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SADOVE

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Extract from:

COST OF CAPITAL IN THE CHOICE BETWEEN HYDRO AND THERMAL POWER

(IHRD EC-53 Dec. 14, 1956; by Robert Sadove)

INTRODUCTION

1. Hydro power installations are regarded in many quarters as one of the primary symbols of economic development. There are, of course, real economic advantages in hydro, the most general of which are distinctly lower operating costs including depreciation. Hydro power may also eliminate fuel imports and thus ease the pressure on the balance of payments. In some cases, there are extensive multipurpose benefits with hydro. In some special cases, there may be significant advantage in the use of hydro for peaking purposes or for stand-by reserve in an integrated electric system.

2. On the other hand, the advantages of thermal power are not negligible. The most important are the feasibility of expanding power output in relatively small stages, and in locations which minimize transmission requirements, greater ability to maintain reasonable average total unit costs if the level of demand falls below expectations, shorter construction period, and lower and more easily determined capital requirements. These factors are particularly favorable to a developing economy where power requirements frequently do not justify the immediate installation of large scale generating facilities, where load factors may be relatively low, where demand is difficult to forecast, and where capital is scarce.

I. STATEMENT OF THE ISSUE

3. The scarcity of capital is a particularly important factor in properly making the comparison of hydro and thermal projects because of the dominant role that the cost of capital usually plays in the cost of producing power, particularly in a hydro station. The cost of capital is the cost of obtaining money for investment purposes. This includes interest, and profits before income taxes. The cost of capital normally averages about 80 to 85% of the unit cost of power in a hydro station while in a steam plant only about 40% of the cost of generating power. The other factor of comparable importance in a thermal plant is fuel which is typically more than 40% of the total cost of power.

4. In considering whether a hydro plant is preferable from the economic point of view to an alternative thermal plant in most situations, the question to be answered is, in essence: Is it worth spending the additional capital needed to build a hydro plant in order to save the cost of fuel? The answer to this question depends to a large extent on how short capital is or how abundant other investment opportunities are in the country concerned.

5. The savings in fuel costs, or more precisely in operating costs, can be stated as a percentage of the difference in total investment between hydro and thermal with the resultant percentage considered as a return on the additional capital invested in hydro. The charges made for power, it should be noted, do not enter this calculation. In five of the Bank projects for which it was possible to make this calculation on the basis of readily available information the yields calculated in this manner range between 6.5% and 13.9%. To judge the adequacy of the return requires a general assessment of alternative investment opportunities which amounts to the same as determining the "real" return or "real" cost of capital, admittedly an elusive concept but, nonetheless, a relevant one. While it is not possible in most cases to determine the real cost of capital very precisely, it should not be impossible to establish in a given country which rates of return are low, which are adequate, and within what range reasonable doubt exists. As experience is accumulated in looking at this problem in these terms the basis for judgment can undoubtedly be strengthened. It is clear that this kind of computation leads to conclusions which cannot be reached by using the nominal cost of capital, however adequate nominal costs may be in judging profitability of alternative investments to the particular enterprise.

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III. APPLICATION OF PROPOSED METHOD

16. Taking into account the scarcity of capital that exists in many countries borrowing from the Bank, and the fact that the nominal cost of capital available to public utility enterprises does not necessarily reflect the real cost of capital to the economy, a need clearly exists for a method of comparing hydro and thermal power costs which does not rely exclusively on the nominal cost of capital to the enterprise. The method proposed here calls for an explicit judgment as to the adequacy of the return on the additional capital to be invested in hydro.

17. As a starting point for the appraisal of the adequacy of the yield on the additional investment, the following guide posts might be considered. In appraising a hydro power project, a return of below 6% on the additional investment in hydro should be considered inadequate in most cases. A return between 6% and 9% may be adequate in some cases; but this is still doubtful because in most countries higher returns seem feasible in certain alternative uses where the risks are not substantially different. In such cases, in order to justify the additional investment in hydro a serious consideration of the thermal alternative is necessary. Such consideration should include an examination of both the alternative investment opportunities for the funds released by the less capital intensive thermal power project as well as the preparation of more exact cost estimates for the thermal project itself. Where the return on the additional investment is found in the preliminary analysis to be 10% to 12% a less careful consideration of the thermal alternative is necessary and only a very cursory examination of the thermal alternative need be made when the yields are above 12%.

18. These guide posts to a judgment of the adequacy of the return on additional investment are admittedly arbitrary. The appraisal of alternative investment opportunities in terms which will yield a meaningful answer for the choice between hydro and thermal power in specific countries must be approached on a case to case basis. The proposed method is easiest to apply in the case where there are specific alternative projects in direct competition for the funds involved. The economic yield on the investment in these alternative projects can frequently be calculated and directly compared with the yield on the additional investment in hydro.

19. When the specific alternatives in competition for capital resources are not known in sufficient detail it is still possible to form a judgment of the adequacy of the yield on the additional capital invested in hydro even though such a judgment can hardly be precise. In many of these countries the Bank has a judgment on the burden which high priority public investment is imposing on available investment resources. These judgments, in each case, could be translated into a range of acceptable yields. In some of the countries the interest rates at which governments can borrow, plus an additional premium to cover the risks associated with specific projects, might be considered as indicative of alternative yields. This method is of limited usefulness, however, whenever the market for government bonds is very thin and is not at all applicable where the government is strictly rationing its limited investment funds.

20. Where the availability of capital to the public sector leaves a wide margin for exploiting investment opportunities it may be appropriate to evaluate the return on the additional investment in hydro in terms of the yields which can be earned in the private sector since the possibility of channeling additional investment resources into the private sector should in such a case normally be considered. Yields in the private sector would, however, have to be discounted for the higher risks that may be associated with such investment and in countries with a history of inflation such yields may also reflect upward price movements.

21. Appraising the adequacy of the yield on the additional capital invested in hydro in terms of the yield on alternative investments poses some real problems when the yields on specific alternatives are not known. Unfortunately, it is exactly when the application of the proposed method encounters the greatest difficulty that the nominal cost of capital to the public utility enterprise is likely to be least representative of the real cost of capital. Thus, an explicit judgment as to the adequacy of the return on the additional investment, while admittedly more arbitrary than the use of nominal costs of capital, should be a sounder guide to the choice between hydro and thermal power.

IV. ILLUSTRATIVE CALCULATIONS

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24. The implications of the proposed method can be illustrated by a series of hypothetical calculations applied to some representative cost situation as shown in Table No. 4. Assuming a fuel price of 50 cents per million BTU which is the typical cost to the economy of fuel used in power plants in most countries, (see Tables 5 and 6) a load factor of 70% and an investment of \$175 per kw of installed capacity in the thermal alternative:

- a) Hydro projects with capital investment requirements above \$650 per kw of installed capacity including transmission costs, are out of the question in most cases as they yield less than 6% on the additional investment.
- b) Hydro projects with capital requirements between \$475 and \$650 are doubtful investments as they yield between 6% and 9% on the additional capital.
- c) Hydro projects with investment requirements of \$425 to \$475 yield 10% to 12% and are thus less doubtful but require careful consideration of the thermal alternative.
- d) Hydro projects with capital requirements of less than \$425 yield more than 12% on the additional capital and are thus most likely sound investments and require only a cursory examination of the thermal alternative.

The effects of different assumptions regarding fuel costs are brought out in Table No. 14. The effects of different load factors are indicated in Table 13 which shows that relatively high load factors are advantageous to hydro, whereas the low load factors which are common in underdeveloped countries are advantageous to thermal power.

V. OTHER ECONOMIC FACTORS IN THE COMPARISON OF HYDRO AND THERMAL

25. The return on the additional capital invested in hydro has been formulated above in terms of the savings in production costs. This assumes that the amount of power to be produced is equivalent and that the hydro project does not produce any benefits other than power. In fact, even though the return to the additional capital invested in hydro is low does not mean that projects cannot be justified on the basis of additional benefits which accrue from multipurpose programs. Where non-power benefits are significant, it is important to determine the return based on the full benefits resulting from the hydro project.

26. The method of calculating the return on the additional capital is not substantially altered by the necessity of taking into consideration multipurpose benefits such as those which accrue from irrigation works. The calculation in this case would indicate the yield, or rather the sum of the savings in operating costs plus the net benefits from irrigation as a percent of the difference between the total investment in all phases of

the multipurpose project and the investment required for a thermal alternative.

27. In evaluating the savings in production costs secured by the hydro alternative, it is important to evaluate fuel costs at their cost to the economy of the country and not their cost to the particular enterprise if these two are different. In some cases there are special taxes, tariffs and monopoly prices on fuel, the effects of which must be eliminated. Furthermore, in some instances fuel costs expected to prevail in the long run may differ substantially from present prices. When this is the case some assumption must be attempted as to what the long run price is likely to be. If fuel is to be supplied from local sources, which incidentally yields a relatively high return on the additional capital before any adjustments are made, and if the capacity for fuel production and distribution would have to be substantially increased if a thermal alternative were adopted, it may be very important to appraise the real cost of future fuel supplies.

28. The importance of imported fuel to at least half of the thermal projects financed by the Bank, suggests that the foreign exchange savings due to hydro may be an important balance of payment consideration. This can be taken into account in computing the investment yield by placing an assumed premium on foreign exchange savings. Assuming all fuel to be imported, the result of a series of calculations for a particular set of examples based on the same assumptions as in Table 4, indicated that with an average price for fuel of about 50 cents per million BTU which is typical for imported fuel oil, hydro investment of \$375 per kw of installed capacity would yield the same return on the additional capital required, as an investment of \$410 if a 10% premium is assumed on foreign currency savings. Similarly, if a 30% premium is assumed hydro could cost \$425 and yield the same return and with a 60% premium, could cost \$450 (see Table 15). In other words, a proper evaluation of the foreign exchange savings which result from hydro may well alter an original determination that thermal was more economical than hydro. This is of some importance since many of the important hydro projects considered by the Bank involve capital costs above \$400 per kw.

29. This adjustment for foreign exchange savings does not, however, apply with equal force to all underdeveloped countries for the following reasons:

The above calculations were based on the assumption that the foreign currency share of hydro capital investment is 40% and of thermal 50%, which is similar to the Bank's average experience. If the assumptions are changed slightly to be more nearly representative of the situation in many underdeveloped areas where the foreign currency share of power investment is higher, that is, for example, 65% for hydro and 70% for thermal, then the effect of the foreign exchange premium is almost nil (see Table 16). This results from the fact that with a higher imported component in

investment, the net effect of the foreign exchange savings on fuel is substantially offset.* Even a 100% premium on foreign exchange savings would normally result in less than a one percentage point change in the return to the additional capital invested in hydro. In other words, a project with hydro costs of \$500 per kw that was doubtful, would still be doubtful no matter what premium is attached to the foreign exchange savings. The foreign exchange benefits of hydro may easily be exaggerated for many of the underdeveloped countries.**

30. All of the above illustrative calculations assume that power output is expanded at the same rate whether the choice be in favor of hydro or of thermal. This is not necessarily the most economically beneficial approach. The construction of thermal stations may be phased to more nearly coincide with the expected increase in power demand. If such is the case then not only is the investment more fully utilized at all times but a significant part of total investment is postponed to a time when the demands upon scarce capital resources may be less pressing in relation to their availability.

*This assumes that the foreign exchange premium to be applied is no greater during the operating stage of the project than in the investment stage.

**The recent Suez crisis has once more brought home the strategic or defense value of domestic sources of energy. This is often adduced as an argument in favor of hydro rather than thermal power based on imported fuel. Quite legitimate in many cases, this argument is not an economic but a political one and should be recognized as such.

Table 4

Levels of capital investment for hydro installations yielding various returns on the additional investment over that required for thermal alternatives. (in \$ per KW of installed capacity)*

Return on additional capital	Low price for fuel at 25 cents per million BTU	Medium price for fuel at 50 cents per million BTU	High price for fuel at 70 cents per million BTU
Below 6%	above \$450	above \$650	above \$850
6% to 9%	\$375 - \$450	\$475 - \$650	\$725 - \$850
10% to 12%	\$325 - \$375	\$425 - \$475	\$525 - \$675
Above 12%	below \$325	below \$425	below \$525

*Assumptions:

Both thermal and hydro stations have installed capacity of 100,000 KW and operate at 70% load factor (annual net generation 614.0 million KWH). Fuel consumption for the thermal plant is 10,000 BTU per KWH, with capital investment at \$175 per installed KW, and production expense excluding fuel and depreciation at 0.50 mills per KWH. Annual depreciation allowance based on a sinking fund method is 2.75% of total capital invested. The depreciation charge for the hydro station is 1.5% with production expenses excluding depreciation at 0.40 mills per KWH.

The above assumptions with respect to fuel consumption imply a thermal efficiency typical of new plants installed in the U.S. Such efficiency may involve operational pressures which are too high for some underdeveloped countries. On the other hand, such countries rarely achieve a 70% load factor. This means that on balance the assumptions adopted here generally are somewhat unfavorable to thermal.

Table 5

DELIVERED PRICE OF IMPORTED BOILER FUEL OIL, CIF PORT
OF IMPORTATION, FOR VARIOUS PORTS OF THE WORLD
AS OF AUGUST 1955.

<u>Port</u>	<u>Price per barrel in U.S. \$</u>	<u>Estimated cost per million BTU in U.S. cents*</u>
New York	2.50	42
Los Angeles	1.80	30
Vancouver	2.97	50
Punta Arenas	3.03	51
Rotterdam	2.79	47
Rijeka	2.93	49
Piraeus	2.87	48
Rastanura	1.64	27
Capetown	2.82	47
Bombay	2.39	40
Yokohama	3.08	52
Wellington	3.38	57

*Based on assumption 18,000 BTU per lb. and 6.04 barrels per short ton.

Source: National Planning Association Confidential Study.

Table 6

COST OF COAL 1* USED FOR POWER PRODUCTION IN VARIOUS
REPRESENTATIVE COUNTRIES DURING 1955

<u>Country</u>	<u>Cost in Cents Per Million BTU</u>
United Kingdom	40
Austria	65
France	57
West Germany	50
Italy	55
Turkey	80
India	25
Japan	90
Union of South Africa	15
Brazil	100
Australia	40
Denmark	45
Greece	30
Netherlands	50
Yugoslavia	30

* Cost delivered to steam plants.

Source: Economic Aspects of Electric Power Production in
Selected Countries, Harry I. Miller, F. Douglas
Campbell, July 1955.
(ICA) Appendix D.

Table 12

Illustration of the calculation of the return to the additional capital required for hydroelectric stations as compared to thermal power alternatives for various cost assumptions for hypothetical projects.*

	Project A	Project B	Project C
1. Installed capacity in KW	100,000	100,000	100,000
2. Net generation in million KWH	614.0	614.0	614.0
3. Plant load factor in % = (2) ÷ (1) x 8760 hrs	70	70	70
4. Cost of hydro plant in \$ per installed KW	500	500	250
5. Cost of thermal plant in \$ per installed KW	175	125	125
6. Capital investment in hydro plant in thousand \$	50,000	50,000	25,000
7. Capital investment in thermal plant in thous. \$	17,500	12,500	12,500
8. Additional capital required for hydro = (6) - (7)	32,500	37,500	12,500
9. Operation and Maintenance of thermal plant in mills per KWH	0.50	0.50	0.50
10. Fuel costs	4.50	3.50	3.50
11. Depreciation cost of thermal plant in mills per KWH	0.80	0.55	0.55
12. Unit production cost of thermal in mills per KWH = (9) + (10) + (11)	5.80	4.55	4.55
13. Annual production cost of thermal in thousand \$	3,550	2,795	2,795
14. Operation & Maintenance of hydro in mills per KWH	0.45	0.45	0.30
15. Depreciation cost of hydro in mills per KWH	1.22	1.22	0.60
16. Unit production cost of hydro in mills per KWH = (14) + (15)	1.67	1.67	0.90
17. Annual production cost of hydro in thousand \$	1,025	1,025	560
18. Annual savings in production costs with hydro = (13) - (17)	2,525	1,770	2,235
19. Annual return to additional capital required for hydro (18) as a per cent of (8)	7.8	4.7	17.9
* Fuel assumptions: Consumption in BTU per KWH	10,000	11,000	11,000
Cost in cents per million BTU	45.0	31.8	31.8
Ave. BTU per lb. of coal	12,500	12,500	12,500
Cost of coal per short ton in \$	11.25	7.95	7.95

Depreciation assumptions: 2.75% for thermal and 1.5%
for hydro on sinking fund basis.

TABLE 13

Illustration of the calculation of the return to the additional capital required for hydroelectric stations as compared to thermal power alternatives for various assumptions as to load factor for hypothetical projects.*

	Project D	Project E	Project F
1. Installed capacity in KW	100,000	100,000	100,000
2. Net generation in million KWH	614.0	438.0	263.0
3. Plant load factor in % = (2) ÷ (1) x 8760 hrs	70	50	30
4. Cost of hydro plant in \$ per installed KW	300	300	300
5. Cost of thermal plant in \$ per installed KW	150	150	150
6. Capital investment in hydro plant in thousand \$	30,000	30,000	30,000
7. Capital investment in thermal plant in thous. \$	15,000	15,000	15,000
8. Additional capital required for hydro = (6) - (7)	15,000	15,000	15,000
9. Operation & Maintenance of thermal plant in mills per KWH	0.50	0.55	0.60
10. Fuel costs	3.75	3.80	4.00
11. Depreciation cost of thermal plant in mills per KWH	0.70	0.95	1.55
12. Unit production cost of thermal in mills per KWH = (9) + (10) + (11)	4.95	5.30	6.15
13. Annual production cost of thermal in thousand \$	3,020	2,320	1,620
14. Operation & Maintenance of hydro in mills per KWH	0.34	0.45	0.80
15. Depreciation cost of hydro in mills per KWH	0.73	1.05	1.70
16. Unit production cost of hydro in mills per KWH = (14) + (15)	1.07	1.50	2.50
17. Annual production cost of hydro in thousand \$	665	657	655
18. Annual savings in production costs with hydro = (13) - (17)	2,355	1,663	965
19. Annual return to additional capital required for hydro (18) as a per cent of (8)	15.7	11.1	6.4
*Fuel assumptions: Consumption in BTU per KWH	10,500	10,650	11,250
Cost in cents per million BTU	35.7	35.7	35.7
Ave. BTU per lb of coal	12,500	12,500	12,500
Cost of coal per short ton in \$	8.95	8.95	8.95

Depreciation assumptions: 2.75% for thermal and 1.5% for hydro on sinking fund basis.

TABLE 14

LEVELS OF CAPITAL INVESTMENT FOR HYDRO INSTALLATIONS
YIELDING VARIOUS RETURNS ON THE ADDITIONAL INVESTMENT
OVER THAT REQUIRED FOR THERMAL ALTERNATIVES*

Investment in hydro in dollars per installed KW	Return based on fuel at 15¢ per million BTU	Return based on fuel at 25¢ per million BTU	Return based on fuel at 35¢ per million BTU	Return based on fuel at 50¢ per million BTU	Return based on fuel at 60¢ per million BTU	Return based on fuel at 70¢ per million BTU
800	0.4	2.2	2.4	3.9	4.9	7.4
700	0.8	2.9	3.1	4.9	6.1	9.2
600	1.3	3.9	4.2	6.4	7.9	11.7
500	2.2	4.1	6.0	8.8	10.7	12.6
400	3.8	8.7	9.3	13.4	16.2	23.6
300	8.1	16.9	17.9	25.3	30.3	42.4
200	41.6	90.0	95.6	132.5	157.5	222.5

*Basic Assumptions:

Both thermal and hydro stations have installed capacity of 100,000 KW and operate at 70% load factor (annual net generation 614.0 million KWH). Fuel consumption for the thermal plant is 10,000 BTU per KWH, with capital investment at \$175 per installed KW, and production expense excluding fuel and depreciation at 0.50 mills per KWH. Annual depreciation allowance based on a sinking fund method is 2.75% of total capital invested. The depreciation charge for the hydro station is 1.5% with production expenses excluding depreciation at 0.40 mills per KWH.

TABLE 15

LEVELS OF CAPITAL INVESTMENT FOR HYDRO INSTALLATIONS YIELDING VARIOUS RETURNS ON THE ADDITIONAL INVESTMENT OVER THAT REQUIRED FOR THERMAL ALTERNATIVES AFTER PREMIUMS FOR FOREIGN EXCHANGE SAVINGS. *

Capital cost of hydro in dollars per installed KW	Return based on no foreign currency premium	Return based on foreign currency premium of 10%	Return based on foreign currency premium of 30%	Return based on foreign currency premium of 60%	Return based on foreign currency premium of 100%
800	3.9	4.1	4.5	5.1	5.7
700	4.9	5.2	5.7	6.4	7.1
600	6.4	6.7	7.4	8.2	9.1
500	8.8	9.3	10.2	11.3	12.6
400	13.4	14.1	15.5	17.2	19.2
300	25.3	25.8	29.5	33.2	37.6
200	132.5	148.5	181.0	239.0	351.0

*Basic Assumptions:

Fuel cost assumed to be 50 cents per million BTU. The foreign currency share of hydro investment and depreciation is 40%; of thermal investment and depreciation 50%; of thermal production expenses 80%. Hydro production expenses excluding depreciation are assumed to be all local. Same foreign exchange premium applied to the investment stage as the operating stage. All other assumptions the same as in Table 14.

TABLE 16

LEVELS OF CAPITAL INVESTMENT FOR HYDRO INSTALLATIONS YIELDING
VARIOUS RETURNS ON THE ADDITIONAL INVESTMENT OVER THAT REQUIRED
FOR THERMAL ALTERNATIVES AFTER PREMIUMS FOR FOREIGN EXCHANGE
SAVINGS ADJUSTED TO INVESTMENT CONDITIONS TYPICAL IN THE MORE
UNDEVELOPED COUNTRIES.*

<u>Capital cost</u> <u>of hydro in</u> <u>dollars per</u> <u>installed KW</u>	<u>Return based</u> <u>on no foreign</u> <u>currency</u> <u>premium</u>	<u>Return based</u> <u>on foreign</u> <u>currency</u> <u>premium</u> <u>of 10%</u>	<u>Return based</u> <u>on foreign</u> <u>currency</u> <u>premium</u> <u>of 30%</u>	<u>Return based</u> <u>on foreign</u> <u>currency</u> <u>premium</u> <u>of 60%</u>	<u>Return based</u> <u>on foreign</u> <u>currency</u> <u>premium</u> <u>of 100%</u>
800	3.9	4.0	4.2	4.4	4.6
700	4.9	5.0	5.2	5.5	5.7
600	6.4	6.5	6.8	7.1	7.5
500	8.8	9.0	9.4	9.8	10.3
400	13.4	13.7	14.3	15.0	15.6
300	25.3	26.1	26.9	28.2	29.5
200	132.5	140.0	153.5	167.0	189.0

*Basic assumptions:

Fuel cost assumed to be 50 cents per million BTU. The foreign currency share of hydro investment and depreciation is 65%; of thermal investment and depreciation 70%; of thermal production expenses 80%. Hydro production expenses excluding depreciation are assumed to be all local. Same foreign exchange premiums applied to the investment stage as the operating stage. All other assumptions the same as in Table 14.

TABLE 17

LEVELS OF FUEL COSTS TO THERMAL PLANTS ADJUSTED FOR PREMIUMS
ON FOREIGN EXCHANGE SAVINGS YIELDING VARIOUS RETURNS ON THE
ADDITIONAL INVESTMENT IN HYDRO INSTALLATIONS OVER THAT REQUIRED
FOR THERMAL ALTERNATIVES. *

<u>Fuel costs in</u> <u>cents per</u> <u>million BTU</u>	<u>Return based</u> <u>on no foreign</u> <u>currency</u> <u>premium</u>	<u>Return based</u> <u>on 10% foreign</u> <u>currency</u> <u>premium</u>	<u>Return based</u> <u>on 30% foreign</u> <u>currency</u> <u>premium</u>	<u>Return based</u> <u>on 60% foreign</u> <u>currency</u> <u>premium</u>
15	2.2	2.4	2.7	3.1
25	4.1	4.5	4.9	5.6
35	6.0	6.6	7.2	8.1
50	8.8	9.6	10.5	11.8
60	10.7	11.7	12.8	14.3
70	12.6	13.8	15.0	16.7

* Basic assumptions:

The Hydro station has capital investment of \$500 per installed KW. The foreign currency share of hydro investment and depreciation is 15%; of thermal investment and depreciation 60%; and of thermal production expenses 80%. Hydro production expenses excluding depreciation are assumed to be all local. Same foreign exchange premiums applied to the investment stage as the operating stage. All other assumptions the same as in Table 14.

NYC

*Submitted for clearance 6/25/65 by Mr. Willoughby
Mr. Lind approved; sponsors of conf. wanted final version by July 1*

Speech of Robert Sadove at the Thirteenth Annual Joint Engineering Societies'
Management Conference, September 13, 1965

THE CHANGING ENGINEERING NEEDS OF UNDER-
DEVELOPED COUNTRIES

As Economic Adviser to the Projects Department of the World Bank, I had great pleasure in accepting Mr. Marble's invitation to participate in your conference. The World Bank, as you know, was founded at Bretton Woods, New Hampshire, in July 1944. Since May 9, 1947, when it concluded its first loan, the Bank and its affiliates have lent about \$10 billion in nearly 90 of its 102 member countries; new loans are being made at a rate of more than \$1 billion a year. Since the early years of the Bank's life loans have been made for well defined projects and programs rather than for general budgetary support. Engineering expertise has been crucial in the preparation of these projects and programs, whether they have been in the field of power and transport, as most of our early loans to less developed countries were, or in fields such as agriculture, industry, urban water supply and education, which are becoming increasingly important in our operations. Yet the majority of our 102 member countries are seriously lacking in the technical expertise which they need to prepare and execute development projects and which you can provide.

I shall have something to say later about principles on which economists and engineers sometimes disagree, so it may be wise to start from a principle that unites us: The comparative advantage of the developed countries will, I believe, increasingly come to lie in the provision of technical know-how. To a growing extent our exports are likely to be goods and services with a high content of technical skills. As a consequence engineers will be involved more and more in world-wide economic development. This involvement,

both direct and indirect, may well emerge as the most significant part of our future engineering activity. International opportunities will become an increasingly large part of the total market for engineering talent. It is my belief that if these opportunities are to be met successfully engineers must give increasing attention to economics. So I hope that you will forgive me this morning if I apply the principle of comparative advantage and talk to you primarily about economics.

Let me first describe something of our own involvement in the World Bank with engineers. We have on our own staff a relatively few specialist engineers, some 55, covering the fields in which we work. They analyze and appraise the detailed feasibility studies which we require before considering a project seriously for financing. They examine prospective projects in the field; they help in the formulation of terms of reference for any jobs that may need to be done by consultants; and they visit Bank-financed projects during and after construction to observe progress and iron out difficulties. The small size of our engineering staff prevents us from undertaking major technical studies on our own; we rely to a considerable extent upon the services of consulting firms. Study of a project feasibility report often shows that certain further engineering investigations are needed before we can commit the Bank to financing the project. Under these circumstances we do not suggest to our potential borrower the names of engineering firms who could do the work but we do reserve the right to approve the borrower's choice of consultant.

However, our technical assistance work involves us more directly with engineering firms. Besides lending for projects, the Bank also carries on a small technical assistance program of its own -- currently running at about \$5 million a year -- and also acts as Executing Agent for certain programs of the U.N. Special Fund -- whose Managing Director I am delighted to see on this same panel. Expenditures under these technical assistance programs are usually for feasibility studies designed to assess the potentialities of resources within a defined area or sector of an economy or to identify and formulate projects. *When the Bank feels the bill it also* ~~In a number of instances the Bank itself selects consultants for such studies.~~

To assist in judging the ability of consultants to carry out proposed tasks the Bank maintains a comprehensive file of the names and experience records of all firms desiring to be included -- about 1,800 of them at present. Inclusion of a firm's name in this file does not imply approval or prequalification by the Bank in any sense. Our classifications do not reflect any evaluation of capabilities. Sometimes we hear of firms representing themselves as having been given a Bank classification of "A-1". The letter "A" in fact only indicates that the firm is independent, that it has no connection with an industrial organization and is not subsidized by its government. The numeral "1" means that it has had some experience on projects outside its own country. If it has not had such experience it is assigned the number "2", or "3", depending upon its size. The Bank takes a wholly impartial view in the selection and approval of consultants. It wants only to be assured that any assigned task will be performed with full professional competence.

Having outlined some of the places where the paths of the Bank and of engineering firms meet, I would like to go on to discuss with you some characteristics of the demand for engineering talent in that two-thirds of the world which we lump together in the category "less developed". Most of what I have to say derives specifically from our experience of large-scale projects in the public sector, but I think that it is relevant to other types of engineering work in the underdeveloped world.

I need not remind you that most of the countries with which we are concerned here have income-levels below and often well below one-tenth those of the United States. Some \$3,000 family income has recently become widely accepted as the poverty line in the United States; here we are often discussing countries with a national average family income of only some \$300 -- and families considerably larger than those in the United States. An increasing proportion of our World Bank work has been in the poorest of these countries, in Asia and Africa, and I would suggest that such countries may loom increasingly large in the total international market for engineering know-how. To work effectively in a context of such extreme poverty is, as you well know, often far from easy. Difficult climatic conditions and poor accommodations can seriously impair the effectiveness of a firm that is not well-prepared. The dearth of statistical and factual information -- especially accurate information -- can cause enormous wastes of time and money unless a carefully planned survey of all available data is first carried through and ingenuity is applied in making inferences from the best available data. Resistance to change and innovation will be a serious problem for firms that desire to do more than merely hand over a "turnkey" plant for local managers to make of it what they can; training programs for

local operators and maintenance men will have to be carried on simultaneously with construction, an incentive wage scheme appropriate to local conditions will have to be designed, and food may have to be distributed to employees if costly sicknesses are to be avoided. It may be worth employing someone who is knowledgeable in fields such as anthropology and sociology provided that he is at the same time ingenious at thinking of ways of getting around obstacles posed by local tradition. At all events a firm must have staff that is knowledgeable about the area. It will probably still need to work jointly with local partners if it is to avoid costly mistakes resulting from ignorance of local language, laws, customs and traditions.

Work in underdeveloped countries clearly needs a wealth of talent. But the context of poverty there also underlines the need to economize in the use of it. If it is correct that one of the oldest of engineers' adages is Wellington's remark that "an engineer can do for one dollar a job that any bungler can do for two" then I feel that a discussion of economizing needs no apology. I want to suggest to you today, and this is the most important point I have to make, that the concept of economizing involves more than trying to meet a given need at least cost. To put a problem into a manageable form engineers usually state as their objective a requirement that is as specific as possible -- for instance, the construction of an urban water supply system that is technically efficient and meets given technical standards of purity.

Once the requirement has been precisely defined, the problem boils down to finding the least-cost way of meeting it. Alternative paths that will achieve similar results are carefully compared; each path is costed in detail

and then the cost streams implied by each set alongside one another to show which is the cheapest, given some discount rate. Straightforward as this type of job may appear, it is not always performed well. Sometimes we have found techniques recommended that are inappropriate to countries which have abundant cheap labor but little capital available -- as most underdeveloped countries have. For instance the design of a water supply system for a large Far Eastern city included the use of an advanced electronic control system for checking water levels. We found that the job performed by the control system could be done perfectly adequately by a man with a pencil and paper and a bicycle to carry him from one check point to another. This was clearly a case where the engineers had allowed their desire for technical perfection to run away with them and in fact recommended a solution to the water supply problem that was not the cheapest. There are, of course, cases where the most modern technique is so much more efficient than old practices that the solution to any given problem will be the same in advanced countries and underdeveloped countries alike. Also, the skilled workers required by a plant may be even more expensive in the underdeveloped country, which is desperately short of them, than they are in the advanced country where the general wage level is higher. Occasionally, advanced capital-intensive methods of production may be preferable to more labor-intensive ones even in an underdeveloped country, not because labor is expensive, but because use of the most modern production method minimizes the need for lengthy training of skilled craftsmen.

The problem of selecting an optimum technique for reaching a given objective is relatively clear and straightforward. Provided that engineers bear in mind the possibility of saving money by varying techniques of production according to local conditions, they will be able to solve this problem --

often quite precisely by calculating comparative costs and at least sufficiently accurately by exercising their judgment.

The question I want to raise before you today is a more difficult one: Are the objectives which you choose and the standards which you apply to define these objectives appropriate to the country in which you are working?

Let me illustrate this point by picking a very general objective that all of us encounter in discussion about a nation's economic growth. Perhaps the most generally agreed purpose of all public efforts at economic development is to raise income per head of population as rapidly as possible. Most countries devote large efforts to raising their national incomes and many countries are now trying hard to reduce the growth rates of their population; this is the familiar context in which we all work. But for specific cases the objective may be too general. In the first place other objectives such as maximizing employment, increasing the availability of certain consumer goods or improving the balance of payments position may be equally important, at least temporarily. Further, if we are to make income maximization more definite and usable we must specify the time, space and other dimensions of this objective. Is it desired to raise incomes per capita to the highest possible level this year, next year or ten years from now? What is the attitude toward the equitable distribution of income between and within different groups of people? Is it desired to raise incomes most rapidly in region A of a country, region B or throughout a country? To highlight the issues by exaggeration: Do we say "Ignore future generations and the countryside, let's concentrate on maximizing incomes next year in the urban centers that provide politicians most of their electoral support" or do

we say "Ignore this generation, the immediate future and the big cities, let's concentrate everything upon attainment of a target income level ten years hence for all regions of the country"? Clearly, patterns of public expenditure and investment appropriate to each objective differ radically from one another. If time and space perspective are very short, for instance, as in the first case, we would not be interested in any expenditures that only yielded a return in later years and we would choose a very high discount rate in our analysis. We would probably not even be interested in hiring the services of engineering consultants for planning longer term investment programs.

There's another point, too, that we economists find especially troublesome but intriguing, that is, the high degree of interdependence among many of the projects in an investment program. Consider the problem of time, for instance: The level of incomes in one year, its increase over the level attained in previous years and the distribution of that income will have a sizable effect upon the level of income that may be attained ten years hence because it will affect the level of saving and the pattern of demand. To take an extreme for illustrative purposes, concentration of increases in incomes among higher income groups may mean that most of the added income is spent abroad on imported goods, like cars, that cannot be produced economically at home. But income levels are also interdependent over space. A few years ago much stress was given to the concept of the so-called "demonstration effect": The aspirations of people in underdeveloped countries were rapidly out-pacing their productive abilities as they became more and more aware of the high standards of living obtaining in other parts of the world. It was also pointed out that people in underdeveloped countries were also becoming more and more aware

of the productive abilities of people living in other parts of the world so that aspirations in underdeveloped areas would not necessarily out-pace capacities to produce. Whatever the merits of that discussion it is clear that contact has a great effect upon people. High incomes in one region will tend to pull up incomes in the neighboring region that produces things demanded in the high income center. A region will often desire to imitate its neighbors, whether by its own efforts or with help from outside.

All this may seem a far cry from the problems encountered by engineers in underdeveloped countries. But I think that these notions are relevant to the engineer's work in preparing both individual projects and investment programs for different sectors of the economy.

Can the engineer any more than the economist count on his "fixed" requirements really being fixed? We already noted that there were many alternative versions to the economist's most general target of raising per capita incomes to the maximum extent possible. Take any more specific target and I would contend that there will be even more alternatives to it. The difficulty often arises on the project level because the alternatives may not appear clearly from the point of view of the entity carrying out the project. The costs and benefits of a project are not always calculated in such a way as to be comparable with the costs and benefits attributable to other alternative uses of funds available for investment. In the case of public projects the costs and benefits relevant to the decision whether or not to go ahead must be stated in such a form that they clearly indicate the benefit which the project will yield to society as well as to the individual or organization. The prices used in the analysis,

especially for important inputs like labor and capital, should be such as to indicate the cost and benefit of the project to society -- what the economist calls "real" prices. Wages and interest rates may need some adjustment in these calculations.

The resultant calculation indicates the economic return on a particular project and it can be compared with the general economic rate of return that one would normally expect in the country in question -- in whatever sector the investment might be made. But often there is an additional need to delve more deeply into specific alternative projects and programs within the sector under study. In some cases such alternatives are appraised and evaluated in detail, but in other cases they have been treated superficially. Consideration of too many alternatives is, of course, a waste of time and money. The line has to be drawn somewhere. But now it is sometimes drawn beneath one single course of action that the engineers have selected as "best". I am asking that you consider -- and present in your reports -- at least the main alternatives in each case, explaining the different implications of each, for example in terms of capital required, employment needed, space, time, etc. This is essential if the decision makers are to be given a real opportunity to choose.

Let me explain my agnosticism about the methods widely used today. Take the question of alternative technical standards used by engineers in designing projects. In numerous instances they are applied with little change from one country to another. Yet the costs of attaining these standards differ considerably from one place to another. Certain extra capital costs are incurred to achieve these standards rather than other lower ones, but maintenance

costs on the one hand or the value of capital on the other varies considerably among countries. There are many reasons why both costs and standards vary. Furthermore, the benefits to be derived in the form of reduced risks or lower operating costs will also vary greatly. Cost-benefit ratios are misleading unless they explicitly treat these points. It is poor economics to accept as unavoidable a specific requirement of a system without the opportunity for choice of a lower or higher standard appropriate to local cost conditions and time horizons.

It is my view that the possible choices are often much wider than generally believed. The field of transport investment offers numerous illustrations. I would suggest that whenever an investment in transport is proposed the first need is to see whether the need for the investment could not be altogether avoided by undertaking some other less costly course of development. Could existing facilities be used more intensively by stimulating off-peak demand? Is physical displacement essential or would the transport problem be solved adequately by fostering another course of development or by less costly improvements in the system? Should attention be turned from the idea of opening up a new area with new transport facilities to that of intensifying the use of existing land and transport facilities? Could the transport requirements be reduced by establishing processing facilities at the site of raw material production? Would some reorganization of industrial land-use reduce the need for transfer of goods? All these questions and many other similar ones merit careful investigation in order to determine the real need for investment in new transport facilities. Only then can the analysis proceed to assessment of specific alternative transport projects.

Having emphasized the need to consider a wide range of alternative investment-patterns I want to go on to discuss the interdependence of investments: the way in which the choice of one particular investment-pattern today implies the choice of other investments at a later date. I mentioned the notion of interdependence briefly before in connection with general investment programming; it is also very relevant to the evaluation of individual projects. Especially in a country at an early stage of economic development forecasting project requirements is almost impossible if carried out in isolation from some view of the over-all growth of the economy. Failure to make proper predictions of demand -- for power, for instance, or irrigation water, or transport facilities -- and of the way in which demand would build up over the years in different areas can result in costly mistakes. What I want to stress here is that once a specific solution has been adopted to satisfy some apparent requirement, it will have a significant impact on the way in which the pattern of demand subsequently develops. Once a road has been built, for instance, it may tend to draw traffic towards itself; its very existence may encourage people to make some journeys that would otherwise have seemed too bothersome. On occasions roads have been built without sufficient consideration of the traffic that they were likely to attract or their effect on existing roads. In some cases, roads have soon proven too small or approach roads have become too congested; costly additions have had to be made. In some cases, a whole series of such costly additions have become necessary. Had the long-run traffic build-up been correctly forecast another form of transport, perhaps a railway, might in some instances have appeared preferable from the economic point of view. This type of case illustrates the need to form a conception of how traffic is likely to develop in a region over a very long period of time. It may be necessary also to

consider a transport project in stages. There have been cases where a long road has been built at one time even though it would have been better to stage the development over a number of years in line with the gradual build up of traffic.

The point I am trying to make is that many projects -- and especially public works projects -- can often only be adequately assessed as parts of a long-term regional program. You can just go along doing many individual projects, each serving their own purpose, as and when they become obvious. Power is needed and the river is there, so build a dam and install a power house. Later when other needs appear, raise the dam for greater storage or provide adjuncts to it. As has often been indicated by my closest colleagues in the World Bank who specialize in large river basin projects, the sum of the results from this type of procedure is usually a good deal less valuable than those obtainable by careful comprehensive programming, with full consideration from the start of the alternative directions possible.

By way of conclusion I would say that if engineers are to meet the demands that the underdeveloped countries will be putting upon them they must give increased attention to the making of balanced long-run assessments of alternative courses of action. Economic considerations are not at present receiving adequate attention from the engineers. Men schooled in the engineering disciplines often take too restricted a view of the possibilities for economic choice. Economists, who are trained to keep in mind the wide scope for choice -- among ends as well as means -- that nature provides us, are too little schooled in the technical aspects of evaluating projects. Yet the addition of a few economists

or a senior economic adviser to an engineering team is not an entirely adequate solution to the problem; any economist who has had contact with project work is acutely aware of the difficulties of communication between engineers and economists, yet what is needed is continuous and close communication throughout the successive stages of preparation of a project. It seems to be mandatory that in the long-run the combination of the two disciplines of economics and engineering be achieved in the training and experience of one and the same individual. In preparing and evaluating projects in the less developed countries, the advantages of specialization appear to be outweighed by the disadvantages resulting from incomplete understanding between economist and engineer. Or perhaps what is really required is precisely a new type of specialist, a man who is neither economist nor engineer but both: briefly grounded in general economics and then following a thorough training in engineering with the usual degree of specialization and, in addition, a series of courses in project economics. Add to this training operational experience and a knowledge of the problems of the less developed world and you get a project engineer with a profound sense of the need ever to be on the horns of a dilemma -- forever raising doubts and asking awkward questions.

THE CHANGING ENGINEERING NEEDS OF UNDERDEVELOPED COUNTRIES

(Abstract: In considering projects in underdeveloped countries it is increasingly important to recognize not only the wide range of choice available -- among means and ends -- but also the way in which a choice today affects the range of alternatives open tomorrow.)

As Economic Adviser to the Projects Department of the World Bank, I had great pleasure in accepting Mr. Marble's invitation to participate in your Conference. The World Bank, as you know, was founded at Bretton Woods, New Hampshire, in July 1944. Since May 9, 1947, when it concluded its first loan, the Bank and its affiliates have lent about \$10 billion in nearly 90 of its 102 member countries; new loans and credits are being made at the rate of about \$1.4 billion a year. Since the early years of the Bank's life loans have been made for well defined projects and programs rather than for general budgetary support. Engineering expertise has been crucial in the preparation of these projects and programs, whether they have been in the field of power and transport, as most of our early loans to less developed countries were, or in fields such as agriculture, industry, urban water supply and education, which are becoming increasingly important in our operations. Yet the majority of our 102 member countries are seriously lacking in the technical expertise which they need to prepare and execute development projects and which you can provide.

I shall have something to say later about principles on which economists and engineers sometimes disagree, so it may be wise to start from a principle that unites us: The comparative advantage of the developed countries will, I

believe, increasingly come to lie in the provision of technical knowhow. To a growing extent our exports are likely to be goods and services with a high content of technical skills. As a consequence engineers will be involved more and more in world-wide economic development. This involvement, both direct and indirect, may well emerge as the most significant part of our future engineering activity. International opportunities will become an increasingly large part of the total market for engineering talent. It is my belief that if these opportunities are to be met successfully engineers must give increasing attention to economics. So I hope that you will forgive me this morning if I apply the principle of comparative advantage and talk to you primarily about economics.

Let me first describe something of our own involvement in the World Bank with engineers. We have on our own staff about 55 specialist engineers covering the fields in which we work. The primary responsibility of our engineers is to appraise the projects for which loans are requested. Besides the technical side they also consider financial, managerial, organizational and economic aspects. They work closely with our economists and financial analysts in reaching judgments on the projects, the amounts of the loans, the grace periods, and the contractual arrangements to ensure successful construction and operation of the projects recommended. After loans are made our engineers visit the projects during construction to inspect progress, to determine if the various conditions set forth in the Loan Agreements are being observed and, in general, to find out what problems, if any, exist. If major problems are found they recommend a course of action for the Bank to take and on lesser problems they assist in ironing out the difficulties. In addition to this project work our engineers also follow development in their various fields of interest and assist other departments of the Bank in various ways

such as participating in general survey missions to member countries. Our engineering staff does not undertake any engineering work for our borrowers. This is almost always done by consultants retained by our borrowers; we merely reserve the right to approve the borrower's choice of consultant.

However, our technical assistance work involves us more directly with engineering firms. Besides lending for projects, the Bank also carries on a small but growing technical assistance program of its own -- currently running at about \$5 million a year -- and also acts as Executing Agent for certain programs of the U.N. Special Fund -- whose Managing Director I am delighted to see on this same panel. Expenditures under these technical assistance programs are usually for feasibility studies designed to assess the potentialities of resources within a defined area or sector of an economy or to identify and formulate projects. When the Bank is meeting the costs of such studies it selects the consultants itself.

To assist it in judging the ability of consultants to carry out proposed tasks the Bank maintains a comprehensive file of the names and experience records of all firms desiring to be included -- about 1,800 of them at present. Inclusion of a firm's name in this file does not imply approval or prequalification by the Bank in any sense. Our classifications do not reflect any evaluation of capabilities. Sometimes we hear of firms representing themselves as having been given a Bank classification of "A-1". The letter "A" in fact only indicates that the firm is independent, that it has no connection with an industrial organization and is not subsidized by its government. The numeral "1" means that it has had some experience on projects outside its own country. If

it has not had such experience it is assigned the number "2", or "3", depending upon its size. The Bank takes a wholly impartial view in the selection and approval of consultants. It wants only to be assured that any assigned task will be performed with full professional competence.

Having outlined some of the places where the paths of the Bank and of engineering firms meet, I would like to go on to discuss with you some characteristics of the demand for engineering talent in that two-thirds of the world which we lump together in the category "less developed". Most of what I have to say derives specifically from our experience of large-scale projects in the public sector, but I think that it is relevant to other types of engineering work in the underdeveloped world.

I need not remind you that most of the countries with which we are concerned here have income-levels below and often well below one-tenth those of the United States. Some \$3,000 family income has recently become widely accepted as the poverty line in the United States; here we are often discussing countries with a national average family income of only some \$300 -- and families considerably larger than those in the United States. An increasing proportion of our World Bank work has been in the poorest of these countries, in Asia and Africa, and I would suggest that such countries may loom increasingly large in the total international market for engineering know-how. To work effectively in a context of such extreme poverty is, as you well know, often far from easy. Difficult climatic conditions and poor accommodations can seriously impair the effectiveness of a firm that is not well-prepared. The dearth of statistical and factual

information -- especially accurate information -- can cause enormous wastes of time and money unless a carefully planned survey of all available data is first carried through and ingenuity is applied in making inferences from the best available data. Resistance to change and innovation will be a serious problem for firms that desire to do more than merely hand over a "turnkey" plant for local managers to make of it what they can; training programs for local operators and maintenance men will have to be carried on simultaneously with construction, an incentive wage scheme appropriate to local conditions will have to be designed, and food may have to be distributed to employees if costly sicknesses are to be avoided. It may be worth employing someone who is knowledgeable in fields such as anthropology and sociology provided that he is at the same time ingenious at thinking of ways of getting around obstacles posed by local tradition. At all events a firm must have staff that is knowledgeable about the area. It will probably still need to work jointly with local partners if it is to avoid costly mistakes resulting from ignorance of local language, laws, customs and traditions.

Work in underdeveloped countries clearly needs a wealth of talent. But the context of poverty there also underlines the need to economize in the use of it. If it is correct that one of the oldest of engineers' adages is Wellington's remark that "an engineer can do for one dollar a job that any bungler can do for two" then I feel that a discussion of economizing needs no apology. I want to suggest to you today, and this is the most important point I have to make, that the concept of economizing involves more than trying to meet a given need at least cost. To put a problem into a manageable form engineers usually state as their objective a requirement that is as specific as possible -- for instance, the construction of an urban water supply system that is technically efficient and meets given technical standards of purity.

Once the requirement has been precisely defined, the problem boils down to finding the least-cost way of meeting it. Alternative paths that will achieve similar results are carefully compared; each path is costed in detail and then the cost streams implied by each set alongside one another to show which is the cheapest, given some discount rate. Straightforward as this type of job may appear, it is not always performed well. Sometimes we have found techniques recommended that are inappropriate to countries which have abundant cheap labor but little capital available -- as most underdeveloped countries have. For instance, the design of a water supply system for a large Far Eastern city included the use of an advanced electronic control system for checking water levels. We found that the job performed by the control system could be done perfectly adequately by a man with a pencil and paper and a bicycle to carry him from one check point to another. This was clearly a case where the engineers had allowed their desire for technical perfection to run away with them and in fact recommended a solution to the water supply problem that was not the cheapest. There are, of course, cases where the most modern technique is so much more efficient than old practices that the solution to any given problem will be the same in advanced countries and underdeveloped countries alike. Also, the skilled workers required by a plant may be even more expensive in the underdeveloped country, which is desperately short of them, than they are in the advanced country where the general wage level is higher. Occasionally, advanced capital-intensive methods of production may be preferable to more labor-intensive ones even in an underdeveloped country, not because labor is expensive, but because use of the most modern production method minimizes the need for lengthy training of skilled craftsmen.

The problem of selecting an optimum technique for reaching a given objective is relatively clear and straightforward. Provided that engineers bear in mind the possibility of saving money by varying techniques of production according to local conditions, they will be able to solve this problem -- often quite precisely by calculating comparative costs and at least sufficiently accurately by exercising their judgment.

The question I want to raise before you today is a more difficult one: Are the objectives which you choose and the standards which you apply to define these objectives appropriate to the country in which you are working?

Let me illustrate this point by picking a very general objective that all of us encounter in discussion about a nation's economic growth. Perhaps the most generally agreed purpose of all public efforts at economic development is to raise income per head of population as rapidly as possible. Most countries devote large efforts to raising their national incomes and many countries are now trying hard to reduce the growth rates of their population; this is the familiar context in which we all work. But for specific cases the objective may be too general. In the first place other objectives such as maximizing employment, increasing the availability of certain consumer goods or improving the balance of payments position may be equally important, at least temporarily. Further, if we are to make income maximization more definite and usable we must specify the time, space and other dimensions of this objective. Is it desired to raise incomes per capita to the highest possible level this year, next year or ten years from now? What is the attitude toward the equitable distribution of income between and within different groups of people? Is it desired to raise incomes most rapidly in region A of

a country, region B or throughout a country? To highlight the issues by exaggeration: Do we say "Ignore future generations and the countryside, let's concentrate on maximizing incomes next year in the urban centers that provide politicians most of their electoral support" or do we say "Ignore this generation, the immediate future and the big cities, let's concentrate everything upon attainment of a target income level ten years hence for all regions of the country?" Clearly, patterns of public expenditure and investment appropriate to each objective differ radically from one another. If time and space perspective are very short, for instance, as in the first case, we would not be interested in any expenditures that only yielded a return in later years and we would choose a very high discount rate in our analysis. We would probably not even be interested in hiring the services of engineering consultants for planning longer term investment programs.

There's another point, too, that we economists find especially troublesome but intriguing, that is, the high degree of interdependence among investment programs at different times and in different places. Consider the problem of time, for instance: The level of income in one year, its increase over the level attained in previous years and the distribution of that income will have a sizable effect upon the level of income that may be attained ten years hence because it will affect the level of saving and the pattern of demand. To take an extreme for illustrative purposes, concentration of increases in incomes among higher income groups may mean that most of the added income is spent abroad on imported goods, like cars, that cannot be produced economically at home. But income levels are also interdependent over space. A few years ago much stress was given to the

concept of the so-called "demonstration effect": The aspirations of people in underdeveloped countries were rapidly out-pacing their productive abilities as they became more and more aware of the high standards of living obtaining in other parts of the world. It was also pointed out that people in underdeveloped countries were also becoming more and more aware of the productive abilities of people living in other parts of the world so that aspirations in underdeveloped areas would not necessarily out-pace capacities to produce. Whatever the merits of that discussion it is clear that contact has a great effect upon people. High incomes in one region will tend to pull up incomes in the neighboring region that produces things demanded in the high income center. A region will often desire to imitate its neighbors, whether by its own efforts or with help from outside.

All this may seem a far cry from the problems encountered by engineers in underdeveloped countries. But I think that these notions are relevant to the engineer's work in preparing both individual projects and investment programs for different sectors of the economy.

Can the engineer any more than the economist count on his "fixed" requirements really being fixed? We already noted that there were many alternative versions to the economist's most general target of raising per capita incomes to the maximum extent possible. Take any more specific target and I would contend that there will be even more alternatives to it. The difficulty often arises on the project level because the alternatives may not appear clearly from the point of view of the entity carrying out the project. The costs and benefits of a project are not always calculated in such a way as to be comparable with the costs and benefits attributable to other alternative uses of funds available for investment. In the case of public projects the costs and benefits relevant to the

decision whether or not to go ahead must be stated in such a form that they clearly indicate the benefit which the project will yield to society as well as to the individual or organization. The prices used in the analysis, especially for important inputs like labor and capital, should be such as to indicate the cost and benefit of the project to society -- what the economist calls "real" prices. Wages and interest rates may need some adjustment in these calculations.

The resultant calculation indicates the economic return on a particular project and it can be compared with the general economic rate of return that one would normally expect in the country in question -- in whatever sector the investment might be made. But often there is an additional need to delve more deeply into specific alternative projects and programs within the sector under study. In some cases such alternatives are appraised and evaluated in detail, but in other cases they have been treated superficially. Consideration of too many alternatives is, of course, a waste of time and money. The line has to be drawn somewhere. But now it is sometimes drawn beneath one single course of action that the engineers have selected as "best". I am asking that you consider -- and present in your reports -- at least the main alternatives in each case, explaining the different implications of each, for example in terms of capital required, employment needed, space, time, etc. This is essential if the decision makers are to be given a real opportunity to choose.

Let me explain my agnosticism about the methods widely used today. Take the technical standards used by engineers in designing projects. In numerous instances they are applied with little change from one country to another. Yet the costs of attaining these standards differ considerably from

one place to another. Certain extra capital costs are incurred to achieve these standards rather than other lower ones. But for many reasons the extent of these extra costs will vary among countries. Furthermore, the benefits to be derived in the form of reduced risks or lower operating costs will also vary greatly among countries. Cost-benefit ratios are misleading unless they explicitly treat these points. It is poor economics to accept as unavoidable a specific requirement of a system without considering whether another lower or higher standard might not be more appropriate to local cost conditions and time horizons. What is needed is a clear statement, for each standard, of the costs involved in attaining that standard as compared to ones slightly below it and above it. It has been estimated, for instance, that to meet fully at all times of the year all the demands placed on one major water-system would involve expansion of storage capacity by 20% -- an enormous investment. No such investment would be required if people could be persuaded to cut down their demand for water by a few percentage points for short periods. The question, therefore, is: would consumers be prepared to pay for the water that they received at these critical periods the full cost of providing that water? The answer is probably negative. The fixed "requirements" dissolve. Requirements and standards must always be treated flexibly, as variables not as givens.

It is my view that the range of possible choice in an investment program is often much wider than generally believed. The Bank's work offers numerous illustrations. I would suggest that whenever an investment is proposed the first need is to see whether the need for the investment could not be altogether avoided by undertaking some other less costly course of development. Could existing transport or power facilities be used more intensively by stimulating off-peak demand? Should the

idea of opening up a new area by construction of large-scale infrastructure works be given up in favor of that of intensifying the use of existing land, transport, power and other facilities? Or should an attempt be made to divert prospective growth of demand away from an already developed area to another area? Should a capital-intensive agricultural project, readily analyzable but costly, be deferred in favor of a crash program to persuade farmers in existing agricultural areas to use improved seeds, better cultivation practices, more fertilizer and more pesticide? Could transport requirements be reduced by establishing processing facilities at the site of raw material production? Again in the field of transport, is physical displacement essential or would the transport problem be adequately solved by expanding the electricity supply network or the area's communication system? Would some reorganization of industrial land-use reduce the need for expansion of communications and transport facilities and of power-generating capacity? All these questions and many similar ones merit careful investigation in order to determine the real need for investment. It is only after they have been asked and answered that the analysis can proceed to the assessment of specific alternative projects.

Even when the stage of analyzing specific projects is reached the broad view must still be kept because it reminds the analyst of effects which each alternative may have on developments over the long-run and in other sectors. In economics we call these effects "external" -- to indicate that they do not bring any immediate increase in costs or revenues to the organization undertaking the project, but they do cause increases in costs and returns of other organizations and individuals.

This interdependence among investments -- the way in which one affects the costs or returns on another -- parallels the interdependence among investment

programs which I mentioned briefly before. What I want to stress here is that once a specific investment has been selected as the best way to meet some apparent need, it will have a significant effect upon the way in which the pattern of demand subsequently develops. An investment in power or transport or large-scale manufacturing -- chemicals or mechanical engineering, for instance -- tends to generate needs for further investments in the same field and in other fields. This is indeed one of the main processes of economic growth. But a careful assessment of this prospective growth has to be made before the initial commitment is made if costly mistakes are to be avoided. Cheap power may be made available but the other disadvantages of the region may be so great as to inhibit the growth of industries which would use the power; equally, the prospective growth of demand for power may be so seriously underestimated that within a short time costly additions to the original investment become necessary. In some cases underestimation of the prospective growth in demand can have even more serious effects, resulting in the adoption of an inappropriate pattern of investment. Roads, for instance, once built tend to draw traffic to themselves; their very existence may encourage people to make some journeys that would otherwise have seemed too bothersome. Sometimes roads have been designed and built without sufficient attention to the traffic they were likely to attract in this way. When the roads have proven too small or the approach roads become too congested costly additions have had to be made. In some cases, a whole series of such costly additions has become necessary. Had the long-run traffic build-up been correctly forecast from the start another form of transport, perhaps a railway, might in some instances have been preferable from the economic point of view. What I am trying to say is that a conception must be formed of how demand for the services of particular facilities is likely to develop in a region over a long period of time; and in formulating this conception account has

to be taken of the effects that the new facilities may themselves have in stimulating greater demand.

While projects should be considered together with all the likely expansions and developments in other fields which may result from their initial construction, it is equally necessary to consider the development of projects in stages. There have been numerous cases where a long road, a large power plant, a steel mill, an irrigation system have been built at one time even though it would have been better to stage the development over a number of years in line with the gradual build-up of demand.

The point I am trying to make is that many projects -- and especially public works projects -- can often only be adequately assessed as parts of a long-term regional program. You can just go along doing many individual projects, each serving their own purpose, as and when they become obvious. Power is needed and the river is there, so build a dam and install a power house. Later when other needs appear, raise the dam for greater storage or provide adjuncts to it. But, as has often been indicated by my closest colleagues in the World Bank when we discuss large river basin projects, the sum of the results from this type of procedure is usually a good deal less valuable than those obtainable by careful comprehensive programming, with full consideration from the start of the alternative directions possible.

By way of conclusion I would say that if engineers are to meet the demands that the underdeveloped countries will be putting upon them they must give increased attention to the making of balanced long-run assessments of alternative courses of action. Economic considerations are not at present receiving adequate attention from the engineers. Men schooled in the engineering disciplines often take too restricted a view of the possibilities for economic choice. Economists, who are trained to keep in mind the wide scope for choice -- among ends as well as means -- that nature provides us, are too little schooled in the technical aspects of evaluating projects. Yet the addition of a few economists or a senior economic adviser to an engineering team is not an entirely adequate solution to the problem; any economist who has had contact with project work is acutely aware of the difficulties of communication between engineers and economists, yet what is

needed is continuous and close communication throughout the successive stages of preparation of a project. It seems to be mandatory that in the long-run the combination of the two disciplines of economics and engineering be achieved in the training and experience of one and the same individual. In preparing and evaluating projects in the less developed countries, the advantages of specialization appear to be outweighed by the disadvantages resulting from incomplete understanding between economist and engineer. Or perhaps what is really required is precisely a new type of specialist, a man who is neither economist nor engineer but both: briefly grounded in general economics and then following a thorough training in engineering with the usual degree of specialization and, in addition, a series of courses in project economics. Add to this training operational experience and a knowledge of the problems of the less developed world and you get a project engineer with a profound sense of the need ever to be on the horns of a dilemma -- forever raising doubts and asking awkward questions.

Speech : R. Sadove

PRELIMINARY PAPER FOR SEMINAR DISCUSSION ONLY

Second Institute of River Mechanics
Colorado State University

BASIN PLANNING CAN BE HAZARDOUS?

by

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August 10, 1972

BASIN PLANNING CAN BE HAZARDOUS?

Proper exploitation and use of water resources can provide a dynamic basis for economic growth. The potential of river basin water resources can be enormous. When effectively harnessed, they can dramatically increase the productivity of millions of acres, provide a reliable source of domestic and industrial water, result in production of large quantities of electric power, give flood protection, help control erosion, improve navigation, assist the development of fisheries and often create important new recreation facilities.

To reap these benefits, there must be extensive and comprehensive planning. Imaginative and careful planning can assure that anticipated benefits are transformed into solid realities, and that these benefits are not vitiated by unintended harmful side effects.

There have been mistakes in river basin planning and much has been made recently of the social and ecological dangers of dam building. But the fact that mistakes may have been made in a few spectacular cases cannot deter us from future planning for the development of water resources. The stakes are too high. Many developing countries are confronted with the problem of rapidly growing and desperately poor populations but limited resources. Without development of water resources, already deplorable economic and social conditions will inevitably deteriorate at an ever increasing pace.

Ill-considered water development -- based on haphazard planning -- is dangerous to people and the environment. But those who advocate a do-nothing policy because of the dangers are wrong.

There are always dangers in any change and change always has a price. According to a recent series of articles ^{1/} it is said that in Egypt the price was high. It is argued that the clear water being provided by the Aswan Dam is scouring the riverbed, eroding the delta coastline, and causing the disappearance of fish; that prevention of natural flooding by the Dam has robbed the land of revitalizing fertile silt deposits; that transpiration and silting in the reservoir have reduced storage capacity; that heavy use of water and poor drainage have caused underground water levels to rise creating serious problems of waterlogging and soil salinity; that overflows have disrupted the lives of many forcing them to move and locate in strange and often destitute areas; and that the constant supply of water in irrigation ditches has exacerbated the spread of water-borne diseases.

^{1/} Claire Sterling, "Superdams: The Perils of Progress," The Atlantic, June, 1972.

But there were also gains from the dam. A large quantity of hydroelectric power has generated new industries and employment opportunities -- in a land of high unemployment and underemployment. The dam has brought additional acres under cultivation and permitted greater intensification and diversification of cropping. It has enabled Egypt -- formerly a food short economy -- to reduce its dependency on cotton, and become a major exporter of such cash crops as rice, onions, and potatoes.

The losses and gains in this illustration highlight the trade-offs that are inherent in dam building. We must plan so that the gains far exceed the costs, financially, socially, and ecologically.

Moreover, the experience at Aswan and elsewhere has shown us where the costs are likely to arise, allowing us to plan to reduce or eliminate them. A responsible plan will provide housing for the displaced, drainage systems for disposal of overflows, anticipatory medical care to prevent disease and fertilizer for downstream land denied the enrichment of periodic flooding.

It is the thesis of this paper that careful, responsible, and successful planning is within our grasp, but that to achieve such success we must give more consideration to preservation of existing natural forces and established ways of indigenous people. The great gains to be achieved from success, and the desperate need for that success, double our responsibility to plan with vision and understanding.

If the basic objective of river basin development is to devise the most economical means of exploiting water and power resources to maximize productivity, then planning techniques can be relatively straightforward. They can deal primarily with the several key variables familiarly used in most hydrological, agricultural, and economic studies. Cost-benefit analysis, for example, can be made of such clear-cut water development alternatives as canal improvement, surface water storage, or tubewells for groundwater. Because maximization of output is so important in the poorer developing countries where basic demands for food and shelter have yet to be met, most river basin analysis has traditionally emphasized the technical, engineering and cost-benefit analysis of dam construction and related irrigation developments. External or secondary effects have been analyzed mostly within the confines of isolated project analysis although they have rarely been quantified.

More recently, increasing emphasis has been placed on the environmental effects of river basin planning. Systematic programming of socio-ecological factors into comprehensive mathematical models could add a new dimension in evaluating individual water resource projects or the series of projects that form an entire river basin program. Such models as these may also be modified to introduce additional elements such as political considerations in weighing the potential benefits and inevitable costs. Known planning techniques -- systems analysis, mathematical programming, as well as physical planning -- may thus be used with much greater sophistication and sensitivity to social and ecological refinement.

In the past comprehensive mathematical models have been used in our river basin development work to represent entire investment programs. Such models were used to analyze a full scheme of development projects integrated on the basis of key economic relationships. This integration allowed the planner to take into consideration the singular as well as simultaneous effect of certain key variables and constraints on the over-all program, and to trace the impact of any change in variables and constraints. In addition to economic factors, certain political, social, and environmental considerations could be reflected in these variables and constraints. Model building, nevertheless, was limited by the modest number of variables which could be handled at any one time. Let me first illustrate the usefulness and limitations of the planning technique, in particular, a linear programming optimization model, which was used in the Indus River Basin Study in Pakistan. ^{1/}

The Indus River Basin program was an outcome of the partition of the Indian sub-continent. This political act disrupted the existing irrigation systems and stood in the way of their continued development. A solution had to be found for rational allocation and use of the water and power resources of the rivers which divided India and Pakistan. After a decade of negotiations, aided by the good offices of the World Bank, these two countries signed the Indus Water Treaty in 1960 which provided for peaceful division of the waters of the Indus River and its six main tributaries.

The imaginative engineering concept which underlay the treaty was a system of "link" canals of unusually large capacity for transferring part of the substantial surplus water from the Indus to its "eastern" tributaries where it could meet the irrigation requirements of the eastern portions of West Pakistan. This area had hitherto been served by the water of three rivers which according to the provisions of the Indus Treaty were to be diverted upstream and made available to India. The plans for diverting water flows from the main Indus across the Punjab to the natural basins in the east were regarded by some as "pie in the sky reverie" because of the boldness of the concept and the large sum of money required.

Fortunately, however, the participants, as well as the aid-giving community, were geared for the challenge. An international agreement was signed in 1960 by seven countries and the World Bank to establish the Indus Basin Development Fund in order to provide funds to implement this conceptual framework and the related works. The donors initially contributed \$895 million.

Over the next several years, the works on the link canals, the Mangla Dam as well as several large barrages were carried out expeditiously but significant cost overruns and the difficulties of financing all of them necessitated a supplemental agreement in 1963 providing \$315 million to complete all the works except the Dam on the Indus. The agreement also

^{1/} For a detailed discussion on the linear programming model, see "A Linear Programming Analysis of Potential Irrigation Developments," supplemental paper IV, Water and Power Resources of West Pakistan: A Study in Sector Planning (Vol. III), Prepared by a World Bank Study Group Headed by Pieter Liefstinck, Johns Hopkins Press, 1969.

established a Special Study Group to determine the economic and technical feasibility of constructing the large multi-purpose dam and reservoir on the mainstem of the Indus at Tarbela with the understanding that if it were economic the Bank would help raise the funds needed. If the Study Group found such a dam uneconomic, an alternative approach to water development eliminating this major dam was to be proposed and any remaining funds would be used for such a program. The decision regarding Tarbela was to be undertaken within the context of a detailed survey of all the water and power resources of West Pakistan and a related investment program.

To test the economic efficiency of this Action Program which was designed to develop fully the entire water and power resources in the Indus Basin a systems analysis was employed through the use of linear programming techniques. The major criterion for selecting the specific investments for the Action Program was the maximization of the rate of return whereas the test used in the linear program was the return for the whole program rather than that for any one project. The ultimate objective was to design a comprehensive program to provide a basis for development planning within the context of successive Five-Year Plans.

The task of formulating actual agriculture and water investments was a very complex one as the different parts of the vast Basin area varied a great deal in their socio-economic characteristics. Soils vary, land holdings change, ground quality differs, to name a few and consequently the development potential of each area differs. This planning task was made even more complex by the overriding regional constraint on Basin development -- uneven distribution and uncertainty of water supply. While the volume of water supply from the Basin and its subdivisions is substantial, eighty percent of annual flows occur in the five months, May to September. Water was scarce in the other months because rainfall is short and major groundwater resources were largely untapped.

Moreover, the development schemes to be proposed for the near term (i.e. 1965-75) had to be designed to promote development of a modern, self-sufficient agricultural economy in the area where traditional agriculture has ruled for centuries.

For the purpose of program formulation the Basin area was broken into a number of different natural territorial subdivisions -- the canal command areas -- covering some 33 million acres of irrigated land and comprising the largest single irrigation system in the world. For each designated zone various combinations of water development activities were simulated, and their relative advantages analyzed in terms of estimated irrigation requirements. In the linear program a series of hypothetical water development schemes were aggregated and analyzed in terms of the greatest returns expected to be realized from each simulated pattern of development for the irrigation system as a whole. Projects (about 500 projects considered for execution in two different time periods) selected on the basis of the simulations were in turn tested to verify each project's

efficiency in the use of limited regional resources -- foreign exchange, surface water, public development funds, implementation capacity. The linear program revealed simultaneously the effects of alternative levels of these and other regional conditions on investment plans and generated an optimum internally consistent water development program for the whole Basin. The actual program which had been formulated by the Study Group was "tested" by comparing it with the program generated by the systems analysis.

Systems analysis and the use of mathematical models helped to confirm the areas of the greatest development potential, to define the range of alternatives, to establish specific investment priorities, to determine the timing of various investment projects, and find the most efficient means of implementing the recommended projects.

The planning procedure undertaken for the Basin development was a significant step forward from the traditional approach under which development programs were composed of a number of projects developed in relative isolation. The development program for the Indus Basin, on the other hand, was designed as a complete system of projects drawn together on the basis of pertinent interrelationships and developed in light of one another. The various large projects, particularly the Tarbela dam, were from the outset never intended to be considered in isolation but as the major component of a larger scheme designed not only to meet West Pakistan's needs for electric power but also for additional supplies of irrigation water through the integration of surface and groundwater.

The special advantage of systems analysis is its capability of taking into account a wide variety of economic, political and social factors and examining the simultaneous effects of these factors for given areas under alternative schemes. However, in the Indus case, the study group deliberately limited the number of variables employed by using an optimizing linear program in order to focus on the relative merits of those several technical and economic variables which appeared directly related to maximizing agricultural production in the specific areas. As large quantities of diverse variables were introduced, the model used quickly became cumbersome in the analysis of 500 projects and some 54 canal commands. The primary objective of devising an economically optimum investment program was in conflict with the introduction of substantially greater complexity into the analysis.

In any case, the voluminous technical studies and economic reports did not systematically incorporate such nonquantifiable data as political, cultural, social, and ecological factors which must also enter into the judgments of decision-makers. In retrospect, one could contend that the focus on economic and technical variables to the exclusion of vital social, political or health data was a severe limitation of the model. This was where the "technical" analysis ended, and policy formulation began.

Close coordination is essential between technicians of diverse fields of discipline and policy-makers who determine public sector investments as well as influence private sector inputs. Cooperation and coordinated effort between planner and policy-maker was well demonstrated in the case of the Indus Basin enterprise. Here an unusual blend of expertise was assembled to articulate an effective course of action.

International experts of high technical competence prepared the extensive studies and analyses on which the water and power development programs were based. This work then served as a framework for the Pakistani policy-makers in executing the country's development projects. The government leaders of Pakistan and especially the chairman and chief engineers of the West Pakistan Water and Power Development Authority knew what had to be done and were determined to do it. River basin planning truly becomes a dynamic process when the traditional gap between the technical planner and the policy-maker has been bridged.

One example of the caliber of these technical inputs which proved so valuable to the success of the Basin Plan was the report on Land and Water Development in the Indus Plan by the U.S. White House Panel, usually referred to as the Revelle Report. ^{1/} This study needs emphasis not only because of its contributions to the achievement of greater agricultural productivity, but also because it reflected the work of some 20 leading experts from all parts of the world covering 15 major scientific disciplines.

These experts proposed a massive program of public groundwater development as a means of increasing irrigation supplies and overcoming the problems of waterlogging and salinity. They proposed a large-scale attack involving a major ecological change. A number of tubewell and drainage projects each covering one million acres were designed to exploit the large aquifer of some 300 million acre feet underlying the Indus Basin to increase irrigation supplies while also providing extensive drainage.

The Revelle recommendations were of lasting significance -- tubewells eventually proved to be one of the most forceful propellants of the "Green Revolution." As a result of continued exploitation of groundwater irrigation by tubewell development throughout the Basin, soil depleted by waterlogging and salinity was once again made highly productive. This major achievement was reflected in the accelerated growth of agricultural production between 1960 and 1969. During this period the volume of wheat production, the most important foodgrain in West Pakistan, increased from the annual average level of 3.4 million tons in the fifties to 7.2 million tons in 1969-70. Most of this improvement took place in Punjab Province where three-quarters of Pakistan's wheat is grown and which was the main beneficiary of the Indus water development scheme.

1/ Report on Land and Water Development in the Indus Plain by the White House Panel on Waterlogging and Salinity in West Pakistan - Dr. Roger Revelle, Chairman. January 1964.

Rice production, the second most important foodgrain, similarly increased from about one million tons to 2.3 million tons during the same period. A combination of irrigation from over 70,000 new tubewells, public and private, and use of Mexi-Pak Wheat varieties contributed to this increased production. For instance, in one year between 1967-68 and 1968-69, the cultivated acreage increased two and a half times from 2.4 million to 6 million.

In retrospect, however, the outcome of the Indus Basin Planning was not without flaws and distortions which could serve as lessons to future river planners.

First, the focus was almost entirely on the maximization of agricultural output and secondarily on the use of water as a power resource. Important factors such as the role of the private sector or the problem of regional balance were more or less neglected. Better distribution of income, both regionally and by classes, and of the benefits from the expected expansion of output were included in the preparatory studies but were hardly considered when it came to actual allocation of funds and execution of projects. Projects were developed with little regard for the need to increase employment and tended to be heavily capital intensive.

It has been argued that the Indus project required a disproportionate share of Pakistan's internal financial resources. To illustrate the magnitude of the program, the total combined expenditures on canals, private and public tubewell development and dam construction represented about 6-7% of the country's Gross National Product.

Some have argued that the enormous investment expenditures devoted to water and agricultural development resulted in gross neglect of the country's urban sector. Without sufficient resources or an adequate development effort it stagnated and ultimately a violent demonstration of dissatisfaction with this situation erupted. Even if a more balanced resource allocation might not have altered the course of history, such an allegation does point up the need to have river basin analysis more cognizant of the "other" dimensions of the problem -- in this case the social impact of program development. Overly ambitious programs straining too harshly human and financial resources must be avoided.

Second, the Indus development scheme failed to take certain contingencies into account. Although difficult, attempts should be made to make plans flexible enough to accommodate some of the mutations of technical innovations. For instance, the Indus scheme greatly underestimated the potential of Mexi-Pak wheat varieties. It was only envisaged that by 1975 a million acres of new varieties would be planted. As noted above, by 1970 some six million acres were being planted.

The prevailing attitude of those involved in the studies had been somewhat pessimistic toward the role of "miracle seeds" as many felt that farmers would resist accepting and growing the new varieties; after all,

they needed more careful planting, better water control, and better land preparation. Had the expected level of crop yields from the new varieties been accepted, rate of return calculations for certain projects might have shown somewhat different results.

It is difficult to judge whether such miscalculations were a factor in too much resources going into capital intensive water projects and too small an effort being directed to farm modernization. In any case, the point is clear that precision in economic analysis is a worthy goal, but rates of return -- particularly extending longer than two to three decades -- can indeed lead one into a false sense of knowledge and security in decision-making.

Finally, another interesting aspect of this experience deserves mentioning as it illustrates the danger of built-in rigidity which often arises from any "plan." It is often said that once a plan is formulated it tends to be regarded as something sacred and policy-makers may become wedded to the objectives expressed in it. What looks good on paper may not be the best thing in realizing desired goals.

In the Indus studies, the Revelle proposal to build large-scale public tubewells as a way to overcome salinity, drainage, and irrigation problems was a brilliant approach to the long term problem, but it created an initial bias against private tubewell development. To the great surprise of many planners, a vigorous private sector investment in tubewells took place without public help. The 66,000 wells which were not forecast until 1971, had been achieved by 1968, and it was indeed fortunate because public sector resources proved so scarce. This again illustrated there was a job for everyone, public and private alike, since the task of developing an extensive system of tubewells covering such a large Basin was a great and costly one.

The lesson to be learned was that it might have been more appropriate to have planned from the outset to take more effective advantage of the private initiative which combined the activities of those primarily responsible for introducing the "miracle" seeds with water development. Instead, the private sector in agriculture had to fight somewhat of an uphill battle, although Pakistan had through most of this period enthusiastically endorsed private sector initiative in other areas such as industry.

Planning techniques now available could have better highlighted this kind of a problem for policy-makers to focus on. Since the mathematical programming activities 1/ applied in the Indus case, more sophisticated models

1/ For various macroeconomic, simulation, and linear programming models used in the Indus Study, refer to Water and Power Resources of West Pakistan: A Study in Sector Planning (Vol. III - Background and methodology), prepared by a World Bank Study Group headed by Pieter Liefstinck, The Johns Hopkins Press, 1969.

have been developed in our work in Bangladesh ^{1/} which can help broaden the frame of analysis. Let me illustrate this point by discussing a particular mathematical model that was used in the planning of the Ganges-Brahmaputra river basin system in Bangladesh. As an initial stage of a comprehensive planning effort, a group working with the World Bank, developed a macro-economic model with a thirty-year time horizon under the guidance of Professor Robert Dorfman of Harvard University in order to provide Basin studies with a proper economic framework. The main objectives of Professor Dorfman's model were to see (1) what burden the agriculture sector would have to carry if Bangladesh were to be a viable economy which would be able to absorb productively expected future population growth; (2) whether, in fact, Bangladesh could remain and/or become a viable economy; and (3) what the financial resource implications of a viable economy would be over a thirty-year time period. The purpose of the model was not to present planning targets or projections based on past figures. Instead, the objective was to provide a tool for analysis which could then be used to judge whether the achievements outlined for agriculture were consistent with overall plans for the country's future.

Technically, this model was very sophisticated in its imaginative use of international data and application of economic theory. It, in effect, took data from the development experience of other countries which have undergone modernization during this half century and applied them to Bangladesh.

The initial computer runs produced some interesting and important data although they were preliminary results. The model showed that Bangladesh, if it followed certain patterns, could become a viable economy over a thirty-period but this would necessitate external financial assistance in the magnitude of \$500-700 million per annum which may not be realistic. It also showed that the role of agriculture would have to decline from 55% of GNP at the beginning of the 70's to 33% of GNP in the year 2000 if unemployment were to be kept at an acceptable level of say 10%. It also showed that the extent of resource mobilization would have to improve from a historical savings rate of 11% of GNP to some 15% by the mid-seventies and stay at that level over some 30 years. Under these assumptions, the investment-savings gap would decrease from 9.3% of GDP in the mid-seventies to less than 0.5% of GDP by 2000. Substantial injection of foreign capital would be needed to close the gap.

^{1/} See East Pakistan Land and Water Resources Sector Study, Vol. III, Sector Economics Technical Report, No. 3, The Framework for Economic Planning (The Dorfman Model), Special Projects Department, International Bank for Reconstruction and Development, February 6, 1972 (mimeographed). Also Bangladesh: Land, Water, and Power Studies: Final Report, Center for Population Studies, June, 1972 (mimeographed). See page 5 of this report for the list of 18 models being studied.

The model is, of course, designed to be run over and over again under different sets of assumptions. That is the whole purpose of such an exercise. One can measure the sensitivity of a system of variables. One can both isolate and interrelate variables. Then, presumably, the study of "implementation" can be limited to those variables which appear most "sensitive." The question is how serious are the omissions. I would say for macro analysis -- not serious at this level of aggregation.

In principle, then, through the use of this kind of a model, the level of agriculture production necessary for growth to meet certain objectives could be related to the level of investments in water resource development which appears necessary. Furthermore, some indication could also be given of the optimum level of external assistance and domestic savings if the economy were to become viable, and accordingly a very rough consistency check could be made to see whether sufficient resources would be available to finance required water control investments. All of this would then become a framework, the intensive implementation evaluation would be related to this prospective. For most of us this is a "starting point."

Despite the obvious usefulness of such models, many are disturbed by their creation. Some feel that most countries cannot really afford the luxury of such models. There are more important things to do. In non-academic circles, some would say such models are dangerous, don't use them, play ostrich, because model results can give ammunition to irresponsible individuals. Others state that it is more important to work on specific policy measures. Still others fear any comprehensive set of numbers because the numbers would tend to freeze positions. Some question the relevance of the data since much of it had been drawn from the experience of other nations at similar stages of development.

In short, the general feeling often is that with this kind of exercise damage occurs very quickly since the preliminary results can be misinterpreted as constituting a foundation for a plan of action. Others, of course, feel that a valuable tool for general economic analysis and for river basin planning can be created and that running models under various assumptions permit the drawing of conclusions concerning both the limits of investment and the parameters of policy for sound socio-economic river basin planning. But there can be no doubt that within these limits, much more work needs to be done by both experienced policy-makers and technicians of many disciplines.

Another model, used in the Bangladesh work illustrated this. For example, a sector-project simulation model was designed as a tool for aggregating specific project proposals into investment programs for the achievement of certain water and agricultural targets. It was, in the first instance, specifically geared to calculating the agricultural production which would result from certain proposed programs. Using the data obtained from the exhaustive research conducted over a 10-year period by a United Nations Development Programme Soil Survey team, the area of Bangladesh was broken down into 50 land development units. A sample program was designed based on the best estimates of constraints: (1) present land use and

availability of irrigation water (surface and groundwater) and (2) capacities for administration, engineering, and training needed for implementation. Using 12% as a minimum discount rate, the model excluded all investments without a positive net present worth. In other words, a 12% rate of return cut-off point was used. The model then formulated a tentative investment program for water and agriculture development based on projects in the order of their greatest returns over a thirty-year span. Since the model was a simulation, it would be possible to introduce many more variables than that used in the Indus Study.

Nevertheless, the model -- an inanimate tool for analysis -- however erroneously became the center of controversy within our own group. The model had printed out some preliminary results which were not only being taken very seriously but also taken out of context. It was indeed a very complex calculating model but it calculated only on the assumptions fed in. The assumptions employed were perhaps socio-economically untenable in some cases. This remains to be tested.

A critical input, for example, that was deliberately omitted was the effect and importance of flood control on the quality of life of the people of Bangladesh. Such a major omission deserves an explanation. First, the Bangladesh Government must determine the importance of flood control but this Government only came into existence when the first runs of the model were made. Second, with the creation of Bangladesh the whole approach to flood control could be broadened to consider potential friendly relations between the two riparian parties. In fact, only with the creation of Bangladesh did it become possible to examine optimum solutions to the Ganges-Brahmaputra-Meghna river basin.

Thus, in this particular model, we did not choose to quantify a qualitative judgment. We left out a dummy variable or made it zero. But we were fully aware of the need to take this factor into account before planning decisions could be made. However, since models are made to be run under different sets of assumptions, we could accept the decision not to quantify the unquantifiable, i.e. the importance of the quality of life.

Despite our careful reservations on the preliminary results of the model runs, the output was taken by some as an absolute and not discounted by the context in which they were derived. Thus, the preliminary results of this model in some discussions we have had presented more of threat than a contribution to planning.

The instrument (the model) should not fall in disrepute because it is misused. Many of us -- and let us be very open -- particularly economists and engineers -- like absolute answers, and absolute answers dictate very static cross-sections ... e.g., a table enumerating a list of projects, a set of numbers, a series of activities which are then taken seriously and analyzed in and of themselves. Instead, these data might look entirely different if carefully interpreted in the full complexity of a dynamic context and tested under completely different sets of assumptions. The models we have developed

allow us to do just that -- but with a far greater degree of precision than in the past. Our obligation must be to use them with full knowledge of their and our own limitations and to develop action alternatives for those charged with decision making responsibility.

To the use of these new tools we have added another, but equally essential, dimension to the planning process. We have begun to look at river basin planning with new eyes -- the eyes of the potential beneficiary -- the farmer who plants the seed and uses the water.

Regional and national goals must be translated into changes of mind and behavior of the village people affected by river basin development. Otherwise, the development effort misses the mark. This means that planners and public officials must become sensitive to the needs and desires of the people for whom the fruits of development are directed.

To obtain this perspective, the Bank is making an analysis of cultural determinants of farmers' response. Attempts are being made to view the anticipated changes in production and village environment from the viewpoint of farmers that will ultimately determine project viability.

We are undertaking careful analyses of enormous changes that have taken place in selected villages located in the Mekong Basin in order to see what caused them and what it takes to make a farmer respond to new investment with new levels of production. For instance, an anthropologist who lived in the village of Pa Ao in Northeast Thailand was sent back to the same village some 18 years later to assess the changed lives of the villagers who had benefited from market access roads and agricultural development programs. The changes were all pervasive. The diet had substantially improved with more food available and new food items such as fresh vegetables and fruits. Improved marketing, credit, education, and sanitation facilities were also observed. These physical changes reflect new mental attitudes and all of the changes, physical and mental, taken together indicate that a foundation has been laid for breaking out of the rigid hold of traditional poverty -- and this is the key to self-sustained economic development.

CONCLUSION

In terms of methodology we have come a long way from the mathematical sophistication of the linear programming model used in the Indus case to the simpler tools of simulation now being used in our Ganges-Brahmaputra work which are extremely sophisticated in their being capable of handling diverse variables. With such simple techniques as these, we can now do a better job of river basin planning. We know there are going to be costs -- social and ecological, as well as financial. In the past we were aware of these costs, but systematic and integrated mathematical analysis was not applied. The new analytical tools can now help us quantify environmental and social costs and measure them against expected economic returns with greater accuracy. We can give policy makers a clear picture of the gains to be achieved and the losses to be borne, and with knowledge of the costs we can plan to eliminate or minimize them.

The Indus Basin Works succeeded in its objectives partly because of the close relations between those who were technically competent in planning and execution and those responsible for policy formulation. With improved methods of analysis, we must discharge our responsibility by the clearest possible articulation of goals, assumptions, and constraints. We must also be frank about the reliability and accuracy which can be accorded to our results.

For valid reasons, the technicians are rarely the decision-makers. The technician must understand his role. He exists to define options and not to prescribe policy. Conversely, the policy-maker bears a heavy responsibility. He must study the options laid before him and make a decision affecting millions of people. He cannot responsibly park the decision on the computer or the technician.

We thus arrive at some very simple fundamentals. River basin planning like penicillin can be hazardous. It requires certain compromises and sacrifices of resources whether ecological or social. With responsible use it could revolutionize the lives of the river's people as dramatically as a Salk vaccine. Without planning, many may have to remain destitute. Thus, the great responsibility rests on the members of the planning profession. Their task is to recognize the errors made in the past, reappraise their roles, respect the views of their critics, and minimize the immediate losses while maximizing the long-term gains.

Speech by Sadove -

Recd. Dec 18, 1972
(edited by Mr. Swain)

PAPER PREPARED FOR THE PRESS FOUNDATION OF ASIA

For Discussion Prior to and at the One Asia Assembly, New Delhi

A VIEW OF THE URBAN NEEDS OF DEVELOPING COUNTRIES

by

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How real is the concern for cities? Major cities everywhere have slums, unemployment, housing shortages, inadequate transport systems and congestion of people and traffic. And as major metropolitan areas are increasing in size, these problems are getting worse. To ignore such problems is to ignite them. Coping with such problems demands not only recognition and concern, but a commitment of financial and human resources to a strategy that is based on the achievement of social as well as economic goals.

The pamphlet "Urbanization Sector Working Paper," produced by the staff of the World Bank and attached to these introductory comments, focuses on the developing part of the world where the magnitudes involved compound every aspect of the urban problem and create an urgency for urban action that is far more intense than in the developed world. The physical dimensions that make the urbanization problem in the developing countries so severe are fourfold -- the rapidity of urban population growth, the worsening of income distribution, the mounting unemployment and the increasing deterioration in average living conditions for city population. The financial dimension of the urban problem is an acute shortage of total resources available for development, coupled with heavy costs of providing urban services. The sector paper reviews each aspect of the urban problem and this note summarizes certain parts of the analysis. The detailed study in the sector paper is pertinent not only to diagnosis of the urban problem, but to an understanding of the various elements of remedy. The sector paper suggests several possible approaches to urban development in light of such analysis; this introductory note highlights one such prescribed

element of remedy -- a minimal standard approach to urban services plus priority for employment creation.

Urban population growth in developing countries is at an all time high. The current growth rate averages about 5% a year, half of which is due to natural increase, and half to rural-urban migration. With very little prospect of immediate change in the growth rate (birth control programs are only slowly effective, and programs to curtail the migratory movement have been notably unsuccessful), the urban population is projected to double in 15 years. By the turn of the century, the urban population of developing countries is projected to increase by over 1 billion people or by more than three times the total urban population of the developed world in 1960. And while the rural and small town populations growing at a rate unprecedented in the developed world at comparable periods will also increase by over a billion people, the proportion of population in urban areas (above 20,000) to population in rural areas will increase from 15% in 1960 to 31% in the year 2000. In countries of South Asia, the proportion of urban population (which at 76.7 million in 1960 was the greatest in absolute magnitude of any developing region) to rural population is projected to rise to an even higher 33% by the turn of the century. Urban population in the ^{Asia} region (projected to increase to about 345 million) by the year 2000 will exceed the total urban population in all developing countries in 1960 (310 million).

As might be expected, countries with the highest rates of total population growth and with the highest proportion of rural to urban populations will experience the highest rates of increase in urban populations. Generally in the developing countries, one urban center, several times the size of the next largest, has borne the brunt of the most rapid

population increases in each country. Lagos grew from a city of less than 250 thousand to 1½ million in population between 1950 and 1970; Bangkok grew from under 1 million to 3 million during the same period; and Bogota grew from 650 thousand to 2.5 million during the same period. Each of these cities far surpasses in size other cities in their respective countries. If such a trend continues, large cities of over half a million inhabitants will probably undergo the most rapid growth. And there is no reason to doubt the continuation of such patterns.

The implications of the rapid growth of urban populations projected for developing countries are alarming. Ironically, a major enticement to rural-urban migrants is the very real income differential between countryside and town. Average per capita income in major cities is often 3 to 5 times that of the countryside. In India, to choose one of many possible examples, the annual per capita income (1961) of Bombay was about Rs 1,020 compared with Rs 390 in Maharashtra State, where Bombay is located, and somewhat less in India as a whole. The disillusionment is that income differentials within the cities are often as great, if not greater, than those between city and countryside, with wealth concentrated in the hands of a very small segment of urban population. In one city where we have been working, for instance, average per capita GDP is around \$600 compared to \$130 in the surrounding countryside, and as many as 80% of the urban families have incomes too low to pay for minimum public housing as presently conceived. Such heavily skewed income distribution is subjecting an increasingly high proportion of urban population in the developing world to despondency and listlessness. Conditions of slum dwelling, unemployment and low per capita incomes breed despair that, as numbers increase and awareness sets in, may erupt into violent protest.

A wretched complement to the problem of worsening income distribution is steadily increasing unemployment among the urban poor. Urban employment affecting between 10% and 20% of the potential labor force (and particularly the 15-24 year old age bracket) is not uncommon in the developing countries, and has been estimated to be as high as 30% in a number of major cities.

The mounting urban unemployment of the last two decades is not likely to abate in the years ahead. International Labor Office (ILO) projections indicate that the total labor force of developing countries will expand by at least 25% between 1970 and 1980. While urban labor force participation rates tend to be somewhat lower than for the overall population (since urban workers tend to enter the labor force later and retire earlier than agricultural workers), there is little ground, given the high urban population growth rate, for expecting the labor force rate of increase in the cities to be significantly less than the projections for the developing world.

Paradoxically, the numbers of the potentially employable are rising sharply at a time when the rate of increase in employment opportunities in the small modern wage paid section of the urban developing world is diminishing. Modern industrial output is expanding, but technological advances are reducing the requirement for industrial employment to about one half the growth rate of industrial output. Further, modern industries are in some instances replacing small-scale handicrafts, and thereby reducing employment. The more traditional sectors of the urban economy (including the bazaar sector and "catch-all" service sector) are absorbing the larger proportion of the labor force, though employment in these sectors often tends to be marginal.

Urban existence for the mounting numbers of unemployed or marginally employed is bleak, and prospects for amelioration still bleaker. Slum

populations growing at a rate of 20% or more a year in big cities are on their way to dominating city populations and by closing in on small modern affluent sectors converting these sectors into virtual ghettos. Various cities in developing countries already have shantytown populations that account for 50% or more of the city population. Yet despite the growing proportion of urban poor, municipalities have generally failed to act in their behalf. A World Health Organization document prepared for the 1972 U.N. Conference on Human Environment has indicated that less than 25% of urban families receive water in their houses or courtyards (and even then the water is often unsafe or insufficient) and that only 12% of urban families in developing countries have sewage facilities. Few squatter areas receive municipal services beyond some marginal system of electricity supply, and what limited public housing is available is too costly for the poor to afford. Unless determined action is taken to accommodate or counter current trends, urban conditions will deteriorate even further in the next decade as urban populations in the developing world soar to an estimated one billion.^{1/} The task requires a commitment to creative planning, for municipalities which are swamped by the physical dimensions of the problem are hamstrung and institutional in undertaking constructive reform by the financial/dimensions of the problem.

Municipal governments are caught between a severe shortage of capital resources and high costs of urban development. Income levels in the majority of countries are less than \$250 per capita, and in many others as low as \$150. (While average urban incomes are generally higher than rural incomes, the rate of increase in urban populations requiring public services is also higher; the net savings in cities and countryside per head of population increase tend therefore to be roughly the same.) Further, as average per

^{1/} See summary table of UN data in Ward and Dubos, Only One Earth, 182 (1972).

capita income in cities increases from \$100 to \$200, the population increases roughly eightfold, thus negating any possible gain of total resources for development.^{1/}

The extent of the gap between possible resource mobilization and the cost of providing employment, housing and other urban infrastructure for the urban population increase is best explained through illustrations noted in the Bank report. As an example, assume that a city has a population of 500,000 and a per capita income of \$150. At a savings rate of 10%, the city will generate \$7.5 million in gross savings annually. At a 6% growth rate of population with 60% labor force participation, there will be 18,000 new labor force entrants and 30,000 new population each year. The annual capital cost of creating employment for the incremental work force would be \$21.6 million, assuming the modest cost of \$1,200 per worker. The annual cost of providing the additional population with necessary infrastructure including housing would amount to \$15 million, assuming a low per capita cost rate of \$500. Thus, some \$36.6 million would be required annually compared to a total gross savings of only \$7.5 million.

The gap between needed costs and available savings becomes still larger when both the capital costs of providing infrastructure for the deprived existing population and the current costs of maintaining and replacing existing municipal facilities and services are included in the calculation.

The dilemma of our hypothetical city is a real one for most of the urban developing world. In Bombay municipal revenues in 1970 totaled \$84 million -- roughly half of the total annual capital requirements estimated for

^{1/} See Ward and Dubos, Only One Earth, 147 (1972).

the new population. With an average per capita income of \$288, the base for taxation in Bombay is simply too small even for improved ^{fully} municipal finance/to make up the difference. A shortage of resources for urban growth is characteristic even of cities with relatively high average levels of per capita income.

The urban problem is worsening day by day as migrants pour into cities (in numbers as high as 5,000 a week in Bombay) and together with the natural increase in population add radically to the ranks of unemployed, poor and deprived. At today's costs and today's standards of what constitutes reasonable conditions for living, most cities are incapable of mobilizing the capital required to provide for the incremental population, let alone meet the backlog of unsatisfied urban needs.

There is no single solution to urban deterioration; political commitment to act in behalf of the squatter and other urban poor is an important ingredient. Must cities erupt into violence before the need to improve living conditions becomes focal to the politician, or before higher income residential groups become fully conscious of the need to forego some material increase for the benefit of the city at large? Rational urban planning and development which will involve the determination of policies for land use, for transportation, for housing, will require the clarification and collective agreement on long range social goals.

As difficult as is the achievement of political concern and consensus on the need for urban reform, it is not the only problem. As we have noted, the urban developing world is horrendously short of resources with which to confront the progressive deterioration in quality of urban life. Elements of cure may be found in international capital transfers and local capital

formation, but the scale of needs outweighs even the most optimistic projections of possible resource mobilization. The physical and financial dimensions of the problem force the planner to ask new questions relating to hitherto assumed urban needs.

The capital requirements of the industrialization/urbanization process are in all countries related to higher aspirations and standards than in the past. Most larger urban centers are closely connected with the more industrialized countries abroad, which they often resemble more closely than they do minor towns in their own country. This resemblance, or aspiration to resemblance, is to the disadvantage of much of the urban developing world; the costs involved in providing similar conditions for living are, as we have noted, far beyond the means available in developing countries. Provision of modern transport, social services, education, and urban amenities on the pattern of the more developed world requires extremely high capital and operating costs. The question whether the urban developing world can adapt itself to a new more practical less ambitious concept of an adequate standard of living becomes pertinent, if not crucial, to an urban solution.

The necessity for a minimal standard approach to urban development in the developing world can be illustrated readily in the field of housing. Housing is basically not the same problem in the cities of the developing world. In the developed countries, the basic problem of housing derives primarily from social and institutional rigidities; in the developing countries, housing needs estimated at a staggering \$12 billion a year are simply beyond national resources. Further housing costs at the standards perceived are

financially beyond the reach of low income families, making the demand for housing in developing countries largely "noneffective".

The practical aspects of noneffective demand can be demonstrated using India as an example. If the cost of a "minimum" dwelling under Indian conditions is Rs 8,000,^{1/} annual debt service payments assuming 100% financing at 10% interest for 10 years, would be Rs 1,304 or monthly payments of Rs 109. If every household in Calcutta were prepared to spend 15% of its income on mortgage payments, which is a reasonable first approximation, then on the basis of the income distribution estimated for the Calcutta population and presented in the table below, 87% of households could not afford such a dwelling. Having cut monthly payments in half for illustrative purposes, the mortgage (not to mention the costs of maintenance and operation) would still be beyond the reach of about 67% of the households.

Estimated Income Distribution
Calcutta Metropolitan District Multi
Member Households, 1971

Income Groups (Current Rs per month)	Housing Expenses Capacity Range 15% Rent- Income Ratio	Percent of Total Households 1971	Total Households 1971 (in 100,000)
Less than Rs 100	Less than Rs 15	16.3	2.33
Rs 100 - 299	Rs 15 - 44	46.7	6.69
Rs 300 - 499	Rs 45 - 74	16.1	2.31
Rs 500 - 699	Rs 75 - 104	7.8	2.12
Rs 700 - over	Rs105 - over	13.1	1.87
Total		100.0	14.32

It is accordingly no surprise to find that public housing intended for low-income groups is frequently occupied by middle-income families. In fact,

^{1/} Assuming 450 sq. ft. at Rs 12 per sq. ft. (Rs 5,400) and including costs for land at Rs 1,600 and site development at Rs 1,000. Source: Catherine Bauer Wurster, "Urban Living Conditions, Overhead Costs, and the Development Pattern," India's Urban Future, edited by Roy Turner (1962), pp. 297-8 (Less than Class A level services assumed.)

perhaps three quarters of the population in the major cities of the poorer developing countries cannot afford the economic rent of the conventional type "low cost" housing. Even assuming substantial transfers by way of subsidies, total national savings are quite inadequate for the effort required. The problem is compounded by high land costs, limited mortgage facilities and poorly organized construction industries. Therefore, for at least the poorer countries of the developing world, public provision of conventional low-cost housing for the urban poor directly or indirectly is simply not a practical proposition.

The necessity of relating infrastructure costs to the incomes of the people is valid for the provision of sewerage, electricity, and other urban amenities, as well as housing (though housing is the greatest urban cost representing often 60-70% of the total). The magnitude of urban investments, however, is such that much more than slight changes in project design is required. A realistic appraisal of what minimal facilities for water supply, sanitation services, transport, educational and health services constitute satisfactory conditions for living is basic to successful urban reform. For only by reducing the standards of urban project design to a somewhat more spartan, though acceptable level, and by seeking less costly means of execution can the bulk of the needy be included in the benefits of economic development. "Self help" is an important aspect of such an approach. Experience has proven that self help efforts are readily engendered among urban poor particularly for house construction.

The payoff from self-help housing is high; radically reduced housing costs and increased national and personal savings (a tendency among all home builders). And equally significant, self-help housing construction has the important effect of creating employment for those most in need of work. The

labor component, often as great as 40% of standard housing construction costs, has been estimated to be closer to 50% for minimal standard self-help housing construction.^{1/} In several detailed studies on employment in the Calcutta area, direct employment generated for each Rs 100,000 expended on housing and other urban infrastructure construction was calculated (assuming an input composition for construction as a whole of 33% for labor and 67% for material inputs) at roughly 18-23 man-years.^{2/} Indirect employment in local building materials industries (based on a local inter-industry demand multiplier for construction of 1.6 and for labor of .6) was calculated at roughly 15-17 man-years. If minimal standard self-help construction is encouraged, the impact of urban infrastructure development in providing at least 35 man-years of employment per Rs 100,000 expended could be significant for Calcutta -- a city of large scale unemployment; the investment required to generate direct employment would be roughly \$450 per worker or (assuming a 33% labor force participation rate) a modest \$150 per capita.

A minimal standard program for urban development can stimulate employment in other ways. Less immediate, though significant, is the increase in economic activity that urban rehabilitation generates -- that is to say dying cities come to life. A potential benefit which can derive from minimal standard programs that has become much more important is the rehabilitation of the very small scale service related industries similar to the cottage industry of semi-rural areas.

1/ In Calcutta, for example, a 1969 UNIDO study on construction indicates that the labor component required by low standard housing is 50% (20% unskilled and 30% skilled) compared with 40% (15% unskilled and 25% skilled) required by high standard housing.

2/ A.N. Bose, A Note on the Estimation of Employment Potential During the Fourth Five-Year Plan Period Based on CMD Development Schemes (Calcutta, CMPO, typescript) 5, and V.G. Bhatia, "Employment Potential of Roads," in R.G. Ridker and H. Lubell, Employment and Unemployment Problems of the Near East and South Asia. Vol. II, 766 as cited in H. Lubell, Urban Development and Employment: The Prospects for Calcutta (1972) 104, 105.

A minimal standard approach to urban development is largely empirical. Physical, financial and attitudinal differences among developing country cities color the identification of minimal standards of urban facilities and services, the mobilization of human and financial resources, and the acceptability of urban plans. A flexible approach to project design -- one that takes advantage of the characteristics of a particular environment -- is important to minimizing project costs. In one country, for example, roads were constructed under a Rural Works Program that in many/^{other} countries would have clearly /been considered substandard. The roads were mostly dirt and compacted by hand hammers or by sections of concrete pipe used as hand pulled rollers. Nevertheless, such roads as these played an important role in accommodating bicycles, rickshaws and animal carts which opened up large areas to agricultural marketing. By using labor-intensive methods of construction, capital costs were kept to a minimum. The high costs of maintaining the roads (which were subject to rapid deterioration) were acceptable to the country because of its large labor surplus.

A minimal standard approach requires that assumptions regarding "fixed" requirements and standards be broken down. What is assumed as a fixed need, may not be a valid assumption on close analysis. In one case study of water supply, it was estimated that all the demands placed on a major water system would involve expansion of storage capacity by 20% -- an enormous investment. Such an investment would not be required if consumers would reduce their demand for water by a few percentage points for short periods -- a probable result if consumers were faced with the alternative of paying the full cost of the water that they received during those critical periods. Another popular example is the use of private automobiles in cities.

Automobile use is often regarded as a necessity, even where alternative modes of transport exist. The question is whether people might give up use of the car in the city, if charged the full costs (direct and indirect i.e., high congestion costs to others, road space costs, road construction costs) of its use. Costs and benefits vary with each locale; and need to be related clearly to each standard proposed.

As noted earlier, successful minimal standard projects have also to take into consideration attitudinal differences. A good example is that of self-help housing construction. The provision of limited housing "core" structures may be required to stimulate self-help efforts in one locale, while the mere provision of urban services may stimulate self-help in housing construction in a locale with more available land. Government-provided roof loans proved successful in generating home building in one case; the provision of minimum urban amenities at low cost appeared sufficient to generate home building in another.

The lack of standardization among urban projects designed to meet only minimal standards makes urban planning a more difficult, lengthy process. Nevertheless, experience has shown that such projects offer a most promising beginning on dealing with urban needs within stringent financial and physical resource limits.

One such project financed recently by the World Bank is a low income settlement scheme in Senegal. The project, involving the provision of building lots, related social services (schools and health facilities) and technical assistance (for a follow-on national program) is designed to stimulate self-help housing construction for some 20,000 families.

The low income families for which the project is intended earn incomes too small (\$40 to \$120 per month) to qualify for standard public housing (typically \$5,100 per household unit). In fact, under the present public housing program only 20% of all new households (based on the expected income distribution) and less than 50% of all existing public housing applicants can afford the \$25 monthly mortgage payment required. Under the sites and services project, installment payments of \$9 monthly are within the means of an additional 40% of new households, and all existing public housing applicants.

The low cost of urban amenities that make up a serviced building lot particular in this / project is the result of a careful limiting in standards: roads are limited to essential arteries with the exception of a few unpaved streets for pedestrians; public water fountains are provided at a ratio of one per 100 households with the possibility of private water connections at additional cost; pit privies are required for all households except where private water connection necessitates septic tanks; electricity is provided for public street lighting, and available for private lot connections at extra cost. Such design standards which provide also for labor intensive building methods where practical, reduce the cost of roads (\$33 per household) to one seventh that in public housing operations; water distribution (\$36 per household) to one half that in public housing operations; sewerage and drainage (\$87 per household) to one third that in public housing. The total cost of such a serviced lot (excluding power distribution lines and the extension of other primary infrastructure paid for by the Government) is estimated at \$290 or \$3.60 per month (including land preparation costs, interest, water service charges and management costs). The project also provides for schools, health

facilities, and community cultural and recreational sites -- the costs of which are typically not charged to the individual household. The only element of subsidy is land over which the Government has title with minor exception.

Housing costs under this scheme make up the remainder of the \$9 monthly installment costs, and are estimated on the basis of self-help housing construction. Labor costs constitute about 40% of private housing costs in Senegal: consequently, if labor costs are excluded, the cost of a typical dwelling of 60 m² is reduced to about \$460 which together with the cost of the serviced lot can be repaid relatively easily over a 15 year period or less.

The site and services project in Senegal is a realistic response to the urban needs of exploding populations in Dakar and Thies. At a cost of around \$100 per capita (households average over 7 persons), a significant amount of basic infrastructure can be supplied to these areas. It is estimated that the 20,000 housing units constructed over the next five years would be some 10,000 units more than would be built at comparable cost by the public housing authority under its standard low cost housing program. Thus the site and services scheme, designed to meet minimal standards and to motivate self-help labor, minimizes costs both to the householder and to the Government. Further, the scheme will have the important effect of creating employment (in construction of schools, clinics, public lavatories, installation of infrastructure and preparation of land, as well as construction), stimulating the mobilization of private savings, and breaking the current trend towards urban deterioration.

Sites and services projects are one means of the best means of effectively ^{matching} / scarce public resources with the needs and demands of the low income sector. A recent survey of sites and services projects in some 32 countries points up the many varieties in financial and physical design of these projects, as well as the ^{diverse reasons for the} / relative successes of several projects more closely analyzed. Sites and services is obviously not a cure-all even for the housing problem, but it can be an element of cure, particularly if undertaken as part of a larger residential settlement policy. Some of the problems encountered in sites and services programs for example, were the result of a lack of integrated urban planning. Site locations were often too far removed from public transportation, sources of employment, health care and education to improve the welfare of the occupants (three quarters of whom fell behind on monthly repayments). Sites developed on urban outskirts where land is cheap tended to ring major cities, segregating rich and poor. More conscious development of the low income settlements themselves on an integrated basis with community service centers and employment sources could have alleviated some of the hardships, and facilitated (through formalization of community leaders and local organizations) the collection of payments. Yet despite these difficulties, a number of the programs can be looked at as a success.

Even minimal standard programs, such as sites and services, will tax to the limit the financial resources of most developing countries.^{1/} Yet

^{1/} Another significant minimal standard program is neighborhood improvement, under which existing squatter settlements are provided minimal utilities and services. The program offers a practical alternative to the tremendous social and economic costs of relocating inhabitants and reconstructing urban infrastructure. The capital formulation in infrastructure in slum settlements is a considerable asset. Upgrading these communities, rather than tearing them down, can, particularly for the poorer developing countries, be the only realistic response to urban needs.

they are realistic programs. The developing countries in their choice of urban investment alternatives will have to resolve the dilemma of excessive real demand for high-income and medium-income facilities against the equally real but unexpressed demand for minimal facilities of the low income groups. But only in their choice of the latter will they effectively tackle the urban problem -- the problem of providing adequate conditions of living for rapidly increasing urban populations. At the same time, few programs offer as promising a road to large-scale employment generation as these minimum standard programs. One is reminded in the difficulty of choice confronting the urban developing world of a well-known development official's comments regarding Greece's recovery program after World War II. In the wisdom of Andrew Jackson, he said, they will have to learn to elevate their sights a little lower.

Provision of urban services at minimal standards is one means of meeting the urban problem. Other measures of partial and complementary remedy are discussed in the World Bank's paper. None is a panacea, for the city is too complex a body to permit easy solutions. The urban effort requires direction, however, and it is this need that the sector paper with its concerted attention to definition of objectives and rough delineation of patterns of urban growth and their determinants has addressed.

A View of the Urban Needs of Developing Countries



—by ROBERT SADOVE—

Director, Urban Projects Department International
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FIRST PART

How real is the concern for cities? Major cities everywhere have slums, unemployment, housing shortages, inadequate transport systems and congestion of people and traffic. And as major metropolitan areas are increasing in size, these problems are getting worse.

To ignore such problems is to ignore them. Coping with such problems demands not only recognition and concern, but a commitment of financial and human resources to a strategy that is based on the achievement of social as well as economic goals.

The pamphlet "Urbanization Sector Working Paper," produced by the staff of the World Bank and attached to these introductory comments, focuses on the developing part of the world where the magnitudes involved compound every aspect of the urban problem and create an urgency for urban action that is far more intense than in the developed world. The physical dimensions that make the urbanization problem in the developing countries so severe are fourfold—the rapidity of urban population growth, the worsening of income distribution, the mounting unemployment and the increasing deterioration in average living conditions for city population.

The financial dimension of the urban problem is an acute shortage of total resources available for development, coupled with heavy costs of providing urban services. The sector paper reviews each aspect of the urban problem and this note summarizes certain parts of the analysis. The detailed study in the sector paper is pertinent not only to diagnosis of the urban problem, but to an understanding of the various elements of remedy. The sector paper suggests several possible approaches to urban development in light of such analysis; this introductory note highlights one such prescribed element of remedy—a minimal standard approach to urban services plus priority for employment creation.

Urban population growth in developing countries is at an all time high. The current growth rate averages about 5% a year, half of which is due to natural increase, and half to rural-urban migration.

With very little prospect of immediate change in the growth rate (birth control programs are only slowly effective, and programs to curtail the migratory movement have been notably unsuccessful), the urban population is projected to double in 15 years. By the turn of the century, the urban population of developing countries is projected to increase by over 1 billion people or by more than three times the total urban population of the developed world in 1960. And while the rural and small town populations growing at a rate unprecedented in the developed world at comparable periods will also increase by over a billion people, the proportion of population in urban areas (above 20,000) to population in rural areas will increase from 15% in 1960 to 31% in the year 2000. In countries of South Asia, the proportion of urban population (which at 76.7 million in 1960 was the greatest in absolute magnitude of any developing region) to rural population is projected to rise to an even higher 33% by the turn of the century.

Urban population in the Asia region (projected to increase to about 345 million) by the year 2000 will exceed the total urban population in all developing countries in 1960 (310 million).

As might be expected, countries with the highest rates of total population growth and with the highest proportion of rural to urban populations will experience the highest rates of increase in urban populations. Generally in the developing countries, one urban center, several times the size of the next largest, has borne the brunt of the most rapid population increases in each country. Lagos grew from a city of less than 250 thousand to 1½ million in population between 1950 and 1970; Bangkok grew from under 1 million to 3 million during the same period; and Bogota grew from 650 thousand to 2.5 million during the same period. Each of these cities far surpasses in size other cities in their respective countries. If such a trend continues, large cities of over half a million inhabitants will probably undergo the most rapid growth.

And there is no reason to doubt the continuation of such patterns.

The implications of the rapid growth of urban populations projected for developing countries are alarming. Ironically, a major enticement to rural-urban migrants is the very real income differential between country-side and town. Average per capita income in major cities is often 3 to 5 times that of the countryside. In India, to choose one of many possible examples, the annual per capita income (1961) of Bombay was about Rs 1,020 compared with Rs 390 in Maharashtra State, where Bombay is located, and somewhat less in India as a whole. The disillusionment is that income differentials within the cities are often as great, if not greater, than those between city and countryside, with wealth concentrated in the hands of a very small segment of urban population. In one city where we have been working, for instance, average per capita GDP is around \$600 compared to \$130 in the surrounding countryside, and as many as 80% of the urban families have incomes too low to pay for minimum public housing as presently conceived. Such heavily skewed income distribution is subjecting an increasingly high proportion of urban population in the developing world to despondency and listlessness. Conditions of slum dwelling, unemployment and low per capita incomes breed despair that, as numbers increase and awareness sets in, may erupt into violent protest.

A wretched complement to the problem of worsening income distribution is steadily increasing unemployment among the urban poor. Urban employment affecting between 10% and 20% of the potential labor force (and particularly the 15-24 year old age bracket) is not uncommon in the developing countries, and has been estimated to be as high as 30% in a number of major cities.

The mounting urban unemployment of the last two decades is not likely to abate in the years ahead. International Labor Office (ILO) projections indicate that the total labor force of developing countries will expand by at least 25% between 1970 and 1980. While urban labor force participation rates tend to be somewhat lower than for the overall population (since urban workers tend to enter the labor force later and retire earlier than agricultural workers), there is little ground, given the high urban population growth rate, for expecting the labor force rate of increase in the cities to be significantly less than

the projections for the developing world.

Paradoxically, the numbers of the potentially employable are rising sharply at a time when the rate of increase in employment opportunities in the small modern wage paid section of the urban developing world is diminishing. Modern industrial output is expanding, but technological advances are reducing the requirement for industrial employment to about one half the growth rate of industrial output. Further, modern industries are in some instances replacing small-scale handicrafts, and thereby reducing employment. The more traditional sectors of the urban economy (including the bazaar sector and "catch-all" service sector) are absorbing the larger proportion of the labor force, though employment in these sectors often tends to be marginal.

Urban existence for the mounting numbers of unemployed or marginally employed is bleak, and prospects for amelioration still bleaker. Slum populations growing at a rate of 20% or more a year in big cities are on their way to dominating city populations and by closing in on small modern affluent sectors converting these sectors into virtual ghettos. Various cities in developing countries already have shantytown populations that account for 50% or more of the city population. Yet despite the growing proportion of urban poor, municipalities have generally failed to act in their behalf. A World Health Organization document prepared for the 1972 U.N. Conference on Human Environment has indicated that less than 25% of urban families receive water in their houses or courtyards (and even then the water is often unsafe or insufficient) and that only 12% of urban families in developing countries have sewage facilities. Few squatter areas receive municipal services beyond some marginal system of electricity supply, and what limited public housing is available is too costly for the poor to afford.

Unless determined action is taken to accommodate or counter current trends, urban conditions will deteriorate even further in the next decade as urban populations in the developing world soar to an estimated one billion. The task requires a commitment to creative planning, for municipalities which are swamped by the physical dimensions of the problem are hamstrung in undertaking constructive reform by the financial and institutional dimensions of the problem.

Municipal governments are caught between a severe shortage of capital resources and high costs of urban development. Income levels in the majority of countries are less than \$250 per capita, and in many others as low as \$150. (While average urban incomes are generally higher than rural incomes, the rate of increase in urban populations requiring public services is also higher; the net savings in cities and countryside per head of population increase tend therefore to be roughly the same). Further, as average per capita income in cities increases from \$100 to \$200, the population increases roughly eightfold, thus negating any possible gain of total resources for development.

The extent of the gap between possible resource mobilization and the cost of providing employment, housing and other urban infrastructure for the urban population

increase is best explained through illustrations noted in the Bank report. As an example, assume that a city has a population of 500,000 and a per capita income of \$150. At a savings rate of 10%, the city will generate \$7.5 million in gross savings annually. At a 6% growth rate of population with 60% labor force participation, there will be 18,000 new labor force entrants and 30,000 new population each year. The annual capital cost of creating employment for the incremental work force would be \$21.6 million, assuming the modest cost of \$1,200 per worker. The annual cost of providing the additional population with necessary infrastructure including housing would amount to \$15 million, assuming a low per capita cost rate of \$500. Thus, some \$36.6 million would be required annually compared to a total gross savings of only \$7.5 million.

The gap between needed costs and available savings becomes still larger when both the capital costs of providing infrastructure for the deprived existing population and the current costs of maintaining and replacing existing municipal facilities and services are included in the calculation.

The dilemma of our hypothetical city is a real one for most of the urban developing world. In Bombay municipal revenues in 1970 totaled \$84 million—roughly half of the total annual capital requirements estimated for the new population. With an average per capita income of \$228, the base for taxation in Bombay is simply too small even for improved municipal finance fully to make up the difference. A shortage of resources for urban growth is characteristic even of cities with relatively high average levels of per capita income.

The urban problem is worsening day by day as migrants pour into cities (in numbers as high as 5,000 a week in Bombay) and together with the natural increase in population add radically to the ranks of unemployed, poor and deprived. At today's costs and today's standards of what constitutes reasonable conditions for living, most cities are incapable of mobilizing the capital required to provide for the incremental population, let alone meet the backlog of unsatisfied urban needs.

There is no single solution to urban deterioration; political commitment to act in behalf of the squatter and other urban poor is an important ingredient. Must cities erupt into violence before the need to improve living conditions becomes focal to the politician, or before higher income residential groups become fully conscious of the need to forego some material increase for the benefit of the city at large? Rational urban planning and development which will involve the determination of policies for land use, for transportation, for housing will require the clarification and collective agreement on long range social goals.

As difficult as is the achievement of political concern and consensus on the need for urban reform, it is not the only problem. As we have noted, the urban developing world is horrendously

short of resources with which to confront the progressive deterioration in quality of urban life. Elements of cure may be found in international capital transfers and local capital formation, but the scale of needs outweighs even the most optimistic projections of possible resource mobilization. The physical and financial dimensions of the problem force the planner to ask new questions relating to hitherto assumed urban needs.

The capital requirements of the industrialization/urbanization process are in all countries related to higher aspirations and standards than in the past. Most larger urban centers are closely connected with the more industrialized countries abroad, which they often resemble more closely than they do minor towns in their own country. This resemblance, or aspiration to resemblance, is to the disadvantage of much of the urban developing world; the costs involved in providing similar conditions for living are, as we have noted, far beyond the means available in developing countries. Provision of modern transport, social services, education, and urban amenities on the pattern of the more developed world requires extremely high capital and operating costs. The question whether the urban developing world can adapt itself to a new more practical less ambitious concept of an adequate standard of living becomes pertinent, if not crucial, to an urban solution.

TO BE CONTINUED

The necessity for a minimal standard approach to urban development in the developing world can be illustrated readily in the field of housing. Housing is basically not the same problem in the cities of the developing world. In the developed countries, the basic problem of housing derives primarily from social and institutional rigidities; in the developing countries, housing needs estimated at a staggering \$ 12 billion a year are simply beyond national resources. Further housing costs at the standards perceived are financially beyond the reach of low income families, making the demand for housing in developing countries largely "noneffective".

The practical aspects of non effective demand can be demonstrated using India as an example. If the cost of a "minimum" dwelling under Indian conditions is Rs 8,000 (Assuming 450 sq. ft. at Rs 12 per sq. ft. (Rs 5,400) and including costs for land at Rs 1,600 and site development at Rs 1,000. Source: Catherine Bauer Wurster, "Urban Living Conditions, Overhead Costs, and the Development Pattern" India's Urban Future, edited by Roy Turner (1962), pp. 297-8 (Less than Class A level services assumed). annual debt service payments assuming 100% financing at 10% interest for 10 years, would be Rs 1,304 or monthly payments of Rs 109. If every household in Calcutta were prepared to spend 15% of its income on mortgage payments, which is a reasonable first approximation, then on the basis of the income distribution estimated for the Calcutta population and presented in the table below, 87% of households could not afford such a dwelling. Having cut monthly payments in half for illustrative purposes, the mortgage (not to mention the costs of maintenance and operation) would still be beyond the reach of about 67% of the households.

It is accordingly no surprise to find that public housing intended for low-income groups is frequently occupied by middle-income families. In fact, perhaps three quarters of the population in the major cities of the poorer developing countries cannot afford the economic rent of the conventional type "low cost" housing. Even assuming substantial transfers by way of subsidies, total national savings are quite inadequate for the effort required. The problem is compounded by high land costs, limited mortgage facilities and poorly organized construction industries. Therefore, for at least the poorer countries of the developing world, public provision of conventional low-cost housing for the urban poor directly or indirectly is simply not a practical proposition.

The necessity of relating infrastructure costs to the incomes of the people is valid for the provision of sewerage, electricity, and other urban amenities, as well as housing (though housing is the greatest urban cost representing often 60-70% of the total). The magnitude of urban investments, however, is such that much more than slight changes in project design is required. A realistic appraisal of what minimal facilities for water supply, sanitation services, transport, educational and health service constitute satisfactory conditions for living is basic to successful urban reform. For only by reducing the standards of urban project design to a somewhat more spartan,

though acceptable level, and by seeking less costly means of execution can the bulk of the needy be included in the benefits of economic development. "Self help" is an important aspect of such an approach. Experience has proven that self help efforts are readily engendered among urban poor particularly for house construction.

The payoff from self-help housing is high; radically reduced housing costs and increased national and personal savings (a tendency among all home builders). And equally significant, self-help housing construction has the important effect of creating employment for those most in need of work. The labor component, often as great as 40% of standard housing construction costs, has been estimated to be closer to 50% for minimal standard self-help housing construction. In Calcutta, for example, a 1963 UNIDO study on construction indicates that the labor component required by low standard housing is 50% (20% unskilled and 30% skilled) compared with 40% (15% unskilled and 25% skilled) required by high standard housing). In several detailed studies on employment in the Calcutta area, direct employment generated for each Rs 100,000 expended on housing and other urban infrastructure construction was calculated (assuming an input composition for construction as a whole of 33% for labor and 67% for material inputs) at roughly 18-23 man-years. A.N. Bose, A Note on the Estimation of Employment Potential During the Fourth Five-Year Plan Period Based on CMD Development Schemes (Calcutta, CMPO, typescript) 5, and V.G. Bhatia, "Employment Potential of Roads," in R.C. Ridker and H. Lubell, Employment and Unemployment Problems of the Near East and South Asia. Vol. II, 766 as cited in H. Lubell, Urban Development and Employment: The Prospects for Calcutta (1972) 104, 105. Indirect employment in local building materials industries (based on a local inter-industry demand multiplier for construction of 1.6 and for labor of 6) was calculated at roughly 15-17 man-years. If mi-

Estimated Income Distribution
Calcutta Metropolitan District Multi
Member Households 1971.

Income Groups (Current Rs per month)	Housing Expenses Capacity Range 15% Rent Income Ratio.	Percent of total Households 1971	Total Households 1971 (In 100,000)
Less than Rs 100	Less than Rs 15	16.3	2.33
Rs 100 - 299	Rs 15 - 44	46.7	6.69
Rs 300 - 499	Rs 45 - 74	16.1	2.31
Rs 500 - 699	Rs 75 - 104	7.8	2.12
Rs 700 - over	Rs 105 - over	13.1	1.87
		100.0	14.32

minimal standard self-help construction is encouraged, the impact of urban infrastructure development in providing at least 35 man-years of employment per Rs 100,000 expended, could be significant for Calcutta — a city of large scale unemployment; The investment required to generate direct employment would be roughly \$ 450 per worker or (assuming a 33% labor force participation rate) a modest \$ 150 per capita.

A minimal standard program for urban development can stimulate employment in other ways. Less immediate, though significant, is the increase in economic activity that urban rehabilitation generates — that is to say dying cities come to life. A potential benefit which can derive from minimal standard programs that has become much more important is the rehabilitation of the very small scale service related industries similar to the cottage industry of semi-rural areas.

A minimal standard approach to urban development is largely empirical. Physical, financial and attitudinal differences among developing country cities color the identification of minimal standards of urban facilities and services, the mobilization of human and financial resources, and the acceptability of urban plans. A flexible approach to project design — one that takes advantage of the characteristics of a particular environment — is important to minimizing project costs. In one country, for example, roads were constructed under a Rural Works Program that in many other countries would have clearly been considered sub-standard. The roads were mostly dirt and compacted by hand hammers or by sections of concrete pipe used as hand pulled rollers. Nevertheless such roads as these played an important role in accommodating bicycles, rickshaws and animal carts which opened up large areas to agricultural marketing. By using labor-intensive methods of construction, capital costs were kept to a minimum. The high costs of maintaining the roads (which were subject to rapid deterioration) were acceptable to the country because of its large labor surplus.

A minimal standard approach requires that assumptions regarding "fixed" requirements and standards be broken down. What is assumed as a fixed need, may not be a valid assumption on close analysis. In one case study of water supply, it was estimated that all the demands placed on a major water system would involve expansion of storage capacity by 20% — an enormous investment. Such an investment would not be required if consumers would reduce their demand for water by a few percentage points for short period — a probable result if consumers were faced with the alternative of paying the full cost of the water that they received during those critical periods. Another popular example is the use of private automobiles in cities.

Automobile use is often regarded as a necessity, even where alternative modes of transport exist. The question is whether people might give up use of the car in the city, if charged the full costs (direct and indirect i.e., high congestion costs to others, road space costs, road construction costs) of its use. Costs and benefits vary with each locale, and need to be related clearly to each standard proposed.

As noted earlier, successful minimal standard projects have also to take into consideration attitudinal differences. A good example is that of self-help housing construction. The provision of limited housing 'core' structures may be required to stimulate self-help efforts in one locale, while the mere provision of urban services may stimulate self-help in housing construction in a locale with more available land. Government provided roof loans proved successful in generating home building in one case; the provision of minimum urban amenities at low cost appeared sufficient to generate home building in another.

The lack of standardization among urban project designed to meet only minimal standards makes urban planning a more difficult, lengthy process. Nevertheless, experience has shown that such projects offer a most promising beginning on dealing with urban needs within stringent financial and physical

resource limits.

One such project financed recently by the World Bank is a low income settlement scheme in Senegal. The project, involving the provision of building lots, related social services (schools and health facilities) and technical assistance (for a follow-on national program) is designed to stimulate self-help housing construction for some 20,000 families. The low income families for which the project is intended earn incomes too small (\$40 to \$120 per month) to qualify for standard public housing (typically \$5,100 per household unit). In fact, under the present public housing program only 20% of all new households (based on the expected income distribution) and less than 50% of all existing public housing applicants can afford the \$25 monthly mortgage payment required. Under the sites and services project, installment payments of \$9 monthly are within the means of an additional 40% of new households, and all existing public housing applicants.

The low cost of urban amenities that make up a serviced building lot in this particular project is the result of a careful limiting in standards; roads are limited to essential arteries with the exception of a few unpaved streets for pedestrians, public water fountains are provided at a ratio of one per 100 households with the possibility of private water connections at additional cost; pit privies are required for all households except where private water connections necessitates septic tanks; electricity is provided for public street lighting, and available for private lot connections at extra cost. Such design standards which provide also for labor intensive building methods where practical, reduce the cost of roads (\$33 per household) to one seventh that in public housing operations; water distribution (\$ 36 per household) to one half that in public housing operations; sewerage and drainage (\$87 per household) to one third that in public housing. The total cost of such a serviced lot (excluding power distribution lines and the extension of other primary infrastructure paid for by the Government) is estimated at \$290 or \$3.60

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housing program only 20% of all new households (based on the expected income distribution) and less than 50% of all existing public housing applicants can afford the \$25 monthly mortgage payment required. Under the sites and services project, installment payments of \$9 monthly are within the means of an additional 40% of new households, and all existing public housing applicants.

The low cost of urban amenities that make up a serviced building lot in this particular project is the result of a careful limiting in standards; roads are limited to essential arteries with the exception of a few unpaved streets for pedestrians, public water fountains are provided at a ratio of one per 100 households with the possibility of private water connections at additional cost; pit privies are required for all households except where private water connections necessitates septic tanks; electricity is provided for public street lighting, and available for private lot connections at extra cost. Such design standards which provide also for labor intensive building methods where practical, reduce the cost of roads (\$33 per household) to one seventh that in public housing operations; water distribution (\$ 36 per household) to one half that in public housing operations; sewerage and drainage (\$87 per household) to one third that in public housing. The total cost of such a serviced lot (excluding power distribution lines and the extension of other primary infrastructure paid for by the Government) is estimated at \$290 or \$3.60

per month (including land preparation costs, interest, water service charges and management costs). The project also provides for schools, health

facilities, and community cultural and recreational sites - the cost of which are typically not charged to the individual household. The only element of subsidy is land over which the Government has title with minor exception.

Housing costs under the scheme make up the remainder of the \$9 monthly installment costs, and are estimated on the basis of self-help housing construction. Labor costs constitute about 40% of private housing costs in Senegal. Consequently, if labor cost are excluded, the costs of a typical dwelling of 60 m² is reduced to about \$460 which together with the cost of the serviced lot can be repaid relatively easily over a 15 year period or less.

The site and services project in Senegal is a realistic response to the urban needs of exploding population in Dakar and Thies. At a cost of around \$100 per capita (households average over 7 persons), a significant amount of basic infrastructure can be supplied to these areas. It is estimated that the 20,000 housing units constructed over the next five years would be some 10,000 units more than would be built at comparable cost by the public housing authority under its standard low cost housing program. Thus the site and services scheme, designed to meet minimal standards and to motivate self-help labor, minimizes costs both to the house-holder and to the Government. Further, the scheme will have the important effect of creating employment (in construction of schools, clinics, public lavatories, installation of infrastructure and preparation of land, as well as construction), stimulating the mobilization of private savings, and breaking the current trend towards urban deterioration.

Sites and services projects are one means of the best means of effectively matching scarce public resources with the needs and demands of the low income sector. A recent survey of sites and services projects in some 32 countries points up the many varieties in financial and physical design of these projects, as well as the diverse reasons for the relative successes of several projects more closely analyzed. Sites and services is obviously not a cure-all even for the housing problem, but it can be an element of cure, particularly if undertaken as part of a larger residential settlement policy. Some of the problems encountered in sites and services programs for example, were the result of a lack of integrated urban planning. Site locations were often too far removed from public transportation, sources of

employment, health care and education to improve the welfare of the occupants (three quarters of whom fall behind on monthly repayments). Sites developed on urban outskirts where land is cheap tended to ring major cities, segregating rich and

poor. More conscious developments of the low income settlements themselves on an integrated basis with community service centers and employment sources could have alleviated some of the hardships, and facilitated (through formalization of community leaders and local organization) the collection of payments. Yet despite these difficulties, a number of the programs can be looked at as a success.

Even minimal standard programs, such as sites and services, will tax to the limit the financial resources of most developing countries.

Another significant minimal standard program is neighborhood improvement, under which existing squatter settlements are provided minimal utilities and services. The program offers a practical alternative to the tremendous social and economic costs of relocating inhabitants and reconstructing urban infrastructure. The capital formulation in infrastructure in slum settlements is a considerable asset. Upgrading these communities, rather than tearing them down, can, particularly for the poorer developing countries, be the only realistic response to urban needs. Yet they are realistic programs. The developing countries in their choice of urban investment alternatives will have to resolve the dilemma of excessive real demand for high-income and medium-income facilities against the equally real but unexpressed demand for minimal facilities of the low income groups. But only in their choice of the latter will they effectively tackle the urban problem - the problem of providing adequate conditions of living or rapidly increasing urban populations. At the same time, few programs offer as promising a road to large-scale employment generation as these minimum standard programs. One is reminded in the difficulty of choice confronting the urban developing world of a well-known development official's comments regarding Greece's recovery program after World War II. In the wisdom of Andrew Jackson, he said, they will have to learn to elevate their sights a little lower.

Provision of urban services at minimal standards is one means of meeting the urban problem. Other measures of partial and complementary remedy are discussed in the World Bank's paper. None is a panacea, for the city is too complex a body to permit easy solutions. The urban effort requires direction, however, and it is this need that the sector paper with its concerted attention to definition of objectives and rough delineation of patterns of urban growth and their determinants has addressed.

The Expanding City

Urban Asia May Have to Lower Its Sights

Robert Sadove

Director, Urban Projects Department, World Bank

Aspiring for a high standard of urban amenities may prove to be dangerous for the Asian city, as it would for the expanding cities of any developing country. But if they accept a minimum standards approach they may yet be able to reach more sustainable economic and social goals.

The necessity for a minimal standard approach to urban development in the developing world can be illustrated readily in the field of housing. Housing is basically not the same problem in the cities of the developing world. In the developed countries, the basic problem of housing derives primarily from social and institutional rigidities; in the developing countries, housing needs estimated at a staggering \$ 12 billion a year are simply beyond national resources. Further, housing costs at the standards perceived are financially beyond the reach of low income families, making the demand for housing in developing countries largely "non-effective".

The practical aspects of non-effective demand can be demonstrated using India as an example. If the cost of a "minimum" dwelling under Indian conditions is Rs 8,000, approximately US \$ 1,000, the cost worked out in a 1962 study, India's Urban Future, edited by Ray Turner, when the annual debt service payments, at 10% financing at 10% interest for 10 years, would be Rs 1,304 or monthly payments of Rs 109.

If every household in Calcutta were prepared to spend 15% of its income on mortgages payments, which is a reasonable first approximation, then on the basis of the income distribution estimated for the Calcutta population and presented in the table below, 67% of households could not afford such a dwelling. Having cut monthly payments in half for illustrative purposes, the mortgage (not to mention the costs of maintenance and operation) would still be beyond the reach of about 67% of the households.

Estimated Income Distribution
Calcutta Metropolitan District Multi-Member
Households, 1971

Income Groups (Current Rs per month)	Housing Expenses Capacity Range 15% Rent- Income Ratio	Percent of Total Households Households	Total 1971 (in 100,000)
Less than Rs100	Less than Rs 15	16.3	2.33
Rs 100 — 299	Rs 15 — 44	46.7	6.69
Rs 300 — 499	Rs 45 — 74	16.1	2.31
Rs 500 — 699	Rs 75 — 104	7.8	1.12
Rs 700 — over	Rs 105 — over	13.1	1.87
Total		100.0	14.32

It is accordingly no surprise to find that public housing intended for low-income groups is frequently occupied by middle-income families. In fact, perhaps three quarters of the population in the major cities of the poorer developing countries cannot afford the economic rent of the conventional type "low cost" housing. Even assuming substantial transfers by way of subsidies, total national savings are quite inadequate for the effort required. The problem is compounded by high land costs, limited mortgage facilities and poorly organized construction industries. Therefore, for at least the poorer countries of the developing world public provision of conventional low-cost housing for the urban poor directly or indirectly simply not a practical proposition.

The necessity of relating infrastructure costs to the incomes of the people is valid for the provision of sewerage, electricity, and other urban amenities as well as housing (though housing is the greatest urban cost, representing often 60-70% of the total). The magnitude of urban investments however, is such that much more slight changes in project design is required. A realistic appraisal of what minimal facilities for water supply, sanitation services, transport, educational and health services constitute satisfactory conditions for living is basic to successful urban reform.

Only by reducing the standards of urban project design to a somewhat more spartan, though acceptable level, and by seeking less costly means of execution, can the bulk of the needy be included in the benefits of economic development. "Self-help" is an important aspect of such an approach. Experience has

proven that self-help efforts are readily engendered among urban poor, particularly for house construction.

The payoff from self-help housing is high: radically reduced housing costs and increased national and personal savings (a tendency among all home builders). And equally significant, self-help housing construction has the important effect of creating employment for those most in need of work. The labour component, often as great as 40% of standard housing construction costs, has been estimated to be closer to 50% for minimal standard self-help housing construction; in Calcutta, for example, a 1969 UNIDO study on construction indicates that the labour component required by low standard housing is 50% compared with 40% required by high standard housing.

In several detailed studies on employment in the Calcutta area, for example, A.N. Bose's Note on the Estimation of Employment Potential During the Fourth Five-Year Period Based on CMD Development Schemes and V.G. Bhatia's Employment Potential of Roads, in E.G. Ridker and H. Lubell's *Employment and Unemployment Problems of the Near East and South Asia*, direct employment generated for each Rs 100,000 expended on housing, and other urban infrastructure construction was calculated (assuming an input composition as a whole of 33% for labour and 67% for material inputs) at roughly 18-23 man-years.

Indirect employment in local building materials industries (based on a local inter-industry demand multiplier for construction of 1.6 and for labour of 0.6) was calculated at roughly 15-17 man-years. If minimal standard self-help

construction is encouraged, the impact of urban infrastructure development in providing

at least 35 man-years of employment per Rs 100,000 expended could be significant for Calcutta - a city of large scale unemployment, the investment required to generate direct employment would be roughly \$400 per worker or (assuming a 33% labour force participation rate) a modest \$150 per capita.

A minimal standard program for urban development can stimulate employment in other ways. Less immediate, though significant, is the increase in economic activity that urban rehabilitation generates - that is to say dying cities come to life. A potential benefit which can derive from minimal standard programs that has become much more important is the rehabilitation of the very small scale service related industries similar to the cottage industry of semi-rural areas.

A minimal standard approach requires that assumptions regarding "fixed" requirements and standards be broken down. What is assumed as a fixed need may not be a valid assumption on close analysis. A flexible approach to project design - one that takes advantage of the characteristics of a particular environment - is important to minimizing project costs.

In one country, for example roads were constructed under a rural works program that in many other countries would have clearly been considered substandard. The roads were mostly dirt and compacted by hand hammers or by section of concrete pipe used as hand pulled rollers.

Nevertheless, such as these played an important role in

accommodating bicycles, rickshaws and animal carts which opened up large areas to agricultural marketing.

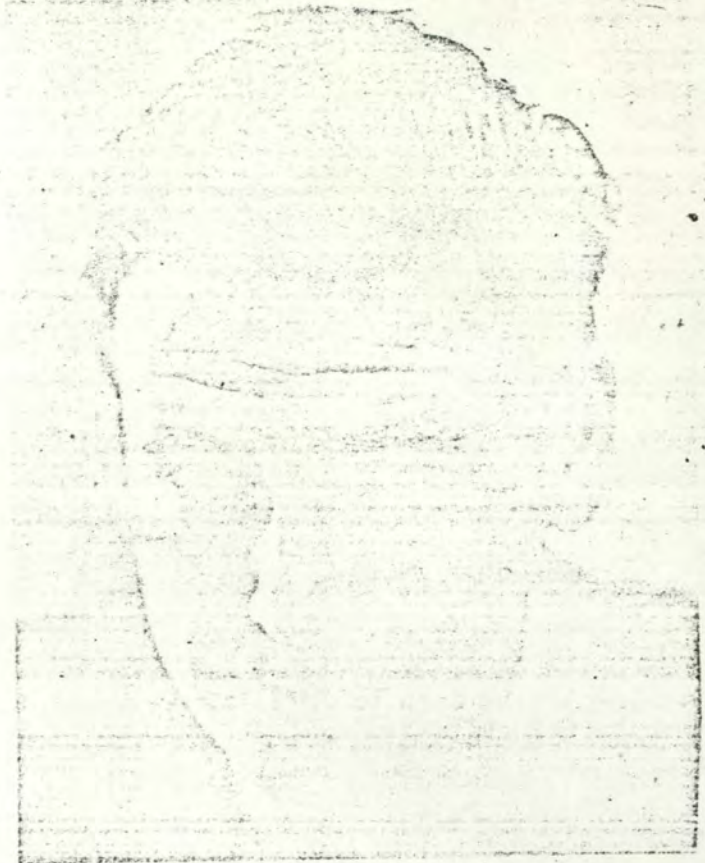
By using labour-intensive methods of construction, capital costs were kept to a minimum. The high costs of maintaining the roads (which were subject to rapid deterioration) were acceptable to the country because of its large labour surplus.

In one case study of water supply, it was estimated that all the demands placed on a major water system would involve expansion of storage capacity by 20% - an enormous investment. Such an investment would not be required if consumers would reduce their demand for water by a few percentage points for short periods - a probable result if consumers were faced with the alternative of paying the full cost of the water that they received during those critical periods.

Another popular example is the use of private automobiles in cities. Use of automobiles is

often regarded as a necessity, even where alternative modes of transport exist. The question is whether people might give up use of the car in the city if charged the full costs (direct and indirect, that is high congestion costs to others, road space costs, road construction costs) of its use. Costs and benefits vary with each locale and need to be related clearly to each standard proposed.

Attitudinal differences must also be taken into consideration. A good example is that of self-help housing construction. The provision of limited housing "core" structures may be required to stimulate self-help efforts in one locale, while the mere provision of urban services may stimulate self-help in a locale with more available land. Government-provided roof loans proved successful in generating home building in one case, the provision of minimum urban amenities at low cost appeared sufficient to generate them in another.



Mr. Robert Sadove

Director of Bank's Urban Projects, World Bank Visits Here

The Director of the Special Projects Department of the International Bank for Reconstruction and Development (World Bank), in this case the Director of the Bank's Urban Projects Department, Robert Sadove is due here today from April 4 to 9.

The Bank has its headquarters in Washington, DC, USA. During his stay in Jakarta at President Hotel, those Jakarta Press members who are interested in interviewing the visiting Bank Staff member is welcome, the Information and Public Affairs Officer of the World Bank reported.—YS.

The Exploding City - III

An African Answer for Asia's Urban Dilemma

Robert Sadove

Director, Urban Projects Department, World Bank

The minimum standards approach is no longer only a theory. It has been tested on the ground in Senegal and has proved a success. Houses and other amenities of lower but adequate standards have been built, using labour intensive methods, and people have facilities now which they would not have had without departure from "normal" city standards.

The lack of standardization among urban projects designed to meet only minimal standards makes urban planning a more difficult, lengthy process. Nevertheless, experience has shown that such projects offer a most promising beginning on dealing with urban needs within stringent financial and physical resource limits.

One such project financed recently by the World Bank is a low income settlement scheme in Senegal.

The project, involving the provision of building lots, related social services (schools and health facilities) and technical assistance (for a follow-on national program) is designed to stimulate self-help housing construction for some 20,000 families. The low income families for which the project is intended earn incomes too small (\$40 to \$120 per month) to qualify for standard public housing (typically \$5,100 per household unit).

In fact, under the present public housing program only 20% of all new households (based on the expected income distribution) and less than 50% of all existing public housing applicants can afford the \$25 monthly mortgage payment required. But instalment payments of \$9 monthly worked out under a sites and services project are, within the means of an additional 40% of new households and all existing applicants for public housing.

The low cost of urban amenities that make up a serviced building lot in this particular project is the result of a careful limiting in standards: roads are limited to essential arteries with the exception of a few unpaved streets for pedestrians; public water fountains are provided at a ratio of one per 100 households with the possibility of private water connections at additional cost; pit privies are required for all households except where private water connection necessitates septic tanks,

electricity is provided for public street lighting, and available for private lot connections at extra cost.

Design standards which provide also for labour intensive building methods where practical reduce the cost of roads (\$33 per household) to one seventh that in public housing operations, water distribution (\$36 per household) to one half that in public housing operations, sewerage and drainage (\$87 per household) to one third. The total cost of such a serviced lot (excluding power distribution lines and the extension of other primary infrastructure paid for by the Government) is estimated at \$290 or \$3.60 per month (including land preparation costs, interest, water service charges, and management costs).

The project also provides schools, health facilities, and community cultural and recreational sites - the costs of which are typically not charged to the individual household. The only element of subsidy is land over which the Government has title with minor exceptions.

An African (Continued from page 4)

Housing costs under this scheme make up the remainder of the \$9 monthly instalment costs, and are estimated on the basis of self-help housing construction. Labour costs constitute about 40% of private housing costs in Senegal; consequently, if labour costs are excluded, the cost of a typical dwelling of 60 square metres is reduced to about \$460 which together with the cost of the serviced lot can be repaid relatively easily over a 15-year period or less.

The site and services project in Senegal is a realistic response to the urban needs of exploding populations in Dakar and Thies. At a cost of around \$100 per capita (households average over 7 persons), a significant amount of basic infrastructure can be supplied to these areas.

It is estimated that the 20,000 housing units constructed over the next five years would be some 10,000 units more than would be built at comparable cost by the pu-

Continued on page 5)

blic housing authority under its standard low-cost housing program.

Thus the site and services scheme, designed to meet minimal standards and to motivate self-help labour, minimizes costs down to the household and to the government. Further, the scheme will have the important effect of creating employment (in construction of schools, clinics, public lavatories, installation of infrastructure and preparation of land as well as construction), stimulating the mobilization of private savings, and breaking the current trend towards urban deterioration.

Sites and services projects are one of the best means of effectively matching scarce public resources with the needs and demands of the low income sector.

A recent survey of sites and services projects in some 32 countries points up the many varieties in financial and physical design of these projects, as well as the diverse reasons for the relative successes of several projects more closely analysed.

A sites and services approach is obviously not a cure-all even for the housing problem but it can be an element of cure, particularly if undertaken as part of a larger residential settlement policy and if problems which result from a lack of integrated urban planning are avoided. For example, site locations should not be too far removed from public transportation sources of employment, health care and education to improve the welfare of the occupants. Yet despite these difficulties, a number of such programs can be looked upon as a success.

Sites developed on urban outskirts where land is cheap tend to ring major cities, segregating rich and poor. More conscious development of the low income settlements themselves on an integrated basis with community service centres and employment sources, can alleviate hardships and facilitate (through formalization of community leaders and local organizations) the collection of payments.

Another significant minimal standard program is neighbourhood improvement, under which existing squatter settlements are provided minimal utilities and services.

The program offers a practical alternative to the tremendous social and economic costs of relocating inhabitants and reconstructing urban infrastructure. The capital for mutation in infrastructure in slum settlements is a considerable asset. Upgrading these communities, rather than tearing them down, can particularly for the poorer developing countries, be the only realistic response to urban needs.

Even minimal standard programs will tax to the limit the financial resources of most developing countries. Yet they are realistic programs. The developing countries in their choice of urban investment alternatives will have to resolve the dilemma of excessive real demand for high-income and medium-income facilities

against the equally real but unexpressed demand for minimal facilities of the low-income groups. But only in their choice of the latter will they effectively tackle the urban problem - the problem of providing adequate conditions of living for rapidly increasing urban populations. At the same time, few programs offer as promising a road to large-scale employment generation as these programs.

✓
April 10, 1973

Mr. Francisco Sison
45-24 17th Street
Manhasset Neck
New York 11756

Monique

Marylouise Jte

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In addition to the draft article, I am enclosing a sector
reviews the Bank's approach in this

Sincerely,

Pastor B. Sison
Information & Public Affairs

Encls:

PBS/mj

Dear Mr. Sugrue:

I have gone over my files and have found out that in November 1972 I had prepared a draft article on the Muda project, based on notes taken during a visit to the project in May 1972 and from the pamphlet issued by the Muda Agricultural Development Authority on the inauguration of the scheme in April 1972. This article has not been published in any periodical and therefore you may use it freely. It attempts to give an idea of the economic and social changes being wrought in the project area.

In addition to the draft article, I am enclosing a sector paper on Agriculture, which reviews the Bank's approach in this sector.

Pastor B. Sison
Information & Public Affairs

PBS/mj

The Muda Agricultural Scheme

The Muda River irrigation scheme is Malaysia's largest agricultural development project, covering over 260,000 acres of traditionally single cropped padi land in the northeastern states of Kedah and Perlis. In these areas, the "green revolution" has wrought striking change.

The scheme was formally opened in April 1972, at an estimated cost of more than \$83.1 million. A World Bank loan of \$45 million helped to finance the project. While the immediate economic benefits are impressive -- two crops are now grown on approximately 115,000 acres and padi production there has risen by over 40% to 180,600 tons -- the true meaning of the project lies in the rising living standards and incomes in the farm communities in the area.

Problems Associated with Double Cropping

The Muda area is a flat, gently sloping alluvial plain. Unlike most tropical rice growing areas where rainfall is fairly uniform during the monsoon, rainfall in the project area during this season is erratic. Construction work started in 1966 on the "engineering backbone" of the project -- dams, canals, drains, water control devices and farm roads. It was soon discovered, however, that water supply was only one of the problems involved in growing two crops a year. The farmer had to be provided with short term, high yielding rice varieties and fertilizer and insecticide. He also had to be assisted in his attempts at farm mechanization and in obtaining access to transportation and padi-drying equipment. A market for his crop had to be assured.

Pilot Projects

As testing grounds for the technological practices associated with double cropping, pilot projects were established in large contiguous areas. In these areas, advice was given to farmers on factors contributing to higher productivity and efficient farm management, cultural practices and plant protection. Credit facilities were provided to farmers in the form of recommended fertilizers and insecticides. Several smaller demonstration projects were also set up in strategic locations throughout the Muda scheme.

Institutional Changes

An integrated approach to development was made possible in large part by the establishment of agencies at the farm locality and regional levels. A Muda Agriculture Development Authority was set up to plan and coordinate project implementation. At the "grassroots" level, farmers associations were organized as channels to provide the package of technological innovations to individual farm units. The formation of farmers associations follows the phased schedule of irrigation implementation -- they start operations about six months prior to assured irrigation in a locality.

When a farmer buys a share in an association, he becomes a voting member and his elected representative participates in the decision-making process. Besides serving as an administrative base for motivating farmers, these associations provide necessary extension services, facilitate credit and marketing, and make available to the farmer the new seed and fertilizer packages required by double cropping.

A large number of farmers speaking with one voice and one bank account can do what few individual farmers are not able to do. Large types of

machinery can be purchased and maintained by the farmers associations, and volume purchasing of seed, fertilizer and insecticide is practiced. By making these large purchases, the associations are able to pass the savings to their members.

Service centers have been set up in each farm community, each consisting of about 8,000 to 11,000 acres, through which the package of modern practices can be provided to farmers. It is planned that each community will have a market center for inputs, equipment and output; adequate roads to connect farm units to the center; agricultural extension services; and access to farm production credit.

Credit and Marketing Assistance

Under the credit scheme devised by the Agricultural Bank for the Muda region, production credits on soft terms are made available to farmers through the ~~farmers~~ farmers associations.

These credits are in the form of negotiable coupons, backed up by centralized record keeping of each farmer's account. Coupons are issued to farmers whose loan applications have been approved. Coupons may only be exchanged for inputs -- high yielding padi varieties, recommended fertilizers -- which meet the technical specifications of the Department of Agriculture. Loans are conditioned on the farmers' acceptance in the recommended amounts and on their following of extension advice on proper application. Farm visits are scheduled to assist farmers in proper utilization.

Farmers associations are responsible for repayment of the loan. Under the Agriculture Bank's policy, repayments are made in kind. The associations help the farmer in marketing padi, and also in the collection, storage and

transportation of his crop. Participation by associations in the marketing scheme as purchasing agents complement their responsibility for loan collection. The associations make appropriate reductions from proceeds of padi sales and the remainder is refunded to farmers.

Effects

The Muda scheme, then, is not limited to purely economic objectives, but is also designed to bring about social changes in the farm community. Participation in the farmers associations provides opportunities for frequent contacts among farmers and leads to group action. Able and qualified farmers are assigned roles of leadership and responsibility. Eventually, these new way of doing things will not only improve the farmer's crop but also enhance the quality of his way of life and work.

April 11, 1973

Mr. Zein Effendi
Chief Editor
Jakarta Times
P.O. Box 224/DKT
Djakarta, Indonesia

Dear Mr. Effendi:

I write to thank you for carrying Mr. Sadove's article, "The Dark World of the Asian City," in your April 5 issue. The fact that this was published the day following the author's arrival in Djakarta and that it was carried in the space usually reserved for your editorials will certainly stimulate discussion of, and interest in, this important subject.

With much appreciation,

Yours sincerely,

Pastor B. Sison
Information & Public Affairs

PBS/mj

Speech By
R. Sadove

THURSDAY APRIL 5, 1973

THE JAKARTA

TIMES

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Mail and Cable Addresses all depts. :

MAIL ADDRESS : P.O. Box 224/DKT.

CABLE : DJAKTIMES

Monthly Subscription Rp. 400,—

The Asia Magazine Weekly Rp. 150,— (monthly)

Postage and freight costs :

Rp. 150,— (in Java)

Rp. 250,— (out of Java)

Advertisement Rate Rp. 90,— per mm col.

Rp. 250,— (front page)

(col. width 4.2 cm)

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Publication Permit : SIT No. 0488/Per. 2/SK/DIRJEN-PG

SIT/1972

September 22, 1972

Printing Permit : Kep. 006 Pk/IC/I/1973

The Exploding City

The Dark World of The Asian City

Robert Sadove

Director, Urban Projects Department, World Bank

The menace of a population explosion has at last begun to be fairly widely understood. But not yet the menace of the more intense explosion which is boiling up within it, the uncontrolled burgeoning of urbanisation, and nowhere is this explosion building up more menacingly than in some of the bestknown cities of Asia. The new generations being born in them or migrating to them are as enormous in numbers as the means of sustaining them are meagre.

Urban population growth in developing countries has reached an all-time high. The current growth rate averages about 5% a year, half of which is due to natural increases and half to rural-urban migration. With very little prospect of immediate change in the growth rate (birth control programs are only slowly effective, and programs to curtail the migratory movement have been notably unsuccessful), the urban population is projected to double in 15 years.

By the turn of the century, the urban population of developing countries is projected to increase by over one billion people, which means this increase alone will be more than three-times the total urban population of the developed world in 1960. And while the rural and small town populations growing at a rate unprecedented in the developed world at comparable periods will also increase by over a billion people, the proportion of population in urban areas (above 20,000) to population in rural areas will increase from 15% in 1960 to 31% in the year 2000.

In countries of South Asia, the proportion of urban population (which at 76.7 million in 1960 was the greatest in absolute magnitude of any developing region) to rural population is projected to rise to an even higher 33% by the turn of the century. Urban population in the Asia region (projected to increase to about 345 million) by the year 2000 will exceed the total urban population in all developing countries in 1960 (310 million).

As might be expected, countries with the highest rates of total population growth and with the highest proportion of rural of urban populations will experience the highest rates of increase in urban populations.

Generally in the developing countries, one urban centre, several times the size of the next largest has borne the brunt of the most rapid population increases in each country.

Lagos grew from a city of less than 250 thousand to 1½ million between 1950 and 1970, Bangkok grew from under 1 million to 5 million during the same period, and Bogota grew from 650 thousand to 2.5 million. Each of these

cities far surpasses in size other cities in their respective countries. If such a trend continues, as it probably will, large cities of over half a million inhabitants will probably undergo the most rapid growth.

The implications of these projections for the developing countries are alarming.

Ironically, a major enticement for migrants from rural to urban areas is the very real income differential between countryside and town. Average per capita income in major cities is often three to five times that of the countryside.

In India, to choose one of many possible examples, the annual per capita income (1961) of Bombay was about Rs 1,020 compared with Rs 390 in Maharashtra State, where Bombay is located somewhat less in India as a whole.

The irony is that income differentials within the cities are often as great, if not greater, than those between city and countryside, with wealth concentrated in the hands of a very small segment of the urban population. On the other hand unemployment is much greater among the urban poor and is increasing further in the developing countries.

Urban employment affecting between 10% and 20% of the potential labour force (and particularly the 15-24 year old age bracket) is not uncommon in the developing countries and has been estimated to be as high as 30% in a number of major cities. International Labour Office (ILO) projections indicate further increases by at least 25% between 1970 and 1980.

Such heavily skewed income distribution and rising unemployment are subjecting an increasingly high proportion of the urban population in the developing world to despondency and listlessness. Conditions of slum dwelling unemployment and low per capita incomes breed such despair that, as the anticipated enchantment gives way to disillusionment, as numbers increase, and as awareness sets in, may erupt into violent protest.

Prospects for amelioration are bleak. Slum populations growing at a rate of 20% or more a year in big cities are on their way to dominating city populations and, by closing in on small modern affluent sectors, converting these sectors into virtual ghettos. Various cities in developing countries already have shanty town populations that account for 50% or more of the city population.

Yet despite the growing proportion of the urban poor, municipalities have generally failed to act in their behalf. A World Health Organization document prepared for the 1972 UN Conference on Human Environment has indicated the less than 25% of urban families receive water in their hou-

Continued on page 5)

The Asian City

(Continued from page 4)

ses or courtyards (and even then the water is often unsafe or insufficient) and that only 12% of urban families in developing countries have sewage facilities.

Few squatter areas receive municipal services beyond some marginal system of electricity supply, and what limited public housing is available is too costly for the poor to afford.

Municipal governments are caught between a severe shortage of capital resources and high costs of urban development. Income levels in the majority of countries are less than \$ 250 per capita, and in many other as low as \$ 150. While average urban incomes are generally higher than rural incomes, the rate of increase in urban populations requiring public service is also higher, the net savings in cities and countryside per head of population, increase tend therefore to be roughly the same).

Further, as shown by Ward and Dubos in *ONLY ONE EARTH* in the time it takes per capita income in cities to increase from \$ 100 to \$200, the population increases roughly eightfold, thus negating any possible gain of total resources for development.

As an example, assume that a city has a population of 500,000 and a per capita income of \$150. At a savings rate of 10%, the city will generate

\$7.5 million in gross savings annually. At a 6% growth rate of population with 60% labour force participation, there will be 18,000 new labour force entrants and 30,000 new population each year. The annual capital cost of creating employment for the incremental work force would be \$21.6 million, assuming the modest cost of \$1,200 per worker. The annual cost of providing the additional populations with necessary infrastructure including housing would amount to \$15 million, assuming a low per capita cost rate of \$500. Thus, some \$36.6 million would be required annually compared to total gross savings of only \$7.5 million.

The gap between needed costs and available savings becomes still larger when both the capital costs of providing infrastructure for the deprived existing population and the current costs of maintaining and replacing existing municipal facilities and services are included in the calculation.

The dilemma of our hypothetical city is a real one for most of the urban developing world. In Bombay municipal revenues in 1970 totalled \$84 million roughly half of the total annual capital requirements estimated for the new population. With an average per capita income of \$288, the base for taxation in Bombay is simply too small even for improved municipal financing to make up the difference. A shortage of resources for

urban growth is characteristic even of cities with relatively high average levels of per capita income.

Elements of cure may be found in international capital transfers and local capital formation, but the scale of needs outweighs even the most optimistic projections of possible resource mobilization. The physical and financial dimensions of the problem force the planner to ask new questions relating to hitherto assumed urban needs.

The capital requirements of the industrialization/urbanization process are in all countries related to higher aspirations and standards than in the past. Most larger urban centres are closely connected with the more industrialized countries abroad, which they often resemble more closely than they do minor towns in their own country.

This resemblance, or aspiration to resemblance, is to the disadvantage of much of the urban developing world, the costs involved in providing similar conditions for living are far beyond the means available in developing countries.

Provision of modern transport, social services, education and urban amenities on the pattern of the more developed world requires extremely high capital and operating costs. The question whether the urban developing world can adapt itself to a new, more practical less ambitious concept of an adequate standard of living becomes pertinent. If not crucial, to an urban solution.

In magnitude the communist aid and trade program so far is not impressive.

Let's look first at trade. Soviet exports in 1957 to all countries outside of the communist bloc -- industrialized countries and underdeveloped countries together -- were on a par with the exports of Denmark, slightly over \$1 billion or not much more than a twentieth of American exports. The trade of the whole communist bloc with the underdeveloped countries amounted to less than 5% of the total foreign trade of those countries. And, most significantly, very little communist trade with the underdeveloped countries involved capital goods. To all of the Middle East and Asia in 1957 the communist bloc shipped only \$85 million worth of capital goods and the biggest items, accounting for a large share of the total, were trucks and other automotive equipment rather than heavy machinery.

Since the communist bloc entered the aid business in 1955, the bloc as a whole has advanced an estimated \$2.5 billion in credits for military and economic aid. But estimates of communist aid are deceptive and require qualification. Leaving aside Yugoslavia as a special case to which I will refer later, it appears that as of six months ago upwards of 90% of these credits had gone to four countries -- the United Arab Republic, India, Afghanistan and Indonesia. Communist aid overtures to Africa and Latin America have as yet produced very little in concrete terms.

But students of the subject estimate that only about 40% of these credits have been drawn upon and most of this has been for military equipment. Perhaps as much as 75 to 80 per cent of the strictly economic aid still consists of promises to deliver in the future, in some cases several years in the future. It would appear safe to say that communist economic aid actually disbursed in the Middle East and Asia has amounted to but a small fraction of American aid disbursed in the same countries over the same period of time. And this is saying nothing about the disbursements of international organizations, such as the World Bank, or about private foreign investment.

If these are the dimensions of Soviet trade and aid, it's tempting to ask: Why all the fuss? Why the fascination? Particularly, why is so much attention paid here in this country to each trade and aid move the Soviets make when the total is so meager in comparison with all that the Free World is doing?

It is clear, I think, that both communist aid and communist trade involve a mixture of political and economic motives and that the mixture varies from place to place and time to time. Given the Cold War it is not surprising that people in this country concentrate on searching out the political motive. The Russians, in fact, invite such a search. We have Mr. Krushchev's word to a Congressional delegation three years ago that he "values trade most for political purposes and least for economic purposes."

But to get a realistic idea of the economic importance of Soviet policy you have to try to strip off the political wrappings. And once this is attempted the evidence suggests that Soviet aid and trade tactics are dictated fully as much by the nature of the communist economic system and by the geography of the communist empire as they are by the existence of a grand political strategy.

It is most significant, I think, that the great majority of the trade of the Soviet bloc today is still made up of raw materials and lately of semi-manufactures like tin and aluminum. Even Russian aid, with one or two notable

exceptions, consists largely of materials and technical assistance rather than machinery. These facts alone suggest caution in assuming any radical new departure from the traditional autarkic isolationism of Russian economic policy.

Traditionally, exports from the Soviet Union have been made up of accidental surpluses which have occurred in their rigidly-planned economies, rather than of production which is specifically undertaken for export. Traditionally, these surpluses have been bartered or sold for foreign exchange, anywhere and everywhere that the Soviets could get the supplies and equipment they needed to speed the completion of specific projects and programs in the prevailing five-year plan. We think that this is still the major purpose of communist bloc trade. The current visit of Russia's foreign trade boss, Mr. Mikoyan, suggests that the Soviets, and presumably the Chinese, still want a good deal from the non-communist world -- very probably a good deal more than they can buy with the materials they have available for export.

This is not to say that the Soviets do not now have larger surpluses than ever available for barter. It should surprise no one that a continent as large as Russia, and one which has been developing as fast as Russia, should produce increasing quantities of some kinds of raw materials -- and of things like tin and aluminum -- which are, in fact, in excess of their planned needs. What we must remember is the fact that the Soviets have been unwilling, and very probably have been unable because of their ideology, to become part of the world trading system. They have been unwilling or unable to enter into long-term, reliable trading relationships with non-communist countries; so each trade has tended to take on the appearance of a one-shot operation. Since they do not, by and large, produce things which the world trading system can easily absorb, they have practically been forced to offer many of their wares at discount prices in order to attract buyers.

One does not have to search for political motives to explain why Russians act like the bull in the china shop when trading on the world market. No doubt political considerations enter in, but the competition would very likely be of the same kind without them. It stands to reason that whichever way the political winds blow, we can expect more and larger sorties onto the world commodity markets by the Russians in the near future. They have made it plain that foreign trade is supposed to provide an important share of the machinery and equipment required for their present ambitious industrialization program. Already tin and aluminum producers have felt the effects of their here-today-and-gone-tomorrow trading tactics; I wouldn't be surprised to see similar raids on the wheat, rice and cotton markets. We should expect repetitions of spectacular deals like Russia's sale of benzene to Dow Chemical well below the market price, for payment in Dutch guilders.

Any increase in this unconventional kind of competition is bound to be felt by many non-communist traders. But the real losers are likely to be governments of the underdeveloped countries, some of whose leaders seem at times to most welcome Soviet trade overtures. Most underdeveloped countries are, of course, peculiarly dependent on their own raw material exports, often on the export of a single commodity. The fall in price of one of these commodities by as little as 1% in a given year can more than wipe out all the aid and investment from abroad which a given underdeveloped country might receive in that year. Since over a wide range of commodities the Soviets are exporting the same things, the growth of these countries may in many instances be disrupted by Russia's trade tactics.

Bolivia, Malaya and Indonesia all had their economic prospects temporarily darkened last year when the Soviets suddenly dumped large quantities of tin on the market just as the new international tin stabilization program was getting underway. There are several possible explanations of why the Russians chose this particular moment to move into the tin market, but I would suggest that the timing was an indication of the fact that the demand for foreign exchange to buy needed imports is much higher in the order of priorities in Russian trade than is generally credited. If the timing was the result of political strategy, it has the earmarks of a blunder.

I do not mean to minimize the all too obvious opportunities which the Soviets have to use trade for sheer political opportunism. When an underdeveloped country finds itself with an embarrassing surplus of its staple commodity export -- either as a result of a recession in the market or a breach in economic relations with the non-communist world -- the Soviet government with its monopoly on foreign trade is in a fine position to step in with an attractive offer. When that commodity is cotton or rice or something else which is produced abundantly in the communist empire, it is no great difficulty under the Russian system to absorb a quantity of imports while at the same time exporting an equal quantity of home production. The appearance of an increasing supply of Russian cotton on the world market coupled with large shipments of Egyptian cotton to Russia suggests this is happening in that commodity.

But I would not jump to the conclusion that the Soviets put this kind of maneuver ahead of their own hell-for-leather industrialization program. What I do suggest is that the political dividends are largely by-products of Soviet policy and they do not always redound to the benefit of the Russians.

The fact is that despite Russian offers and promises, Russian trade today competes with the trade of the underdeveloped countries more than it complements that trade. It may be that over a period of years the Russians will discover that it is to their economic advantage to rely more on the import of raw materials in exchange for exporting more capital goods. But a marked swing in that direction would amount to a revolution in Soviet policy. While Russian exports of capital goods will inevitably increase somewhat in the near future, there is little reason to expect that the Russians will be willing to become dependent on the underdeveloped countries for any significant percentage of their raw material needs. And so long as they hold to their tradition of autarkic self-sufficiency, we need not expect that their capital goods exports will approximate in volume those of any of the larger western trading nations.

What gives more substance to the belief that the Soviets have embarked on a new course of economic imperialism is the fact that they have recently jumped on to the foreign aid bandwagon. It is undeniably a great departure for Russia to provide a non-communist nation with a steel mill on long-term credit as has happened in India. In fact, Krushchev went to the length of justifying it to his own people in a special broadcast.

So far there has been very little experience on which to judge Russian aid. It appears that a typical communist credit runs for 12 years -- sometimes less but so far no more -- and bears an interest label of $2\frac{1}{2}\%$. On the surface this looks cheap, although you can't tell whether or not there are additional charges in the prices of the goods covered by the credit.

The Soviets claim that they offer aid with "no strings attached." In practice this amounts to saying to the borrowing country: "We can't finance

all the things you want, but tell us a project you are particularly anxious for and we will tackle that. Interest is only $2\frac{1}{2}\%$ and we will take the principal back in goods and foreign exchange you can spare." They would not think of demanding anything like an economic justification for the projects they finance, such as is common practice with World Bank loans. In fact, they righteously denounce such practices as "interference in the internal affairs" of the borrowing country.

This does not mean that the projects to which the Russians tie their credits are not carefully chosen. They appear to be tailored to the individual market with some care. In Afghanistan it's paving the streets of the capital city of Kabul; in Egypt it's a nuclear physics laboratory and a down payment on the huge Aswan Dam; in India, in addition to the steel mill, there is an offer pending to build a pharmaceutical factory, providing it will be state-owned; in Syria the Russians claim they are building 30 different power plants and small industrial enterprises. Some of the latter, incidentally, were taken out of a survey report conducted for the Syrian government several years ago by the World Bank!

This aid has one further attraction worth noting. Unlike aid from the affluent West, Russian aid undoubtedly has a special appeal in the underdeveloped world because there is a feeling that it represents a real sacrifice by the Russian people. Aid from the West is regarded more as an inconvenience to the lender, if not actually a welcome pump primer to the economies of the West with their unused productive capacity.

We in the World Bank are not surprised that the Soviet approach gets an interested reception in the underdeveloped world. In view of the overwhelming demands for economic growth in most underdeveloped countries any new help, and any new source of help, is bound to be welcomed. Governments which refused at least to explore what the Soviets offered might well find themselves in trouble with their own people. Perhaps the attraction is greatest among the newer nations, all of which are in a hurry to develop their economies and feel they cannot afford delay.

Nevertheless we in the Bank do not conclude that in the foreseeable future Soviet aid will be a very important factor compared with what the Free World is doing now. In addition to the fact that the demands of the home front would seem to preclude any significant outpouring of aid, we do not believe that the communists can become seriously interested in fostering economic growth under any auspices but their own. Their ideology tells them that self-sustaining growth in an underdeveloped country today is impossible except under communism. It seems to us, therefore, that the Soviets will probably withhold any consistent, long-term aid programs until and unless a country falls into the Soviet orbit through its own disintegration or through the mistakes or failures of the Free World powers.

Syria is a case in point. The concentration of Russian aid in Syria today is potentially dangerous; the danger is that the Syrian economy may become so closely tied to Russia that the Syrians will not be able to disentangle themselves before being swallowed up in the communist empire. But in this instance Soviet aid is being used not so much to create the proper political conditions for subversion as to consolidate a political windfall that came with the Suez crisis.

Except as the result of extraordinary failure, I find it hard to believe that any underdeveloped country today would be duped into selling its independence for a mess of Russian aid. As the Yugoslav case has shown, Soviet aid in the final analysis has more strings attached to it than a kitchen mop. Not only did Russia cut off Yugoslavia without a ruble of aid last year when the Yugoslavs refused to mold their foreign policy to the Russian model, the Yugoslavs also found themselves exposed to difficulties in conducting current trade. I would not be surprised if other countries now receiving substantial Soviet aid did not suffer the same disillusioning experience, with the result that distrust of Soviets bearing gifts will spread.

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If the story ended here, we in the World Bank would not be unduly alarmed by the new fashion in international economics. Insofar as Russian trade and aid actually succeed in adding to the goods and equipment the underdeveloped countries need without compromising their independence, we would even welcome it. Communist practice as regards quality and delivery of goods and services, while not especially good, is regarded as adequate by most countries. (There is a story in Washington about a Russian official who is supposed to have said: "Russian trucks are like my wife; not very well-designed, but adequate for normal purposes." This seems to be the consensus among those who do business with Russia.)

But the story does not end here. Back of the communist aid and trade overtures stands the picture of two countries, Russia and China, which today appear to be growing faster than any other major economic powers in the world except Germany and Japan. Over the past several years, Russian gross production has been rising between two and three times as fast as that of the United States. And in the perspective of history, according to a recent study, one can say that under communism Russia has accomplished its industrial revolution faster than any major country -- though, as a matter of fact, not much faster than Japan or South Africa.

I do not cite these facts to make the Russians out to be ten feet tall; growth rates, we all know, are not measures of total economic strength; the United States, growing at 3 or 4 per cent a year, is still incomparably the strongest economic power on earth and promises to remain so. I cite these facts rather to give a further and, I think, much more important reason for the fascination with Russia and China which exists throughout the underdeveloped world today. Whether we like it or not, many of the leaders of the underdeveloped world see in Russian and Chinese experience something much more relevant to their own problems than anything they see in the West.

Russia and China started in the recent past as poor, backward countries -- at least they were closer to being backward than any European or North American country. They have in a remarkably short time grown, if not rich, at least powerful under communism. If in the process their people have undergone great sacrifices and been reduced to the status of ants, the standard of living -- in Russia anyway -- has finally gone up and is higher today than that which prevails in most underdeveloped countries.

It is against Russian economic progress that many in the underdeveloped world tend to measure their own growth. It is not that these people are blind to the hideous scars which the Russian system has left. They hope to avoid

these scars. At the same time they know their people, too, will have to make sacrifices to grow. And in a country like India where there is still mass starvation in the teeming cities and in the over-populated and run-down countryside, they wonder how the people can be brought to accept the necessary sacrifices except by coercion.

These countries start from such a low point on the economic scale that the experience of the affluent West seems hopelessly irrelevant to them. They sometimes feel that no other model than totalitarianism exists to give them hope of eventual escape from the humiliation and degradation of a life of abject poverty. If the Free World has an alternative way to economic development that can approximate the rate of growth under communism without the terrible cost to humanity which communism entails, they do not yet see how that alternative applies to their particular situation.

Here we have, I think, the real nature of the competition that exists between the Free World and communism. We must ask ourselves, "Do we truly have an alternative that applies in the underdeveloped world?" Then we must ask, "Is it in our interests to pay the necessary price to see that our alternative has a real chance to work?" And let's not engage in the old American habit of fooling ourselves; the price will not be cheap; the job will not be done quickly; and no one will be able to guarantee results. With all those reservations is it worth our while to try?

These are the real economic questions posed to us by the co-existence of communism and the half of the world that is in revolt against a life of abject poverty. Those questions are not altered in any significant way by the new fashion in communist aid and trade. If we see the competition in terms of these incidentals rather than in terms of the broader challenge, we will indeed waste our resources.

A wise man recently wrote that "people who do not stand for anything are in danger of falling for anything." We must reconsider what the Free World stands for and see if it involves trying to make our experience relevant to the dire problems of these far-off countries. If it does, then we must calculate how much of our wealth and ingenuity we should throw into this objective, not just over one year or two, but over as many years as may be necessary to give our ideas a fair chance to take root and grow. Then we should cultivate the institutions and the careers necessary to manage this program wisely and consistently. And we should avoid pulling up plants by their roots every year or so to see how they are doing.

It is these long-term questions, not just what the Russians are doing from day to day, which should be commanding our attention. And it would seem to me that if we cannot demonstrate in the underdeveloped world the effectiveness of our own approach to economic growth, we are likely all too soon to find ourselves out of touch with more than half of the world's population and confronted with a horde of converts to the thesis that communism is inevitable.

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