	Potato	16.59
	Green gram	16.00	Wheat	6.18
	Horse gram	3.62	Tomato	2.96
	Khesari	11.98	Soyabean	0.84
	Mustard	1.05	Winter Vegetable	4.82
	Total	45.20	Total	31.39
Summer crops	—	—	Brinjal	7.19
			Groundnut	6.13
			Ragi	5.80
			Maize	2.11
			Arum	6.35
			Summer Vegetables	0.84
	Total	—	Total	29.42
	Year round crop	—	Sugarcane	5.75
	Grand Total	100.00		100.00

crops excepting local paddy as the cropping pattern under these two conditions widely vary. As the estimation in case of local paddy, the yield rate varies form 7.30 quintals to 8.85 quintals per acre of land under unirrigated situation. The same varies from 9.03 quintals to 9.98 quintals under irrigated situation. This shows that the assured water supply facility increases the productivity of land by 13 to 28 percent.

Cost and returns

However, the higher productivity of irrigated farms can not be attributed to water input alone. The presence of irrigation facility generally influences for higher investment in corp raising through higher doses of fertilizer and other chemical uses. It was therefore desirable to estimate and analyse the cost and returns of different crops raised in both the conditions, namely irrigated and unirrigated farms. Table 4 gives a comparative picture of cost of cultivation, gross income and net profit of different corps grown by the sample farms. The cost of cultivation per acre of local paddy is estimated as Rs. 387 and Rs. 420 in unirrigated and irrigated farms respectively. It may be further observed that in case of unirrigated situation not only the cost of cultivation of local paddy is lower as compared to its cost under irrigated situation, the gross income and net profit per unit area also works out to be of similar order. The gross income and net profit of local paddy grown under irrigated condition are estimated at Rs. 671 and Rs. 251, respectively.

The corresponding estimated figures in case of unirrigated farms come to Rs. 605 and Rs. 218. In other words, the total cost of cultivation, gross income and net profit in case of irrigated local paddy increases by 9 percent, 10 percent and 15 percent, respectively over the unirrigated local paddy. In case of ragi, there is no evidence of any significant difference between irrigated and unirrigated situation with respect to cost of cultivation, gross income and net profit. The cost of cultivation of ragi comes to Rs. 340. Its gross income and net profit come around Rs. 560 and Rs. 220 respectively. The pulse crops such as black gram, green gram and khesari which find prominent place in the cropping pattern

TABLE 3

YIELD RATE OF DIFFERENT CROPS IN DIFFERENT AREAS ACCORDING TO SIZE OF HOLDING

(Yield in quintals/acre)

Size group	Unirrigated Farms				Tubewell Irrigated Farms			
	I	II	III	Average	I	II	III	Average
1. Local Paddy	7.3	8.4	8.85	8.18	9.03	9.25	9.98	9.42
2. H. Y. V. paddy (Kharif)	—	—	—	—	15. 8	16. 2	16. 5	16.16
3. H. Y. V. Paddy (Summer)	—	—	—	—	—	—	—	—
4. Green gram	1.85	1.94	2.10	1.93	—	—	—	—
5. Black gram	1.60	2.36	2.46	2.14	—	—	—	—
6. Groundnut (Kharif)	—	—	—	—	—	—	9.03	9.03
7. Groundnut (Summer)	—	—	—	—	—	9.20	8.72	8.96
8. Potato	—	—	—	—	48.05	51.50	53.52	51.02
9. Sugarcane	—	—	—	—	35. 0	36.66	39.20	36.95
10. Wheat	—	—	—	—	8. 2	8.50	8.44	3.38

TABLE 4

TOTAL COST OF CULTIVATION, GROSS INCOME AND PROFIT PER ACRE OF MAIN CROPS UNDER DIFFERENT SITUATION

(Amount in rupees)

Sl. No.	Crops	Unirrigated			Tubewell irrigated		
		T. C. C.	G. I.	N. P.	T. C. C.	G. I.	N. P.
1.	Local paddy	387.37	605.25	217.88	419.51	670.73	251.22
2.	H. Y. V. Paddy (Kharif)	—	—	—	603.28	1114.38	511.10
3.	Wheat	—	—	—	470.41	904.10	433.69
4.	Sugarcane	—	—	—	1592.60	3926.46	2335.29
5.	Groundnut (Kharif)	—	—	—	493.54	1207.52	713.98
6.	Ragi	342.60	552.00	219.40	340.00	565.00	225.00
7.	Khesari	97.28	237.51	140.23	—	—	—
8.	Potato	—	—	—	1258.98	2135.50	876.57
9.	Winter Vegetable	—	—	—	624.03	1631.57	1007.54
10.	Summer Vegetables	—	—	—	703.00	1750.00	1047.00
11.	Black gram	94.75	253.80	159.05	—	—	—
12.	Green gram	114.74	295.00	180.26	—	—	—

T. C. C. — Total Cost of Cultivation
G. I. — Gross Income
N. P. — Net Profit

of unirrigated farms during rabi season are characterised by their less capital intensive and less remunerative nature. The cost per acre of raising green gram, black gram and khesari is estimated at Rs. 115, Rs. 95 and Rs. 97, respectively. Their respective gross income comes to Rs. 295, Rs. 254 and Rs. 238 and their respective net profit comes to Rs. 180, Rs. 159 and Rs. 140.

Under irrigated condition, sugarcane gives maximum net profit per acre than any other crop grown under the similar condition. Though about Rs.1600 is spent on working expenses for raising one acre of sugarcane, it gives a net profit of Rs. 2335. If we compare between local paddy and high yielding paddy both grown under irrigated condition in Kharif, it can be seen that the cost of cultivation of high yielding paddy is one and half times more than the local paddy and the net profit generated from the high yielding paddy is two times more than that of local paddy.

Input output ratio

Table 5 shows the estimated figures of input output ratio per acre of irrigated and unirrigated farms distributed over various sizes. The table reveals that the input output ratios in case of tube well irrigated farms are significantly higher than that of the unirrigated farms. The input-output

TABLE 5

INPUT-OUTPUT RATIO PER ACRE IN IRRIGATED AND UNIRRIGATED FARMS

Sige group	I	II	III	Average
Unirrigated				
Input	462.31	493.39	515.93	490.54
Output	695.28	761.51	799.81	752.22
I/O Ratio	1:1.50	1:1.54	1:1.55	1:1.53
Tubewell irrigated				
Input	1889.73	1890.97	1989.36	1923.25
Output	3598.26	3710.31	3931.36	3746.46
I/O Ratio	1 : 1.90	1 : 1.96	1 : 1.97	1 : 1.94

ratios in the unirrigated farms varies from 1:1.50 to 1:1.55, whereas in case of irrigated farms, it varies from 1:1.90 to 1:1.97. The higher productivity of irrigated land complied with higher remunerative crops raised in this land has attributed to the higher input-output ratios for the irrigated farms. It may also be seen in table 5 that irrespective of irrigation facilities higher size group of farms achieved higher input-output ratios, though not significantly higher ratios. This may perhaps indicates that the large size farms now find better opportunities in the efficient use of modern farm resources compared to small size farms.

II

In section I Benefit-cost studies relating to one acre of tubewell irrigated farm has been analysed. Section II now deals with the benefit-cost analysis of the Kusumitada Tubewell irrigation project as a whole.

Primary direct benefits and costs

The estimated values of primary direct benefits and cost have been indicated in table 6. Since only two-third of the potential irrigated area of 30 acres has been utilised for the crop husbandry, the estimated benefits and costs relate to 20 acres of presently used irrigated area under the Kusumitada tubewell irrigation project. The direct benefit through additional crop output from the tubewell project comes to Rs. 61.980. Similarly, the direct costs through additional inputs used in the crops husbandry come to Rs. 29,200.

TABLE 6

DIRECT BENEFITS AND COSTS IN TUBEWELL IRRIGATION PROJECT

(in Rupees)

Primary Direct Benefit (B)	
i. With tubewell irrigation for 20 acres "R"	77,024
ii. Without tubewell irrigation "R'"	15,044
iii. Additonal output due to tubewell irrigation or Additionai benefit B=(R—R')	61,980
Primary Direct Cost (A)	
i. With tubewell irrigation "T"	39,010
ii. Without tubewell irrigation "T'"	9,810
iii. Additional input due to tubewell irrigation A=(T-T')	29,200

Annual cost structure of the project

Annual cost to the project includes both the fixed cost and variable cost. The fixed cost while includes depreciation, interest, repair and maintenances of the project, the variable cost includes the cost of consumed electricity and the operational expenses. Table 7 shows the estimated values of the fixed cost with respect to various components of the projects. The table also gives the annual expenditure for running the tube well for irrigation purpose. However, the details of the cost structure and expenditure are given in the Appendix. The estimated annual fixed cost of the project work out to Rs. 1440 and the variable cost comes around Rs. 3010. In other words, the total annual cost of the project comes to Rs. 4,450.

TABLE 7

ANNUAL COST STRUCTURE OF KUSUMITADA TUBE WELL POINT DURING 1973-74

Fixed cost —(Depreciation, Interest, Repair)		
i. Tubewell	Rs.	244.48
ii. Centrifugal pump	Rs.	448.75
iii. Electrical wiring	Rs.	149.50
iv. Distribution system	Rs.	598.00
"F"	Rs.	1440.73
Variable cost		
v. Cost of electricity consumption	Rs.	907.65
vi. Operational cost (One operator for pump)	Rs.	2100.00
"V"	Rs.	3007.65
Total cost "C" =F+V= Rs. 4,448.38, say	Rs.	4450.00

Benefit/cost ratio for the project

Table 8 presents the estimated values of B/C ratios. Here two estimates have been given, one for the presently used 20 acres of ayacut area and the other for the potential ayacut area of 30 acres. while the presently used capacity of the project made B/C ratio of 1.84, the potential capacity made a B/C ratio of 1.90, which suggests for the full utilisation of the capacity of the project as early as possible to derive maximum economic benefits from the Irrigation project.

TABLE 8

BENEFIT-COST RATIO FOR THE KUSUMITADA TUBEWELL IRRIGATION PROJECT

Ayacut area	Total additional output due to irrigation from farming 'B'	Total additional cost due to irrigation from farming 'A'	Amount fixed cost 'F'	Annual Variable cost 'V'	Total cost A+F+V=c	B/C
1. Tubewell with 20 Ac ayacut.	61.980	29,200	1440.73	3007.65	33648.38	1.84
2. Tubewell with 30 Ac. ayacut.	92.970	43,800	1440.73	3,462	48702.00	1.90

TABLE 9

BENEFIT PER RUPEE SPENT ON TUBEWELL IRRIGATION DURING 1973-74

(Amount in Rupees)

Kind of irrigation project	Total additional output due to irrigation from cultivation B=(R—R')	Total additional cost due to irrigation for farming A—(T—T')	Annual fixed cost of the project (F)	Annual variable cost of the project (V)	Annual total cost of the project (F+V) C = (F+V)	Net benefit due to irrigation B—(A+C)	Benefit per rupee spent on irrigation during 1972-73 B-(A+C) / C
1. Tubewell irrigation (20 acre ayacut)	61,980	29,200	1,440.73	3,007.65	4,448.38	28,331.62	6.36
2. Tube well irrigation (30 acre ayacut)	92.970	43,800	1,440.73	3,462.00	4,902.73	44,267.27	9.95

Benefit per rupee spent

Table 9 shows the benefit per rupee spent annually for the purpose of irrigation. It has been found out that in existing commanding area of the Kusumitada tube well irrigation project, the benefit per rupee spent comes to Rs. 6.36. If the ayacut area is extended to its full capacity the benefit per rupee spent would rise to Rs. 10. It is therefore desirable to make full utilisation of the irrigation project than its under-utilisation which promised less benefits than what is expected.

In view of the above findings top priority should be given to tube well irrigation projects wherever feasible. The ground water resource survey should be intensified and under the feasible conditions such type of low cost, but quick recovery projects should be given priority in our agricultural development strategy.

"APPENDIX"

Detail cost structure of Kusumitada tubewell point
Depth of T.W.=110 ft.

(A)	a) Cost of drilling 100' @ Rs.4.45/ft. ...	445.00	
	b) Cost of drilling 100'-120 @ Rs.5.06/ft ...	100.00	
2.	Cost of 4 " dia (M.S.) 85' @ Rs.14/ft ...	1190.00	
3.	Cost of 4" dia strainer 25' @ Rs.5/ft. ...	125.00	
4.	Cost of 4" dia check valve & other G.I. fittings: L.S. ...	400.00	
5.	Cost of transportation of materials L.S. ...	300.00	
	Total ...	2,560.00	...(A)
(B)	Cost of one 5 H.P. centrifugal pump coupled to 5 H.P.electric motor with all fittings and accessories ...	2,500.00	..(B)
(C)	Cost of electric connection including internal wiring ; ...	1,000.00	...(C)
(D)	Distribution system.		
	i) Cost of one delivary tank (4' × 4') ...	600.00	
	ii) Cost of pump chamber (6'×6') ...	600.00	
	iii) Cost of 800' brick lined channel at the rate of Rs. 3.50/ft. ...	2,800.00	
	iv) Contingencies and other unforeseen items. ...	200.00	
		4,200.00	...(D)

Grand total ... (A+B+C+D)== Rs.10,260.00

Fixed cost: (depreciation + interest + repair and maintenance)

a) Tube well:

i) Cost of tube well Rs.2,560/-
life assumed = 25 years.

ii) Depreciation/annum = $\frac{2560-256}{25}$ ... ... = 92.16

iii) Interest on average capital/annum. $\frac{2560+256}{2} \times \frac{9}{10}$
= 126.72

iv) Maintenance at the rate of 1 per cent... ... ... = 25.60
244.48

b) Cost of centrifugal pump life assumed 10 years. 2500/-

ii) Depreciation/annum $\frac{2500-250}{10}$ ... ... = 225.00

iii) Interest on average capital/annum $\frac{2500+250}{2} \times \frac{9}{10}$
= 123.75

iv) Maintenance @ Rs.4 of initial cost/annum. ... = 100.00
Rs. 448.75

c) i) Cost of electrical wiring life = 15 years = 1,000.00

ii) Depreciation/annum. $\frac{1000-100}{15}$ ... ... = 60.00

iii) Interest on capital/annum = $\frac{1000+100}{2} \times \frac{9}{10}$ = 49.50

iv) Maintenance 4 per cent. ... ... = 40.00
Rs. 149.50

d) Cost of distribution system = 15 years = Rs4,000.00

ii) Depreciation/annum. $\frac{4000-400}{15}$ = ... = 240.00

iii) Interest on average capital/annum - $\frac{4000+400}{2} \times \frac{9}{10}$
= 198.00

iv) Maintenance 4 per cent of initial cost/annum... = 160.00
Rs. 598.00

Total cost/annum = 244.48 + 448.75 + 149.50 + 598.00
= Rs.1440.73

AN ANALYTICAL STUDY OF THE BENEFIT COST RATIO AND OTHER ECONOMIC PARAMETERS OF STATE TUBE-WELLS OF ORISSA

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Introduction

The development of tube-well irrigation in this state dates back to the year 1963. Prior to this, the lift irrigation activity of the state was mainly confined to hiring of limited number of pumps to the cultivators and to supplying of pumps to the Gram Panchayats. Of course, the working of a pilot scheme for pumping water directly from the river bed and for installing filter points or shallow tube-wells in the Rushikulya basine, installation of pumping points on the river Nagavali by a cooperative society of sugarcane producers, survey of some areas in Balasore and Cuttack districts by the exploratory tube-well organisation of the Central Government during 1958-59 had demonstrated that the crops can be grown profitably by utilisation of ground water potential of the state and the assured irrigation facility can be extended to the compact areas unsuitable for flow irrigation. Since then a large number of pump sets are being installed every year by making heavy investment on the programme. Presently, 646 number of tube-wells are operating in the public sector in addition to 1370 number of direct pumping units in various parts of the state to cater to the irrigation needs of a large humber of cultivators as per an inventory prepared recently by the lift irrigation corporation Ltd., Orissa.

Since heavy expenditure is incurred on this programme with the sole objective of increasing agricultural production, it is desirable to assess the economic viability of these projects working at different stages of their life period. This paper attempts to assess and analyse the Benefit Cost ratio (B/C ratio), Net Present Value (N.P.V.) and Pay Back Period (P.B.P) of 17 stars tube-wells working for the last six years in discounted cash flow method.

Methodology

Since 83 per cent of the total 229 completed state tube wells were located in the three districts of Balasore, Cuttack and Ganjam (as on 31. 3. 71.) these three districts have been selected for the purpose of this analysis. Ten per cent of all those projects which were energised two years prior to 1.1.72 were selected on simple random basis. Five beneficiaries owning lands inside the ayacut area of the project and utilising irrigation potential and five non-beneficiaries owning unirrigated lands outside the project area were selected at random from each project. Thus 17 tube wells, 85 beneficiaries and 85 non-beneficiaries were selected for the study.

The importance of benefit cost analysis

It is necessary that the lift irrigation projects should be economically viable and should give such returns that will attract institutional finance as well as the farmer's savings. The B/C ratio is one of the mesures of economic viability. A new tube well extends irrigation facility to some unirrigated areas. But unless the irrigation facility thus created is fully utilised and thereby increased agricultural production is obtained, the objective of spending money on institution of such wells is not achieved. The B/C ratio which is calculated taking into account costs incurred and benefits derived indicates the extent of economic viability of the project.

A ratio between the values of benefits (that has already been derived and the present or discounted value of the benefit extended to be derived) and the costs (that has already been incurred

and the present or discounted values of the costs expected to be incurred) indicates the anticipated profitability of the project. If this ratio is one, it indicates the fact that the benefit (that has already been derived and the present or discounted value of the benefit expected to be derived) is same as the cost (that has already been incurred and the present or discounted values of the costs expected to be incurred). If it is more than one., this benefit is more than the cost and the vice versa.

The role of N. P. V. and P. B. P.

Net present value indicates the total values of the benefits over total values of investment cost and operational and maintenance cost. This economic parameter helps in finding out the magnitude of profitability that will accumulate at the life period of the project.

Pay Back period is the period during which the progressive total of benefits exceeds the progressive total of investment cost and operational and maintenance cost. So while working out economic viability and magnitude of profitability, it is also equally important to find out the number of years required to cover all costs by the benefits.

The formulae for B/C ratio and N. P. V.

The formulae adopted in this study to calculate the B/C ratio and N. P. V. are as follows :

$$\text{B/C ratio} = \Sigma \frac{B_n - C_n}{K_n}$$

$$\text{N. P. V.} = \Sigma B_n - C_n - K_n$$

Where—

E_n—Progressive total of additional benefits
C_n—Progressive total of operational and maintenance cost.
K_n—Progressive total of investment cost.

Method of calculation

Benefits

The real benefit of a tubewell project is the difference between the income received from the irrigated lands over the net income received from comparable unirrigated lands. Statistics on agricultural production and prices were collected from the sample cultivators (both beneficiaries and non-beneficiaries) of each project for the years, 1968-69, 1969-70, 1970-71 and 1971-72. The net value of agricultural production per acre was calculated separately for each of these four years, in respect of lands receiving irrigation from the tube-well and control lands. The net additional benefit per acre due to irrigation was obtained separately for each of these four years by deducting the net value of agricultural production per acre of unirrigated land from the net value per acre of irrigated land and the balance was multiplied to the ayacut area of the tube-well to get the net additional benefit of the project. On the basis of average percentage rise (or fall) of the net additional benefit during these four years, the net additional benefit of 1971-72 was projected to each of the rest of the year of the life period of the tube-well. The value of net additional benefit of each year beginning from 1974-75 was then discounted at the rate of 10% to get the present value of the expected benefits. Details regarding values of net additional benefits including projected and discounted values have been presented in Annexure I.

Costs

The costs of all the goods and services used for the installation, operation and maintenance of the tube-well have been included in the total cost. The cost of installation has been taken as investment cost and the operational and maintenance cost included the pay of pump driver, electricity charges, repairs and other establishment charges. The interest on capital cost (or investment cost) is also another constituent of the total cost. However, B/C ratio, N.P.V. and P.B.P. have been calculated in this study both taking into account the interest charges of 10% and also without interest charges. Like the benefits, the interest charges of each year after

1973-74 have been discounted at the rate of 10%, The year wise break up of investment cost has been given in Annexure II and the values of interest charges along with their discounted values have been presented in Annexure III. Operational and maintenance costs were collected for 4 years viz. 1968-69, 1969-70, 1970-71 and 1971-72. On the basis of average percentage rise (or fall) of this cost during these four years, the cost incurred during 1971-72 was projected to each of the remaining years of the life period of the tube well. The values of operational and maintenance cost of each year, thus obtained, were also discounted at the rate of 10% beginning from the year 1974-75. The details of operational and maintenance cost and their discounted values have been presented in Annexure IV.

B/C Ratio

The B/C ratio has been calculated adopting the formula given earlier. The difference of the progressive total of benefits and the progressive total of operational and maintenance cost has been divided by the total investment cost at one instance and by the sum of total investment cost and progressive total of interest charges in another instance to give the B/C ratio without interest charges and B/C ratio with interest charge of 10 % on the investment cost respectively.

N. P. V.

N. P. V. has been worked out without interest charges and with interest charge of 10% on investment cost. In the former case, total investment cost and the progressive total of operational and maintenance cost have been deducted from the progressive total of benefits and in the latter case, the progressive total of interest has also been deducted from the benefit in addition to the costs deducted earlier.

P. B. P.

There being no specific formula for calculating P. B. P., it was obtained by adding up the net additional benefit of each year till it

exceeded the total values of investment cost and operational and maintenance cost.

Assumptions

It is not known as to what will be the magnitude of real benefit and real cost during each of the future years of the life period of the project. It has been assumed in this study that the benefit and cost will rise (or fall) at the same rate as it was noticed in the foregoing years. Accordingly, the benefit and cost figures of 1971-72 have been projected. In fact one may find unusual (inflated or deflated) figures of benefit and cost in the later years of the life period of the project by such projection. However, we are more concerned with total benefit that will be derived and total cost that will be incurred during the entire life period of the project rather than the benefit and cost of individual years for calculating the B/C ratio and other economic parameters. Moreover, both benefit and cost get inflated (or deflated) simultaneously for which no difficulty is faced while calculating these parameters.

The operational cost of Kalidaspur tube well for the years 1968-69 and 1969-70 was not available. Therefore, the expenditure incurred during each of these two years has been assumed to be the same as the expenditure incurred during 1970-71.

In case of Basudevpur tube well, the contingency expenditure for 1968-69 was not available. The avarage contingency expenditure of the next three years has been taken as the contingency expenditure for this year.

The operational and maintenance expenditure incurred during 1968-69 appeared to be very abnormal compared to the expenditure incurred in rest of the years in case of Narayanpur tube well. So the expenditure incurred during this year has not been taken into account while projecting the cost.

In case of Hansapur project, the operational and maintenance cost varied widely over the reference period. The avarage percentage rise of operational and maintenance cost of all the

sample projects with 5 HP (since this is a 5 HP project) has been taken into account in this case while projecting the cost of this project.

The yearwise break up of investment cost of Kamargaria and Basudevpur tube well was not available. Therefore, the total investment cost has been divided by the number of years of construction in order to find out roughly the cost incurred during different years.

The secondary benefits and costs which cannot be easily measured and the intangible benefits and costs which can not be easily quantified have not been taken into account in this study. Therefore, the B/C ratio (or other economic parameters) thus calculated, cannot be taken as the only criterion for judging the efficiency of tubewells. Other benefits such as increase in employment potential, saving of crops from drought situation etc. may also be taken into account while evaluating such projects.

Results and Discussions

The B/C ratio, N. P. V. and P. B. P. thus obtained are presented in the table below :

Name of the tube well	B/C ratio		N. P. V. (Rs.)		P. B. P. (years)	
	Without interest charges	With interest charge of 10%	Without Interest charges	With Interest charge of 10%	Without interest charges	With Interest charge of 10%
1	2	3	4	5	6	7
1. Basta	6.51	3.23	1,36,871.71	1,11,617.96	9	10
2. Kalidaspur	5.35	3.65	1,14,075.18	87,424.40	10	10
3. Kamargaria	12.99	6.38	3,08,415.56	2,81,788.62	2	3
4. Basudevpur	8.56	4.12	3,09.054.27	2,64,955.91	4	5
5. Garadih-II	12.96	6.63	5,37,620.74	4,94,684.64	2	3
6. Thalkudi	3.84	1.39	1,20,270.65	76,414.62	4	6
7. Bramhana Sahi	1.08	0.44	868.94	—15,608.81	20	—
8. Narayanpur-II	2.36	0.97	38,658.24	— 2,265.88	20	—
9. Hansapur-I	0.34	0.15	—11,541.99	—33,554.36	—	—
10. Hundata-I	2.58	1.17	15,704.47	3,645.91	20	20
11. Hundata-II	4.06	1.75	40,782.28	23,236.57	15	17
12. Jamuni-I	29.32	12.82	3,50,044.21	3,34,133.42	4	4
13. Sikri-IV	1.13	0.47	2,008.78	—19,100.57	20	—
14. Sologarh-II	9.29	4.03	91,242.80	76,892.07	12	13
15. Bathua-I	15.65	6.76	58,162.06	50,604.73	10	11
16. Budura-I	11.25	4.66	1,33,854.86	1,15,370.61	5	6
17. Kittingi	7.57	3.25	86,772.20	69,256.76	11	13

The figures in the above table indicate that almost all the sample projects qualified to be economically viable when the interest charge on investment cost was not taken into account. But the interest charge is a main constituent of the total cost. When it was taken into consideration, about 23.5 per cent of the sample projects ceased to be economically viable ones. A wide range of variation was noticed in the B/C ratios of the rest of the sample projects. It varied from a minimum of 1.2 in case of Hundata-I to a maximum of 12.8 in case of Jamuni-I. The percentage distribution of sample projects among various size groups of B/C ratios was as follows :

B/C ratio (with interest charges)	Percentage of tubewells
0 1	23 5
1— 4	35.3
4— 8	35.3
8—12	—
12—16	5.9
	100.0

The net present value (without deduction of interest charges) was positive in case of 16 out of17 tube wells. This indicates that the present value of benefits was more than the present value of investment cost and operational and maintenance cost in 16 tube wells. However, there was a wide range of variation among these tube wells with respect to N. P. V. It varied from a minimum of Rs. 868.94 in case of Bramhana Sahi to a maximum of Rs. 5.37, 620.74 in case of Gardih-II.

The number of tube wells with negative N. P. V. increased to 4 after deduction of the interest charges. The N. P. V. in this case varied from a minimum of Rs. 3,645.91 in Hundata-I to a maximum of Rs. 4,94,684.64 in Gandih-II. The percentage distribution of sample projects among various size groups of N. P. V. was as follows :

Net present value (with deduction of interest charges) ('000 Rs.)	Percentage of tube wells
With negative N. P. V.	23.5
0—100	41.1
100—200	11.8
200—300	11.8
300—400	5.9
400—500	5 9
	100.0

The pay back period was more than the life period of the project in case of Hansapur-I which had the lowest B/C ratio and negative N. P. V. (both without and with interest charges) This indicates the fact that the value of investment cost and operational and maintenance cost cannot be covered with the progressive total of net additional benefit within the life period of this project. In case of other tubewells, these costs can be covered within a period of 2 to 20 years. However, these costs alongwith the interest charges cannot be covered within the life period of four sample tube wells. In rest of the tube wells, it will take 3 to 20 years to cover these costs. The percentage distribution of sample projects among the size groups of P. B. P. was as under :

Pay Back period (with interest charges) (years)	Percentage of tube wells
More than life period of the tube well	23.5
0— 4	11.8
4— 8	23.5
8—12	17.6
12—16	11.8
16—20	11.8
	100.0

By correlating B/C ratio, N. P. V. and P. B. P., it was observed that the N. P. V. was negative and the P. B. P. was more than the life period of the tube well when the B/C ratio

was less than one. When the B/C ratio was equal to one or a little more than one, the N. P. V. was fairly high and the P. B. P. was about equal to the life period of the tube well. The tube wells with higher B/C ratios had very high N. P. V. s and very low P. B. Ps.

Conclusion

The investment cost of a working tube well being fixed, a higher B/C ratio can be obtained by enhancing the net additional benefit on the one hand and by reducing the operational and maintenance cost on the other hand. Net additional benefit can be raised by utilisation of the created irrigation potential fully through multiple cropping and improved method of cultivation. The operational and maintenance cost of the projects with lower B/C ratios can be reduced by efficient management and maintenance of the projects. Another crucial point to be borne in mind at the time of planning for installation is that the alternative cropping pattern and the present cropping pattern of the proposed project area should be prepared properly and the net additional benefit (viz. the difference in net income of two types of cropping patterns) should be worked out first. The investment cost and the operational and maintenance cost of the tube well should be fixed in such a way that the difference of net additional benefit and operational and maintenance cost will be atleast four times of the investment cost of the tube well in order to give a higher B/C ratio.

Last but not the least point is that the secondary benefits and costs and the intangible benefits and costs which have not been taken into account in this study may be taken into consideration alongwith the economic parameters for arriving at the total benefit from a tube well particularly in areas where installation of tube wells is a promotional policy to demonstrate the use of tube wells to unsophisticated farmers. But once the idea catches on, the practice of using shadow prices to arrive at social costs and benefits of such projects have to be discontinued and the tube wells should be made to pay commercially.

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ANNEXURE-I

PROGRESSIVE TOTAL OF NET ADDITIONAL BENEFITS OF STATE TUBE WELLS

Sl. No.	Name of the tube well	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72
1	2	3	4	5	6	7	8
1.	Basta	—	—	10455.00	22318.00	22527.00	23789.00
2.	Kalidaspur	—	—	10281.00	24198.00	25355.00	27853.00
3.	Kamangarla	—	—	—	39730.00	38987.00	39715.00
4.	Basudevpur	—	—	26207.00	33985.00	34021.00	34094.00
5.	Garadih II	—	—	33230.00	52124.00	52695.00	53771.00
6.	Thalkudi	—	—	19851.00	20553.00	20927.00	21266.00
7.	Bramhan Sahi	—	—	5115.00	7532.00	7936.00	8044.00
8.	Narayanpur II	—	—	—	4975.00	11712.00	3873.00
9.	Hundata-I	—	—	3363.00	5295.00	5317.00	5429.00
10.	Hanspur-I	—	—	312.00	595.00	821.00	763.00
11.	Hundata II	—	—	5332.00	6544.00	6859.00	7027.00
12.	Jamuni-I	—	—	32849.00	32925.00	33135.00	33841.00
13.	Sikri-IV	—	—	1368.00	2128.00	2189.00	2223.00
14.	Sologarh-II	—	—	14207.00	15973.00	15859.00	16378.00
15.	Bathua-I	—	—	25023.00	20954.00	21793.00	21849.00
16.	Budura	—	—	21316.00	18127.00	18895.00	19220-00
17.	Kittingi	—	—	5586.00	6137.00	6985.00	7426.00

Sl. No	1972-73	1973-74	1974-75	1975-76	1976-77
1	9	10	11	12	13
1.	33304.60	46626.44	65277,02	91387.83	127942.96
			(59343.34)	(75522.90)	(96123.55)
2.	41779.50	62669.25	94003.88	141005.82	211568.73
			(85458.93)	(116527.21)	(158906.51)
3.	39715.00	39715.00	39715,00	39715.00	39715.00
			(36104.91)	(32820.48)	(29837.88)
4.	37503.40	41253.74	45379.11	49917 02	54908.72
			(41254.15)	(41251.43)	(41252.92)
5.	64525.20	77430.24	92916.29	111499.55	133799.46
			(84470.20)	(92143.23)	(100523.53)
6.	21761.50	22268.54	22787.40	23318.33	23861.67
			(20716.03)	(19270.28)	(17927.27)
7.	9491.92	11200.47	13216.55	15595.53	18402.73
			(12015.17)	(12888.15)	(13825.97)
8.	5199.12	6979,30	9369.01	12576.96	16883.31
			(8517.37)	(10393.60)	(12684.43)
9.	6514.80	7817.76	9381.31	11257.57	13509.08
			(8528.55)	(9303.26)	(10149.37)
10.	1072.02	1506.19	2116.20	2973.26	4177.43
			(1923.84)	(2457.10)	(3138.50)
11.	7729.70	8502.67	9352.94	10288.23	11317.05
			(8502.76)	(8502.19)	(8502.50)
12.	34179.41	34521.20	34866.41	35215.07	35567.22
			(31697.05)	(29101.73)	(26721.65)
13.	2667.60	3201.12	3841.34	4609.61	5531.53
			(3492.16)	(3809.38)	(4155.84)
14.	17196.90	18056.75	18959.59	19907.57	20902.95
			(17236.16)	(16451.62)	(15704.39)
15.	20975.04	20136.04	19330.60	18557.38	17815.08
			(17573.45)	(15335.82)	(13384.47)
16.	18643.40	18084.10	17541.58	17015.33	16504.87
			(15947.05)	(14061.47)	(12400,11)
17.	8242.86	9149.57	10156.02	11273.18	12513.23
			(2932.84)	(9316.16)	(9401.19)

(Bracketed figures indicated discounted (present) values

Sl. No.	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
1	14	15	16	17	18	19
1	179120.14 (122339.06)	—	—	—	—	—
2.	317263.10 (216690.70)	—	—	—	—	—
3.	39715.00 (27125.35)	39715.00 (24659·04)	39715.00 (22419.12)	—	—	—
4.	60399.59 (41252.92)	66439.55 (41252.32)	—	—	—	—
5.	—	—	—	—	—	—
6.	24417,65 (16677.25)	—	—	—	—	—
7.	21715.22 (14831.50)	25623.96 (15909.92)	30236.27 (17068.37)	35678.80 (18310.36)	42100.98 (19640.11)	49679.16 (21068.93)
8.	22664.16 (15479.62)	30424.37 (18890.49)	40841.67 (23055.12)	54825.86 (28136.63)	73598.23 (34333.57)	98798.26 (41900.34)
9.	16210.90 (11072.04)	19453.08 (12078.42)	23343.70 (13177.52)	28012.44 (14375.98)	33614.93 (15681·36)	40337.92 (17107.31)
10.	5869.29 (4008.73)	8246.35 (5120.16)	11586.12 (6540.36)	16278.50 (8354.13)	22871.29 (10669.46)	32134.16 (13628.10)
11.	12448.76 (8502.50)	13693.64 (8502.38)	15063.00 (8503.06)	16569.30 (8503.36)	18226.23 (8502.54)	20048.85 (8502.72)
12.	35922 89 (24535.33	36282.12 (42527.57)	36644.94 (20686.07)	37011.39 (18994,25)	37381.50 (17438.47)	37755.32 (16012.03)
13.	6637.84 (4533.64)	7965.41 (4945.72)	9558.49 (5395.77)	11470.19 (5886.50)	13764.23 (6421.01)	16517.08 (7004.89)
14.	21948.10 (14990 55)	23045.51 (14308.96)	24197.79 (13659.65)	25407.68 (13039.22)	26678.06 (12445.31)	28011.96 (11879.87)
15.	17102.48 (11680.99)	16418.38 (10194.17)	15761.64 (8897.45)	15131.17 (7765.32)	14525.92 (6776.34)	13944.88 (5914.02)
16.	16009.72 (10934.64)	15529,43 (9642,22)	15063.55 (8503.37)	14611.64 (7498.69)	14173.29 (6611.84)	13748.09 (5830.56)
17.	13889.69 (9486,66)	15417.56 (9572.76)	17113.49 (9660.57)	18995.97 (9748.73)	21085.53 (9836.40)	23404.94 (9926.04)

1983-84	1984-85	1985-86	1986-87	1987-88	Total
20	21	22	23	24	25
—	—	—	—	—	622747.99
					(512348.89)
—	—	—	—	—	955917.28
					(769719.10)
—	—	—	—	—	436152.00
					(370828.78)
—	—	—	—	—	484108.13
					(413327.88)
—	—	—	—	—	671990.74
					(610912.40)
—	—	—	—	—	221012.11
					(201217.87)
58621.41	69173.26	81624.45	96316.85	113653.88	720960.44
(22598.55)	(24245.23)	(26005.55)	(27902.99)	(29925.07)	(325557.26)
138626.78	178038.19	238998.47	320831.55	430684.27	1705413.76
(51127.62)	(62402.39)	(76144.91)	(92944.90)	(113399.17)	(633662.83)
48405.50	58086.60	69703.92	83644.70	100373.64	589071.85
(18660.32)	(20359.35)	(22207.67)	(24231.87)	(24428.38)	(257097.96)
45148.49	63433.63	89124.25	125219.57	175933.50	610181.25
(17404.74)	(22233.49)	(28394.99)	(36276.11)	(46323.29)	(211542.21)
22053.74	24259.11	26685.02	29353.52	—	271353.76
(8501.72)	(8502.82)	(8501.85)	(8503.71)		(152528.48)
38132.87	38514.20	38899.34	39288.33	—	682932.21
(14700.22)	(13499.23)	(12393.33)	(11381.33)		(461139.37)
19820.50	23784.60	28541.52	34249.82	41099.78	241168.66
(7640.80)	(8336.50)	(9093.33)	(9922.17)	(10821.57)	(105236.00)
29412.56	30883.19	32427.35	34048.72	35751.16	469252.84
(11338.54)	(10824.56)	(10331.35)	(9863.91)	(9413.28)	(279158.02)
13387.08	12851.60	12337.54	11844.04	—	329737.87
(5160.72)	(4504.49)	(3930.74)	(3431.22)		(245279.28)
13335.65	12935.58	12547.51	12171,08	—	305472.82
(5140.89)	(4533.92)	(3997.64)	(3525.96)		(222913.86)
25979.48	28837.22	32009.31	35530.33	—	309732.38
(10015.09)	(10107.45)	(10198.17)	(10293.14)		(170321.63)

ANNEXURE

INVESTMENT COST OF

Sl. No.	Name of the Project	1966-67	1967-68
1	2	3	4
1.	Basta	—	24832.07
2.	Kalidaspur	—	26205.81
3.	Kamargarla	—	8571.19
4.	Basudevpur	13622.33	13622.34
5.	Garadih-II	18000.00	12249.64
6.	Thalkudi	20000.00	16107.47
7.	Bramhansahi	—	11469.54
8.	Narayanpur-II	—	28485.62
9.	Hanspur-I	—	3746.00
10.	Hundata-I	—	3128.00
11.	Hundata-II	3065.00	5844.00
12.	Jamuni-I	2320.00	2912.00
13.	Sikri-IV	—	12483.00
14.	Sologarh-II	—	4543.00
15.	Bathua-I	520.25	1263.43
16.	Budura-I	4544.00	4678.00
17.	Kittingi	2207.00	4586.60

STATE TUBE WELLS

1968-69	1969-70	1970-71	1971-72	Total
5	6	7	8	9
..	..	..	..	24882.07
..	..	..	..	26205.81
8571.19	8571.19	..	..	25713.57
13622.33	..	..	..	40,867.00
14511.40	..	190.20	..	44,951.24
1496.80	4064.31	617.10	..	42,285.68
..	..	..		11469.54
..	..	..	..	28485.62
4557.00	4642.00	2120.00	2348.00	17413.00
839.00	..	2223,00	3778,00	9968.00
..	..	1968.00	2464.00	18341.00
..	3855.00	3273.00	..	12360.00
443.00	2089.00	..	..	15015.00
1773.00	1294.00	3390.50	..	11000.50
40.00	2145,52	..	..	3969.20
3834.00	..	..	..	13056.00
667.00	4540.00	1211.00	..	13211.60

ANNEXURE

PROGRESSIVE TOTAL OF INTEREST CHARGES AT THE

Sl. No.	Name of the tube well	1966-67	1967-68	1968-69	1969-70	1970-71
1	2	3	4	5	6	7
1.	Basta	..	2483.21	2483.21	2483.21	2483.21
2.	Kalidaspur	..	2620.58	2620.58	2620.58	2620.58
3.	Kamargaria	..	857.12	1714.24	2571.36	2571.36
4.	Basudevpur	1362.23	2724.47	4086.70	4086.70	4086.70
5.	Garadih-II	1800.00	3024.96	4476.10	4476.10	4495.12
6.	Thalkudi	2000.00	3610.75	3760.43	4166.86	4228.57
7.	Bramhansahi	..	1146.95	1146.95	1146.95	1146.95
8.	Narayanpur-II	..	2848.56	2848.56	2848.56	2848.56
9.	Hanspur-I	..	374.60	830.40	1294.50	1506.50
10.	Hundata-I	..	312.80	396.70	396.70	619.00
11.	Hundata-II	306.50	890.90	890.90	890.90	1087.70
12.	Jamuni-I	232.00	523.20	523.20	908.70	1236.00
13.	Sikri-IV	..	1248.30	1292.60	1501.50	1501.50
14.	Sologarh-II	..	454.30	631.60	761.00	1100.05
15.	Bathua-I	52.03	178.37	182.37	396.92	396.92
16.	Budura-I	454.40	922.20	1305.60	1305.60	1305.60
17.	Kittingi	220.70	679.36	746.06	1200.06	1321.16

III

RATE OF 10 % PER ANNUM ON INVESTMENT COST

1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
8	9	10	11	12	13	14
2483.21	2483.21	2483.21	2483.21	2483.21	2483.21	2483.21
			(2257.49)	(2052.12)	(1365.64)	(1696.03)
2620.58	2620.58	2620.58	2620.58	2620.58	2620.58	2620.58
			(2382.37)	(2165.65)	(1968.84)	(1789.86)
2571.36	2571.36	2571.36	2571.36	2571.36	2571.36	2571.36
			(2337.62)	(2124.57)	(1931.36)	(1756.24)
4086.70	4086.70	4086.70	4086.70	4086.70	4086.70	4086.70
			(3715.22)	(3377.25)	(3070.34)	(2791.22)
4495.12	4495.12	4495.12	4495.12	4495.12	4495.12	—
			(4086.51)	(3714.77)	(3377.18)	
4228.57	4228.57	4228.57	4228.57	4228.57	4228.57	4228.57
			(3844.19)	(3494.49)	(3176.92)	(2888.11)
1146.95	1146.95	1146.95	1146.95	1146.95	1146.95	1146.95
			(1042.69)	(947.84)	(861.70)	(783.37)
2848.56	2848.56	2848.56	2848.56	2848.56	2848.56	2848.56
			(2589.63)	(2354.05)	(2140.12)	(1945.57)
1741.30	1741.30	1741.30	1741.30	1741.30	1741.30	1741.30
			(1538.02)	(1439.01)	(1308.04)	(1189,31)
996.80	996.80	996.80	996.80	996.80	996.80	996.80
			(906.19)	(823.75)	(748.89)	(680.81)
1334.10	1334.10	1334,10	1334.10	1334.10	1334.10	1334.10
			(1212.83)	(1102.50)	(1002.31)	(911.19)
1236.00	1236.00	1236.00	1236.00	1236.00	1236.00	1236.00
			(1123.65)	(1021.43)	(928.61)	(944.19)
1501.50	1501.50	1501.50	1501.50	1501.50	1501.50	1501.50
			(1365.01)	(1240.84)	(1128.08)	(1025.52)
1100.05	1100.05	1100.05	1100.05	1100.05	1100.05	1100.05
			(1000.06)	(909.08)	(826.47)	(751.33)
396.92	396.92	396.92	396.92	396.92	396.92	396.92
			(360.84)	(328.01)	(298.81)	(271.10)
1305.60	1305.60	1305.60	1305.60	1305.60	1305.60	1305.60
			(1186.92)	(1078.95)	(980.90)	(891.72)
1321.16	1321.16	1321,16	1321.16	1321.16	1321.16	1321.16
			(1201.07)	(1091.81)	(992.59)	(902.35)

Sl. No.	1978-79	7979-80	1980-81	1981-82	1982-83	1983-84
1	15	16	17	18	19	20
1.	—	—	—	—	—	—
2.	—	—	—	—	—	—
3.	2571.36	2571.36	—	—	—	—
	(7956.56)	(1451.53)				
4.	4086.70	—	—	—	—	—
	(2537.43)					
5.	—	—	—	—	—	—
6.	—	—	—	—	—	—
7.	1146.95	1146.95	1146.95	1146.95	1146.95	1146.95
	(712.14)	(647.45)	(588.61)	(535.05)	(486.42)	(442.15)
8.	2848.56	2848.56	2848.56	2848.56	2848.56	2848.56
	(1768.67)	(1608.01)	(1467.88)	(1328.85)	(1208.07)	(1098.12)
9.	1741.31	1741.30	1741.30	1741.30	1741.30	1741.30
	(1081.17)	(982.96)	(893.64)	(812.32)	(738.49)	(671.27)
10.	996.80	996.80	996.80	996.80	996.80	996-80
	(618.91)	(562.69)	(511.55)	(465.00)	(422.74)	(384.26)
11.	1334.10	1334.10	1334.10	1334.10	1334.10	1334.10
	(828.34)	(753.10)	(684.66)	(622,36)	(565.79)	(514.30)
12.	1236.00	1236.00	1236.00	1236.00	1236.00	1236.00
	(767.43)	(697.72)	(634.32)	(576.59)	(524.19)	(476.48)
13.	1501,50	1501.50	1501.50	1501.50	1501.50	1501.50
	(932.28)	(847.60)	(770.57)	(700.45)	(636.79)	(578.83)
14.	1100.05	1100.05	1100.05	1100.05	1100.05	1100.05
	(683.02)	(620.98)	(564.55)	(513.17)	(466.53)	(424.07)
15.	396.92	396.92	396.92	396.92	396.92	396.92
	(246.45)	(224.06)	(203.70)	(185.16)	(768.33)	(153.01)
16.	1305.60	1305.60	1305.60	1305.60	1305.60	1305.60
	(810.65)	(737.01)	(670.03)	(606.06)	(553.70)	(503.31)
17.	1321.16	1321.16	1321.16	1321.16	1321.16	1321.16
	(820.31)	(745.79)	(678.02)	(616.32)	(560.30)	(509.31)

Bracketed figures indicate discounted (present) values.

1984-85	1985-86	1986-87	1987-88	Total
21	22	23	24	25
—	—	—	—	27315.31
				(25,258.75)
—	—	—	—	28826.38
				(26650.78)
—	—	—	—	30856 32
				(26626.94)
—	—	—	—	49040.40
				(44098.36)
—	—	—	—	45243.00
				(42986.10)
—	—	—	—	47366.60
				(43856.08)
1146.95	1146.95	1146.95	1146.95	24,085.95
(402.01)	(365.42)	(332.27)	(301.99)	(16477.75)
2848.56	2848.56	2848.56	2848.56	59819.76
(998.42)	(907.55)	(825.23)	(750.03)	(40924.12)
1741.30	1741.30	1741 30	1741,30	33608.10
(610.33)	(554.78)	(504,45)	(458,48)	(22012.37)
996.80	996.80	996.80	996.80	18670.80
(349.37)	(317.58)	(288.77)	(262.45)	(12053.66)
1334.10	1334.10	1334.10	1334.10	25412.50
(467.60)	(425.04)	(386 49)		(17545.71)
1236.00	1236.00	1236.00	—	23199.10
(433.22)	(393.79)	(358 07)		(15910.79)
1501.50	1501.50	1501.50	1501.50	31069.40
(526.28)	(478.38)	(434.98)	(395.34)	(21109.35)
1100.05	1100.05	1100 05	1100.05	21647.80
(385.57)	(350.48)	(318.68)	289.64)	(14860.78)
396.92	396.92	396.92	—	7557.33
(139.12)	(126.46)	(114.99)		(5216.81)
1305.60	1305.60	1305.60	—	26183,00
(457.61)	(415.96)	(378.23)		(18484.25)
1321.16	1321.16	1321.16	—	25305.90
(463.07)	(420.92)	(382.74)		(17515.42)

ANNEXURE

PROGRESSIVE TOTAL OF OPERATIONAL AND

Sl. No.	Name of the tube well	1966-67	1967-68	1968-69	1969-70	1970-71
1	2	3	4	5	6	7
1.	Basta	—	—	2442.28	8296.00	9622.00
2.	Kalidaspur	—	—	1771.80	3146.00	7250.00
3.	Kamargaria	—	—	—	52.00	10032.00
4.	Basudevpur	—	—	10363.62	8650.20	10035.76
5.	Garadih-II	—	—	1963.26	2353.29	2412.80
6.	Thalkudi	—	—	2800.56	2126.00	2550.00
7.	Bramhansahi	—	—	9968.00	8974.00	6334.90
8.	Narayanpur-II	—	—	756.00	2123.20	4091.20
9.	Hanspur-I	—	—	1580.82	2281.88	2119.62
10.	Hundata-I	—	—	2310.25	2743.13	2220.57
11.	Hunata-II	—	—	1621.99	2484.61	1967.92
12.	Jamuni-I	—	—	2500.65	2273.43	3855.10
13.	Sikri-IV	—	—	2127.90	2077.64	2468.63
14.	Sologarh-II	—	—	891.90	2380.37	2492.85
15.	Bathua-I	—	—	2027.00	2253.06	2413.41
16.	Budura-I	—	—	1957.00	1957.51	2268.78
17.	Kittingi	—	—	1729.00	1639.54	2077.86

IV

MAINTENANCE COST OF STATE TUBE WELLS

1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
8	9	10	11	12	13	14
6828.00	11843.85	20544.34	35636.21	61814.57	107223.55	185989.97
			(32396.88)	(51083.56)	(80557.08)	(127031.15)
8432.00	15973.58	30260.35	57325.21	108596.88	205725.93	389727.20
			(52114.35)	(89744.46)	(134561.89)	(266183.68)
7626.00	5797.20	4407.10	3350.28	2546.88	1936.14	1471.85
			(3045.74)	(2104.74)	(1454.62)	(1005.27)
6938.18	6212.45	5562.63	4980.78	4459.79	3993.30	3575.60
			(4528.03)	(3685.57)	(3000.17)	(2442.13)
2858.44	3247.76	3690.10	4192.69	4763.73	5412.55	—
			(3811.57)	(3936.75)	(4066.45)	
3616.01	4049.93	4535.92	5080.23	5639.86	6372.64	7137.36
			(4618.44)	(4702.10)	(4787.76)	(4874.82)
11332.06	12805.23	14469.91	16351.00	18476.63	20878.59	23592.81
			(14864.69)	(15269.09)	(15686.02)	(16113.89)
7457.12	9395.97	11838.92	14917.04	18795.47	23682.29	29839.69
			(13561.08)	(15532.58)	(17792.50)	(20380.51)
2904.47	3630.59	4638.24	5672.80	7091.00	8863.75	11079.69
			(5157.14)	(5860.00)	(6659.34)	(7567.43)
3778.41	4658.77	5744.26	7082.67	8732.93	10767.70	13276.57
			(6438.85)	(7216.89)	(8089.77)	(9067.89)
2463.64	2936.41	3499,91	4171.54	4972.06	5926.20	7063.44
			(3792.35)	(4108.91)	(4452.35)	(4824.33)
3272.92	3768.11	4338.23	4994.60	5750.28	6620.30	7621.95
			(4540.59)	(4732.03)	(4973.83)	(5205.79)
3082.60	3507.38	3990.70	4540.62	5166.32	5878.24	6688.26
			(4127.38)	(4269.45)	(4416.32)	(4568.08)
3435.72	4166.15	5051.87	6125.90	7428.27	9007.32	10922.52
			(5569.06)	(6138.72)	(6757.35)	(7460.08)
3607.13	4421.62	5420.02	6643.36	8144.04	9982.96	12237.11
			(6039.93)	(6730.23)	(7500.20)	(8357.95)
2834.33	3220.37	3658.98	4157.33	4723.56	5366.91	6097.33
			(3779.43)	(3903.55)	(4032.16)	(4164.85)
2517.33	2875.80	3285.31	3753.14	4287.59	4098.14	5595.64
			(3471.98)	(3543.26)	(3679.97)	(3821.82)

Bracketed figures indicate discounted (present) values.

Sl. No.	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84
1	15	16	17	18	19	20
1.	—	—	—	—	—	—
2.	—	—	—	—	—	—
3.	118.90 (694.73)	850.59 (480.16)	—	—	—	—
4.	3201.59 (1987.87)	—	—	—	—	—
5.	—	—	—	—	—	—
6.	—	—	—	—	—	—
7.	26659.88 (16553.12)	30125.66 (17005.94)	34042.00 (17470.35)	38467.46 (17945.07)	43468.23 (18434.88)	49119.10 (18935.41)
8.	37598.01 (23344.60)	47373.49 (26742.34)	59690.60 (30633.22)	75210.16 (35085.54)	94764.80 (40189.75)	119403.65 (46030.11)
9.	13849.61 (8599.22)	17312.01 (9772.63)	21640.01 (11105.65)	27050.01 (12618.83)	33812 51 (14339.89)	42265.64 (16293.40)
10.	16370.01 (10164.13)	20184.22 (11393.99)	24887.14 (12772.08)	30685.84 (14314.94)	37835.64 (16046.09)	46651.34 (17984.09)
11.	8418.91 (5227.30)	10034.50 (5664.48)	11960.12 (6137.93)	14255.27 (6650.08)	16990.86 (7205.82)	20251.41 (7806.92)
12.	8775.15 (5448.49)	10102.83 (5703.05)	11631.39 (5969.23)	13391.22 (6247.00)	15417.31 (6538.48)	17749.95 (6842.61)
13.	7609.90 (4724.99)	8658.54 (3194.25)	9851.69 (5055.89)	11209.25 (5229.12)	12753.88 (5408.92)	14511.36 (5594.13)
14.	13244.65 (8223.60)	16060.46 (9066.13)	19474.91 (9994.52)	23615.28 (11016.53)	28635.89 (12144.48)	34723.88 (13386.06)
15.	15000.25 (9313.66)	18387.31 (10379.64)	22539.16 (11567.10)	27628.50 (12888.70)	33867.02 (14363.00)	41514.19 (16003.72)
16.	6928.41 (4301.85)	7872.06 (4443.78)	8944.23 (4590.18)	10162.43 (4740.77)	11546.55 (4896.89)	13119.19 (5057.45)
17.	6392.46 (3969.08)	7302.75 (4182.40)	8342.66 (4281.45)	9530.65 (4446.05)	10887.81 (4617.52)	12433.23 (4794.94)

1984-85	1985-86	1986-87	1987-88	Total
21	22	23	24	25
—	—	—	—	450240.77
				(350645.11)
—	—	—	—	828208.95
				(629438.11)
—	—	—	—	39189.03
				(36699.65)
—	—	—	—	67973 90
				(63,406.61)
—	—	—	—	30894.62
				(28340.42)
—	—	—	—	43958.51
				(38661,54)
55504.58	62720.18	70873.80	80087.30	634251.41
(19454.36)	(19982.65)	(20532.14)	(21087.01)	(313218,78)
150448.60	189565.24	238852.20	300953.77	1436757.42
(52732.23)	(60395.49)	(69195.48)	(79241.13)	(566518.97)
52832.05	66040.06	82550.08	103187.60	510302.44
(18517.63)	(21040.36)	(23914.76)	(27169.30)	(205671.20)
57521.10	70923.51	87448.68	107824.22	561646.96
(20161.14)	(22596,23)	(25333.88)	(28390.13)	(231425.49)
24137.66	29769.68	34290.58	—	206216.71
(8460.25)	(9166.02)	(9933.02)		(98405.20)
20435.52	23527.41	27087.11	—	193113.46
(7162.65)	(7495.83)	(7847.14)		(98735.16)
16511.03	18786 25	21375.00	24320.48	185115.67
(5787.12)	(5985.30)	(6192.34)	(6403.58)	(88212.22)
42706.18	51057.95	61912.87	75075.56	417811.19
(14758.22)	(16267.06)	(17936.16)	(19767.39)	(176914.72)
50888.09	62378.62	76463.71	—	405817.06
(17836.28)	(19873.83)	(22151.54)		(183148.02)
14906.02	16936.22	19242.93	—	145900.79
(5224.56)	(5395.88)	(5574.68)		(76003.00)
14209.43	16232.85	18544;41	—	136540.60
(4980.41)	(5171.79)	(5372.32)		(70337.83)

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