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PREFACE

This document contains the speeches and biographical sketches of participants of the first series of a two-part seminar series conducted by the School of Engineering of Howard University during the 1972-73 school year.

These seminars were made possible by a grant from the U.S. Agency for International Development. The report of the second series of seminars given under this grant is contained in a separate volume.

The seminar program was under the direction of Dr. Percy A. Pierre, Dean of the School of Engineering, and a former member of the National Academy of Engineering's Panel on the Role of United States' Engineering Schools in Technical Assistance Overseas; and Dr. M. Lucius Walker, Jr., Associate Dean of Engineering. This report was prepared by Mrs. Leatha S. Henson who was also the coordinator of the seminar program.

TABLE OF CONTENTS

Introduction i

An Historical Perspective on U. S. Technical Assistance: Where It Has Been and Where It Is Going . . 1
Joel Bernstein

Intermediate Technology and Cumulative Technical Processes in East African Agriculture 13
Victor C. Uchendu

Global Development and Underdevelopment 27
George L. Beckford

Problems Relating to Human Factors in Transferred Technology in African Countries. 42
Raimi Olawale Ojikutu

Technology and the Environmental Crisis. 50
Barry Commoner

Economics and the Technology of Development. 63
A. R. Abdel Meguid

Anticipated Changes In Development Approaches. 76
Samuel C. Adams, Jr.

INTRODUCTION

During the 1972-73 academic year, the School of Engineering conducted the first part of a two-part series of "Seminars on Technology and Development in Developing Countries." These seminars were made possible by a grant from the United States Agency for International Development.

The purpose of the seminar series was to examine the process of development, the role of technical assistance, and the application of technology to the needs of developing countries, and thereby generate greater interest in the problems of development on the part of the students and faculty of the School of Engineering. An attempt was made not only to examine the beneficial aspects of technology, but also to assess some of the possible detrimental effects of technology on developing nations in the light of the experience of technologically advanced countries. It should be noted that most of the speakers also addressed themselves to political, social, cultural and economic factors which provided an essential background for understanding how various technologies and approaches might be applied most effectively in the context of these societies.

Howard University is unique in that it has the largest Washington area enrollment of foreign students from the developing nations of Africa, the Caribbean, and the Middle East. A significant proportion of these students are enrolled in the School of Engineering. Thus, this series gave both the American and international students, whose engineering and technological knowledge will be applied to meeting societal needs, the opportunity to examine some of the myths and realities of development as viewed through the eyes of experts and scholars. The presentations also delineated some of the areas where engineers could make important contributions to development.

Since the series was also open to the Howard community and the Washington technical assistance community, it offered an excellent opportunity for individuals with similar interests to meet and exchange ideas, and through cross-fertilization, thereby add to their understanding of the interrelationship between the goals of development and the application of technology to the realization of those goals.

An Historical Perspective on U.S. Technical Assistance: Where It Has Been and Where It Is Going

by

JOEL BERNSTEIN, Assistant Administrator, Bureau of Technical Assistance, U.S. Agency for International Development

A lecture given on February 27, 1973, Seminar Series on Technology and Development, School of Engineering, Howard University

Dr. Bernstein was appointed to his present post in September 1969. Dr. Bernstein began his career in foreign assistance with the inauguration of the Marshall Plan in 1948, and has served in a variety of positions with A.I.D. Dr. Bernstein was Mission Director in Nigeria from 1959 to 1964, when he moved to Korea as Mission Director and Minister at Seoul. He served there until reassignment to Washington in 1967 as Director of Program Evaluation in the Office of the A.I.D. Administrator. He holds an A.B., M.A., and Ph.D. from the University of Chicago.

AN HISTORICAL PERSPECTIVE ON U. S. TECHNICAL ASSISTANCE: WHERE IT HAS BEEN AND WHERE IT IS GOING

by

Joel Bernstein

As the lead speaker in this seminar series on technology and development, I have been asked to provide some historical perspective on the role of U.S. technical assistance in development and some ideas on its future role. I shall dwell on those aspects that seem most germane to the themes of the seminar and not try to give you a description of the many different types of technical assistance activities in which AID or others have been engaged.

Historical Origins

Next year will be the 25th anniversary of an event of historic importance. I hope that historians will, over time, recognize its profound involvement with the well-being of mankind.

I'm referring to the launching of comprehensive technical assistance for countries that have had relatively little access to modern technologies through their own people--the so-called developing or less developed countries (LDCs). This launching was in Point IV of the foreign policy program set forth in President Truman's Inaugural Address of 1949. Point IV was the charter for American technical assistance in the underdeveloped world. Despite the great and immediate security threats of that period, heavy preoccupation with traditional relations with Europe, and growing disillusionment with international cooperation and its demands on the U.S. budget, the President had the vision and courage to start down a broad road of long-range constructive help for the two-thirds of mankind who were struggling to enter the modern world.

Of course, the provision of training and other technical help for peoples of less-developed countries was not a new practice. It had been provided in substantial measure by Western countries to people in politically dependent areas, both to discharge political responsibilities and for missionary motives. Point IV was launched as a departure from such paternalistic efforts. It proposed technical cooperation between sovereign states, to assist the efforts of the poorer nations to provide better lives for their peoples. This was revolutionary.

Blossoming of Technical Assistance

From the seeds planted by President Truman, technical assistance as an official concern of government has blossomed into a major dimension of international relations--with large bilateral and multilateral programs. There has been a parallel expansion of private technical assistance.

U.S. Government appropriations for Technical Assistance grew from the provision of $31.9 million for Fiscal Year 1951, to almost $600 million in Fiscal Year 1972. The share allocated to the United Nations organizations also rose steadily to $156 million in the last fiscal year. Using a broader definition of technical assistance applied by the Development Assistance Committee--an organization of the 16 major donor countries--its members spent $9.3 billion during the seven years through 1968. The annual level rose steadily to $1.8 billion in the last year. The U.S. share for the seven years was 35 percent.

By now, most countries of the world have participated in technical assistance activities as donors or recipients--some as both. On the broadest definitional base, there may be something like 320-350,000 foreign experts of public and private organizations now working in developing countries--40 percent or more from public sources.

At the outset, the complexity of the technical assistance undertaking was scarcely recognized. The early supporters and practitioners alike had rather simple images of the process of transferring skills. Skilled people would "show and tell" the unskilled in the field. Or the unskilled could be brought to training institutions, either in their own countries or in the United States or elsewhere. A few pilot projects would inspire emulation that would induce large scale application. This was conceived of as a low-cost, largely technical and "grass roots" endeavor. The emphasis was on health, education and agriculture--areas of development which touched the lives of people directly and stressed human involvement. A favorite description was "shirt-sleeve diplomacy." From this relatively simple prescription, development was expected to flow.

As it has turned out, the task is much more complicated. The teaching of technology, by itself, is the easiest part, if we know what to teach. What is infinitely more difficult is identifying what knowledge is relevant, and fitting its use into existing systems of human effort in order to produce the types of change that are the goals of the particular country's development policy.

The systems of human effort for which new technology is sought are in turn integral portions of complex and highly varied social and political systems, which in turn reflect a great range of historical experiences of the societies and individuals being exposed to new technologies. Each technical innovation changes the relative position and welfare of many people, and the effects of this must be attended to. The whole context of values, policies, and institutions must support or at least allow the intended changes. Finding the right combinations may take much time and investment, and also good luck.

The process of influencing these factors--of guiding social change--is of course difficult at best, even for those with authority in the societies where the change is occurring, whether they are developed or developing countries. Finding effective and acceptable systems for external participation in this process has required much learning.

Moreover, it has turned out that the developed countries have comparatively little knowledge that is directly applicable to the problems of developing countries--that is, little that can be applied without considerable further technical development or adaptation, and the creation of locally fitted policies and institutional devices for applying the knowledge. Thus, technical assistance has had to become much more research oriented.

It has also had to recognize, increasingly, the interactions and interdependence of all aspects of development. What is faced are problems of inducing and supporting desired changes. To bring these changes about requires closely coordinated applications of physical resources or capital, and of technical services. Experience has indicated that effective assistance for this process requires an ability to participate in or influence the whole sequence of actions and resource applications that affect the desired outcomes, so that separate manipulations of development investments and technical training and innovation often become artificial and inefficient. From this experience has come the concept of development assistance, deploying in an integrated fashion whatever packages of capital and technical services are appropriate to achieve the assigned purpose.

These and many other lessons had to be learned the hard way, by trial and error.

In short, development assistance has turned out to be a more complex, expensive and long-term process than was envisaged at the outset. However, despite the complex dimensions of technical assistance that have been revealed since Point IV was announced by President Truman, and despite the great importance for each nation's development of the aggregate of resources available to it--a concern that has preoccupied development planners--development in the end must concern itself with people--with their perceptions, abilities, behaviour and well being. In stressing this, the basic concept of technical assistance has from the start been sound, even if its applications have been too unsophisticated.

Changing Emphasis in AID Programs

Recognizing this, and also that resources of development capital are increasingly available to the poor countries from many other private and public, national and international sources, the stress in AID's programs has been shifting from resource transfers to help governments fill gaps in their balance of payments, budgets, or investment levels, towards efforts that focus more on the major problems of the masses of poor people in the less developed countries.

Before going on to some new approaches and emphases in U.S. technical assistance, perhaps I should define a few terms. Technical assistance refers to subsidized development and transfer of skills and technology--the latter being the application of knowledge to practical tasks. Technology refers not only to industry and engineering, but to the means of using resources in agriculture, health, education, administration and all other pursuits. Generally, we are talking about helping less developed countries to find better ways of doing things in their specific environments. The services provided include training in the U.S., the assisted country or third countries; advisory and analytical services; provision of technical and other needed information; and provision of skilled operators. Also involved, increasingly, is research and testing work to discover and try out better products and processes to apply to development purposes--i.e., work to develop better technologies--and to understand better the important cause and effect relationships between the factors in development and how the course of development can be influenced constructively.

AID's approach to the applications of technology to development reflect the growing recognition that people are at the center of the development process--both as the principal means of bringing about development and because improvement in their well being is the end purpose of development.

Central Role of People in Causing Development

Consider the role of people as a means of development. The extent to which the various development goals are reached--for output, employment, income distribution, health, education, or whatever--depends on two factors, to oversimplify somewhat. One is the amount of resources available to pursue the development purposes. The other is how well these resources are actually used. Typically, there is more annual potential for advancing development purposes by improving the use of the resources already available to a country than by adding additional resources from outside. This is because the stock of resources already available is many times larger than any increments that could be added, and because there are massive inefficiencies in the prevailing uses of the available resources. That is why the role of people is so critical. They make the decisions and carry out the activities that determine how resources are used--for better or for worse. The mass of the people participate in this process, not just a few entrepreneurs. Their role is much more important than simply that of another resource to be used in productive processes--labor, to be used along with land and capital --as they have sometimes been regarded.

The individual's decisions on how to use available resources are affected by the interaction of market forces, available technological alternatives, and a variety of socio-political and administrative considerations. To improve the actual uses of the resources available to LDCs, one need is for widespread investment in people's capabilities for making good resource use choices, by objective scientific and technological criteria as well as other considerations, given their development goals. Another important need is to widen the technological alternatives from which people can choose, so as to provide better opportunities to improve LDC people's lives in their actual situations.

Need to Introduce More Suitable Technological Options for LDCs

This may be a good juncture at which to stress a concern that has long bothered me, and that is particularly relevant in considering the relations between technology and development. The analytical methods of economics normally take technological relationships as givens--partly because it is the task of others, such as engineers and scientists, to establish what technological relationships are possible. On the basis of these and other givens, economists may then try to estimate what actions would maximize selected types of development results (too often the goal is confined to national output), or try to assess the comparative effects on various development goals of alternative investment, regulatory or other interventions into the development process, or try to answer other questions. This procedure skews the development recommendations in favor of those that are compatible with the assumed or given technological relationships. It tends to limit the range of choices of resources use to a group of alternatives that is less favorable for the pursuit of some objectives (for example, employment and income distribution) than the range of choices that would be open if other, currently unavailable technological relationships were included in the analysis. It ignores a major developmental need, which is to widen the technological options so as to introduce more favorable alternatives for LDC conditions.

Many have observed that the available technologies, mostly developed for the conditions of the technologically advanced countries, often do not fit well the needs of the less developed countries. Thus, a principal need of these countries--to be able to select from a wider range of technological alternatives and particuarly to have new options available that fit better their particular factor endowments and other circumstances--is not given adequate consideration in the analyses of economists and other social scientists that guide development programs. At the same time, the technologists who do concern themselves with the introduction of new technological alternatives for LDCs--who are all too few to begin with--generally use a set of goals, as givens, that are too limited and limiting to produce the best technological options for the millions of farmers, businessmen and officials who are deciding among alternatives uses of LDC resources. The technologists usually pursue a single goal--increased output of a given type--and often under an assumption of optimum or alien production conditions, like those in developed countries rather, than the actual conditions of LDCs. They have been little concerned with who benefits, and in what way, from the development process.

Need for Better Integration of Technological and Socio-Economic Analyses.

These observations suggest why AID and development agencies are seeking better collaboration between those who do economic and social analysis to guide development programming and those who work on changing the technological alternatives. A parallel need is to improve the analytical methodologies used by both groups so as to integrate into each as much as possible of the considerations that are examined as variables by the other. For example, the technologists need to be able to identify and develop better responses to socio-economic factors that inhibit effective use of specific technologies, and to be guided to invent efficient new technological relationships that are better suited to pursuit of whatever combinations of development goals sought by LDCs. Let me illustrate with some concrete examples.

AID has been financing research on weed control by Oregon State University. The results have been well received in a number of Latin American countries. But close examination has shown that the technologies used--essentially adaptations of those applied under U.S. conditions--require too much capital for equipment and pesticides, and too much management skill to be used extensively by the mass of small farmers. Recognizing employment and income distribution goals as well as output objectives, and the prevailing LDC conditions, the project has been redesigned to produce efficient weed control technologies that substitute labor for capital inputs and that are simpler to apply. At the same time, by lessening dependence on pesticides, the new technologies reduce environmental contamination.

Another agricultural example is the use of high yielding hybrid corn varieties. This technology was a great success in the U.S. Although suitable varieties were developed for LDCs, after much time and research investment, they were little used there because of different socio-economic factors than those prevailing in the U.S. Belated discovery of this factor after many wasted years caused a switch to a search for better non-hybrid varieties which meets LDC needs, and this effort promises to be highly successful.

Similarly, it is well known that the agricultural technologies that are most efficient for large and small farms are quite different in many cases and, conversely, that the type of technology available can affect whether large or small holdings are most efficient and thus more favored, say in conditions of excess labor supply. Our weed case is an example of this interdependence of the suitability of technology and farm size plus labor supply. Thus technology should not be pursued independently of social policy.

In the manufacturing area, the tendency to apply in LDCs technologies that are unsuited to their conditions and social needs has been widely noted. There has thus far been comparatively little effort to design technologies that minimize requirements for capital, maintenance and imported materials, and that maximize use of labor, local materials, ruggedness, and operating simplicity. The few exceptions dramatize this gap. Two such exceptions are Ford's and General Motors' initiatives to design a radically simplified and low cost, all purpose vehicle for LDC conditions. I was struck by the efforts to adapt to local conditions that I saw under way at the Korean Institute of Science and Technology during a visit two years ago--for example, the development of efficient designs for concrete boats that take advantage of Korea's abundant supply of good quality limestone in contrast to its lack of timber and steel plate.

If there were time, we could describe comparable examples of failure to relate technologies efficiently to socio-economic goals and conditions, in the fields of health, education and other social areas--indeed in all areas of resource application.

Market Forces

My stress thus far, and in what follows, on the role of technological factors in development is not meant to downgrade the critical importance of market forces in shaping development and of using and taking due account of such forces in development activities. This normally has been a basic consideration in development programming, and should remain so. The role of market forces, and how to influence and react to them in the pursuit of development goals is now comparatively well understood on all sides, and many assistanc agencies are helping LDCs to expand their knowledge and skills in this field. Nevertheless, their importance in particular problem situations is still commonly underestimated. I should add, however, that market forces have serious weaknesses in guiding the allocation of resources for new technological development, for reasons that I won't elaborate here.

My concentration this afternoon on improvement in the technological alternatives available to LDCs, as a major factor in development, follows the focus of this seminar series on the role of technology in development. It also reflects a growing AID conviction that there is a unique U.S. and AID potential for contributing to this particular LDC need, and for assisting LDCs to strengthen their capabilities for developing technologies to fit their own circumstances.

People's Well-Being as the Central Goal of Development

We have been talking about seeking more suitable technological alternatives and otherwise gearing the full range of technologies applied in LDCs more fully to meeting their actual human needs, recognizing the well being of people as the end purpose of development.

What are the most basic needs of LDC peoples, seen from the point of view of the individual? They have been described in various ways. I prefer a formulation that reduces the most basic needs of the individual to two. One is for productive employment, in order to meet material requirements for food, shelter, clothing and so forth, and also to meet psychological needs.

The other is for health--broadly defined to mean satisfactory adjustment of the individual to the disequilibrating forces in his internal environment (mind and body) and in his external environment. This includes a need for adequate psychological adjustment. One factor here is a sense of security. Another is a sense of equity or propriety--that things are as they should be. Increasingly, with the explosion of communications, a sense of opportunity to participate in what is going on and in the fruits of development is also part of the need for adequate psychological adjustment. Other development goals can be seen as means to one or more of these basic needs of the individual.

The sense of priority for the well being of peoples has reinforced the stress in AID programs on growing more food and slowing population growth rates in LDCs--these being twin imperatives if their masses of poor are to have much opportunity for better lives. At the same time, it is leading to increased stress on:

- expanding employment and improving income distribution;

- new means for providing mass coverage of basic health services (including nutrition and family planning) within the LDCs budgetary capabilities;

- maximizing the positive nutritional effects of overall development efforts;

- finding new ways to widen peoples' access to learning opportunities and to gear these more effectively to the individual's needs for improving his well being in his actual environment;

- taking fullest advantage of each country's renewable and non-renewable natural resources for the benefit of its own people and preventing environmental degradation;

- exploring other ways that America's outstanding scientific and technological talent and knowledge can be applied to the major problems affecting the lives of LDC peoples--both today's problems and those looming even larger in the near future, recognizing that the developing country populations are moving rapidly into the urban/industrial sector.

Need for Better Answers

I have been saying that AID is trying to encourage and support a better focusing of development activities on the problems of people in the actual LDC environments, and on devising more efficient systems for ministering to peoples' needs. This is easier said than done.

As was suggested earlier, the actual problems are much more difficult than was perceived in the early stages of development assistance. Moreover, it has turned out that, in one form or another, a basic cause of underdevelopment is pervasive, extreme, technical inefficiency. This interacts in a mutual cause and effect relationship with shortages of productive resources. In a typical less developed country, this technical inefficiency pervades production processes, administrative and governmental processes, institutional and educational processes.

Under traditional production processes, food crops use land, fertilizer, and often scarce water, very inefficiently. Animals convert feed into meat, milk or eggs very inefficiently. Available foods may satisfy hunger, but satisfy peoples' nutritional needs very poorly, often leaving such gaping holes in the required nutritional balances that, from a health standpoint, more food is worse than less. Almost all modern industrial processes in the LDCs are highly inefficient in achieving optimum utilization of characteristically low-cost labor, very expensive capital and a combination of cheap local and expensive imported raw materials, based as they are on imported technologies developed for countries where the relative costs of these factors are the opposite of those characteristic of the LDCs.

Similarly, inefficient administrative processes often tie up the scarce trained manpower in low-consequence tasks. Education and health delivery systems often use precious highly trained manpower in unproductive activities, ill-adapted to the requirements of the situation. And so it goes. This actual experience has provided vivid illustrations of the general problem mentioned earlier--the lack of adequate technological alternatives to permit the best use of LDC resources to meet the needs of their peoples.

To address this situation effectively requires much better mobilization of U.S. and worldwide scientific and technological capabilities than has been achieved in the past. Accordingly, AID is putting increasing stress on program components and methods of working that will strengthen this mobilization.

Some New Agency Emphasis in Mobilizing Science and Technology

One such stress is on building strong support for research and development (R&D) into AID programs at the country, regional and interregional levels. I shall not take the time here to go into the many facets of this effort. Its twin aim is to help LDCs find better answers to their most important development problems while simultaneously helping them hasten the building of their own capabilities to find such answers. We are putting great stress on seeking research results that are likely to be used effectively to achieve significant developmental advances in LDCs.

Supporting this stronger R&D thrust is a range of Agency efforts to mobilize and make continuing use of adequate portions of the best U.S. scientific and technological capabilities that are relevant to the work on LDC problems. This includes special efforts to strengthen the capabilities of this U.S. talent to deal with specific LDC dimensions of the problems on which they have expertise.

Further support for this R&D thrust is being sought by encouraging and assisting the building of international networks of research, information exchange and technical assistance--linking together, through all kinds of mutually supportive activities, organizations throughout the world that are working on more or less the same problem. Of course, this network building is concentrated on problems that have major significance for the LDCs as a whole. The networks include institutions from both less developed countries and more developed countries, and also various intermediate institutions such as the international agricultural research institutes or other regional and international problem-solving organizations. The network relationships may be formal or informal, or mixes of both.

For example, there is a rather fully developed worldwide network of institutions working on improving the quantity and nutritional value of LDC wheat production. The principal scientific and technological leadership comes from the international wheat and corn breeding center in Mexico (CIMMYT), working primarily on spring wheats with financing from a series of development assistance agencies. Complementary scientific thrust comes from the University of Nebraska, working on winter wheats and focusing on increasing protein

content of new wheat varieties. These institutions are each linked to dozens of research institutions in LDCs and to each other in joint research programs, training, and information exchange activities. Other institutions are also involved. AID provides support for the Nebraska work, for 25 percent of the CIMMYT budget, and for some of the LDC participation in the system. By strengthening and using this network, U.S. technical assistance achieves greater impact than could be achieved merely by assistance to individual LDCs. In fact, the wheat network has been one of the principal factors in the "Green Revolution" that has greatly accelerated LDC grain production.

This network approach has great potential for furthering LDC development (and for producing major spin-off benefits in the developed countries as well).

- It facilitates massing of adequate scientific and technological power, including the essential element of LDC experience, to achieve major breakthroughs on the key bottleneck problems that have impeded LDC progress. In some cases, this approach may be the only feasible way to mobilize enough problem solving power to succeed.

- It also facilitates bringing the total relevant worldwide experience to bear on individual LDC problems--feeding into adaptive efforts in the individual countries--to an extent that is not feasible through country-by-country efforts.

- It tends to further mutual support between R&D programs and resources, and the current operational programs of LDCs, by providing convenient means for interchanges between the two. This includes training and other support via the networks for the building of LDC capabilities to develop answers for their own problems.

- It also provides for sustained build-up of the specialized knowledge and individual and organizational expertise that is needed to cope with the toughest LDC development problems.

- Not the least of the virtues of the network approach is its attractiveness to the participants--from many points of view--as a format for long-term technical collaboration across the oceans.

The Real Significance of Point IV

What is emerging, gradually, is a shift from technical assistance to technical exchange and collaboration. The historical significance of President Truman's Point IV program is that it thrust the world strongly into a process of learning to work together across international boundaries, on a scientific and technical level, to exchange and pool knowledge on how to cope with the increasingly inseparable pieces of global development problems. It is not simply a process of transferring static skills from those who have them to those who do not. Rather, it is part of a historic drama of global dimensions--the drama of mankind, heretofore separated in relatively self-contained and limited communities, coming together to cooperate in seeking solutions for basic problems facing us all.

While the element of governmental or social subsidy and leadership in this process of joint work on development problems is, I believe, an essential component, it is only incidental. The fundamental requirement is for broader and better means to extend this process of bringing people and organizations of all kinds together to work across the oceans on problems of common interest, involving the management of social change and the applications of technology thereto. Moreover, we see evolving the 1970's a less mechanistic approach to development problems than was typical of the 1960's--a less exclusive concentration on piling up investment and national output and more direct concern with the achievement of the purposes of expanding resource capabilities--with such humanistic goals as distributive justice and the quality of life.

Finally, we can see growing prospects for feedback benefits within the developed countries from technical collaboration overseas. These include improved insights on how to handle a wide range of domestic development problems, and useful technical knowledge. They also include strengthening of the U.S. knowledge base and private linkages overseas that the developed and developing countries both need to develop positively their ever-growing economic, social and political interactions with the rest of the world.

Intermediate Technology and Cumulative Technical Processes in East African Agriculture

by

VICTOR C. UCHENDU, Director, African Studies Center, University of Illinois, Urbana-Champaign

A lecture given on March 6, 1973, Seminar Series on Technology and Development, School of Engineering, Howard University

Dr. Uchendu was with Makerere University, Kampala, Uganda, from 1969-71, where he was Executive Director of the Makerere Institute for Social Research from 1970-71. He received his B.S. (Economics) from the University of Ibadan, and his M.A. and Ph.D. (Anthropology) from Northwestern University. Dr. Uchendu's field research has included studies of agricultural labor migration among the Navajo Indians of the American Southwest, and studies of agricultural change in Uganda, Kenya, Tanzania, Zambia, Nigeria and Ghana. He is the author of numerous technical and scholarly publications, including several books and monographs.

INTERMEDIATE TECHNOLOGY AND CUMULATIVE TECHNICAL PROCESSES IN EAST AFRICAN AGRICULTURE

by

Victor C. Uchendu

Introduction:

The theme of this seminar--Technology and Development--is one that easily lends itself to an interdisciplinary perspective. It also raises fundamental questions: What are the assumptions, if not the perspectives, which different disciplines bring to the study of the role of technology in the development of institutions and cultures? How much interdisciplinary communication has been fostered by this collaboration? As an anthropologist interested in the role of technology in the development of African economies, particularly the agricultural sector, I cannot help posing further questions: What do technical experts and academic engineers know of the work of anthropologists in the study of technology and development, and what do they really need from anthropologists? Do they need hand maids, trouble shooters, or equal partners, in working in the ex-colonial, low-income countries that anthropologists had hitherto regarded as their exclusive vineyards?

I think that there is a job of interdisciplinary collaboration to be done in the field of development. For one thing, the contemporary development environment is one in which planned change is a dominant emphasis and laissez faire no longer an option; it is one in which laissez faire has been rejected as neither laissez nor faire. Secondly, the task of generating development in the Third World is so great that it would be rather unwise to leave it to any one single discipline to resolve.

The aim of this presentation is to recreate interest in intermediate technology by examing its developmental impact on East African agriculture. By reviewing the experiences in agricultural development in this region, we hope to indicate both the conditions which make for cumulative technical processes in small-scale agriculture and also the factors which frustrate these processes and thereby inhibit productivity. The implications which these experiences have for development policy will be explored, as well as the lessons they offer to other Third World areas at a similar level of agricultural development.

Technology and Development:

Before presenting the substantive data, let me summarize my thoughts on the development process and the role of technology in that process so that the importance of technology in African development could be made obvious.

We view development as an ecological process of adaptation, a successful, but cumulative confrontation and eventual transformation of the various sectors of man's environment--including his sociocultural systems--in so far as man's

traditional and emerging value systems would allow. Developed countries are, in this definition, those countries that have tended to confront their environment successfully--and in their own interest--through the mediation of progressive and efficient technology. On the other hand, undeveloped or poor countries are marked by low levels of technological development and lack of control over their physical and human environments.

That technology and development have much to do with each other is an observation matched in self-evidence only by the parallel observation that the basic disparity between the poor nations and the rich nations of the World today lies in an observable "technological" gap. All the more striking then is the difficulty one meets in attempting to state with precision how technology and development are related. The difficulty seems to lie in the fact that we cannot state this relationship without linking both technology and development by the action of the human agent. The anthropological dogma which views "Man as a tool maker who fashions his civilization by making and using tools" states this relationship between technology and culture in equally general terms. The implication of this anthropological proposition is that I do not have to defend whether or not Africa has a technological subsystem. We now take this for granted, since by definition, the very fact of a viable cultural system presupposes a capacity to produce and use technology. It is therefore not in the capacity to produce technology but in the need for technical solutions to realize the goals of society that we may look for the explanation of the technological differentials among societies.

The striking feature of the modern world is that the contour lines of international economic inequality are not only more easily drawn today than say five hundred years ago, but practically they coincide with the world's technological contour. Poverty is not a new condition of human affairs, nor is the disparity in the wealth of nations. But the emergence of very few rich nations, co-existing with very many poor nations, which are divided not only by income and resource gaps but also by wide technological differentials, are the novelty of the modern world. To account for these developments, the most plausible hypothesis is the one that accepts the inherent capacity of human cultures to create and use technology but tries to isolate the factors which inhibit the cumulative technical processes in any given culture at a particular period of its history.

Although we do not yet have all the answers as to what causes development to take place, we have enough evidence to reject any hypothesis based on the "one factor magic"--the naive assumption that our own disciplinary input--whether economic, political, technological or anthropological variable is the missing in our traditional model of the development but rather how much of each variable must interact with other growth-generating variables at each level or stage of the development process. In this logic, it is not enough to identify technology as an important variable in development. We must try to specify the characteristics of a given technology which, in interaction with other variables in the system, will generate growth at a particular period, given the goals of the sociocultural system. We must not stop at this. Since it is in the nature of new technologies, in interaction with other variables in a social system, to generate not only the desired goals but unexpected consequences and bottlenecks, the need to monitor technologies is therefore imperative. In developing countries, the lack of awareness or ability to monitor and correct the second and

third generation bottlenecks created by imported technologies is probably limiting productivity and output more than any other single factor or combination of factors.

Unfortunately, the technical approach in development seems to assume the posture that all the technologies required for Third World development are readily available. That the limiting factor is the traditionalism, non-receptiveness and lack of aspiration among the so-called peasants of the poor countries. We shall return to this question later to examine closely the assumptions which govern these claims. Before that, let us attempt a profile of East African agriculture and make an assessment of its prevailing agricultural technologies.

East Africa Profile:

The three countries of East Africa--Tanzania, Kenya and Uganda--share most of the characteristics associated with low income countries. A large region, with a combined land area of 681,761 square miles which is more than twice the combined size of Texas and Oklahoma, the three countries have a total population of about 34 million. Tanzania with a land area of 362,800 square miles, is about the size of Nigeria but has approximately about 20% of the estimated population of Nigeria. The demographic characteristics of East Africa reflect the "youthfulness" that is associated with the populations in developing countries. (See Table I). The birth rate per 1000 population varies from 43 in Uganda, 47 in Tanzania, and 50 in Kenya; and the rate of population growth is 2.7% for Uganda and 3.0% and 3.1% for Tanzania and Kenya respectively. With about 41% to 46% of the population under 15 years, and more than 85% of the population supported by agriculture, in an economy where non-farm employment is proving difficult to generate, the estimated 23 to 27 years it takes to double the population is giving rise to major political concern.

Agricultural Development:

Two of the most significant facts of the East African development experience--and they are shared by most developing countries--are, (1) uneveness in the development that has taken place, and (2) the disparity in natural resources, institutional and technical endowments, both within the region and within each country. These features are shared by other export-dependent economies whose economic policies were dictated, until recently, by the colonial situation. The internal consequences of this pattern of development is that districts which lack export capacity, in agricultural or mineral production, have tended to lag behind in the current pace of development. We are therefore dealing with an economy in which the road system, research base, access to economic opportunity and institutional resources have been conditioned, not only by geography, but in a more important way by the recent colonial history.

The British colonial agricultural policy in East Africa is a study in paradox. In Kenya, this policy was dominated by one single question: the interest of settler agriculture. In Uganda, where European or settler or plantation agriculture was discouraged, African cultivators were actively

encouraged. Fiscal considerations seemed to have played an important part in the agricultural policy in Uganda. The Administration had to be paid for and poll tax was introduced. The Uganda people were not taxed in order that they might be made to grow cash crops, rather, they were urged to produce export crops in order that they might be able to pay their taxes.

Although Africans in Uganda and Tanzania were encouraged to grow export crops, settler politics in Kenya ensured that nothing more than lip service was paid to the promotion of export production among Kenya Africans. Before the mid-1940s, the stated official economic policy in Kenya, rooted in racial dominance of the economy, was phrased in economic, and later, technological terms. The earliest argument was that such export crops as coffee and tea were "plantation crops" which required capital and management and scale of operation which no Kenyan African could afford. The low quality of coffee produced in Uganda by African cultivators was used as an argument against Kenya Africans. As the "plantation" argument wore thin, the technological argument was invoked. The latter conceived export crops production as essentially plantation enterprises that demanded technologies and technical competencies and organizational skills which no African could supply.

German East Africa, as mainland Tanzania was known before 1919, had a different, but related development history. The German administration tried three methods of development: (1) "Government plantations" in which a number of tropical crops were cultivated by African laborers for export. (2) German settlement, particularly in the Highlands and (3) the use of persuasion and coercion to get Africans to grow cash crops, as a fiscal measure, and of course to supply German industries.

TABLE I

East Africa: A Demographic Profile (1972)

	East Africa	Tanzania	Kenya	Uganda
Land Area (sq. mile)	681,761	362,820	224,960	93,981
Population (million)	33.9	13.2	10.9	9.8
Birth rate per 1000		47	50	43
Death rate per 1000		22	20	18
Rate of growth (%)		3.0	3.1	2.7
Number of years to double		27	23	27
% under 15 years		42	46	41
Projected population: 1985	52.2	20.3	17.9	14.0
Population Increase 1965-70		1.6	1.5	1.0
Density per sq. mile		34	47	90

SOURCE: Africa (Annual Review, 1972) Africa Journal Ltd, London, 1971, pp. 129, 171, 177.

As we know, German East Africa was short-lived. But the international status of Tanganyika as a Mandatory Territory of the League of Nations (1919), and later as a Trust Territory of the United Nations (1947), offered Britain, the administering power, a strong excuse to neglect the conomic development of Tanganyika.

The Agricultural System:

The agricultural system that emerged from these policies have been further modified by a decade of nationalist control of the economy. Agriculture remains the dominant activity that employs most labor, land and capital. The Gross Regional Product is estimated at over $3,500 m (Uganda $832 m; Kenya $1356 m and Tanzania $1315 m). Cotton, coffee, sugar, tea, pyrethrum, tobacco and cattle bulk large in the export economy of the region.

Agriculture is practiced on small-holdings under rain-fed conditions. Farm sizes vary according to ecology and population pressure but the typical farm is about 5 to 15 acres and in many areas, demographic pressure on land and resources is heavy, and in a few areas this pressure is proving quite intolerable. The traditional response to population pressure on limited land is the intensification of cultivation--a process that is increasing and therefore demands the complementary input of appropriate technology if productivity is to increase.

We are therefore dealing with agricultural economies which combine the following characteristics:

1. The existing resources of land and labor are under utilized because the technology and other inputs are not available.

2. The African cultivators who manage their household farms are often under-capitalized, lack technical knowledge and skills, and sometimes have no access to reliable information that can improve their yields.

3. Farm productivity is low.

4. Although institutional infrastructure exists for the export crops, very little attention has been paid to other important crops.

5. T' history of agricultural development and the policies that promoted this development have combined to create "enclavism" and "dualism" in the agricultural export structure.

6. Technical breakthroughs, as in the eradication of tsetse fly, introduction of new crops and improved husbandry, for instance, have led to uneveness in growth.

7. The structural transformation of the whole economy has hardly started and efforts to achieve this have been frustrated by inappropriate or non-existent technologies.

Given these characteristics of the farming system, the challenge of technology become rather obvious.

The Role of Intermediate Technology:

We frequently think of technology as "concrete physical objects"--machines and machine parts--rather than as the ideas from which these concrete stuff derive. This limited notion of technology probably results from our association of technological traits with diffusion mechanism--where technology is perceived as the physical item that is generally transferred. What is probably most important in the technological process that results in cumulative change is not the physical item as such but the idea of idea systems associated with it. It is the idea and the idea system that allow adopters or receivers of a technology to adapt, reproduce or incorporate a technology into their socio-cultural system. This adaptation or indigenization of technology is easier to achieve with intermediate and micro-technology than with sophisticated technology.

The popular conception of technology as a "problem solver," an instrumental mechanism for realizing set goals, creates more problems than it solves when it is literally applied to development seen as a process of transformation Of course, technology solves problems. It also creates problems; it creates subsequent bottlenecks which require technical action. The recognition that the problem-solving activity of technology must be balanced by its problem-creating function demands a new awareness about the dynamics of the technological process. It is this lack of awareness which inhibits the monitoring of a new technology, frustrates its cumulative character, and eventually prevents its indigenization, as well as its integration into the technical inventory of the receiving culture.

The plea that technical innovations must be adapted to the prevailing farming system is a familiar one. The characteristics of technical innovations that suit a particular farming system must be systematically specified. For labor-intensive and capital-scarce farming systems, this specification is particularly crucial. In this respect we must distinguish between (1) a technology-centered farm adaptation in which the operations of a farm unit are determined by the available technology, and (2) a farm-centered adaptation in which the bottlenecks faced in a farming system determine the kind of technology, and particularly its timing. The group farms which have proven a failure in East Africa are an example of a technology-centered adaptation; and the other self-spreading technical measures which have increased productivity and output in small-holder agriculture in East Africa represent farm-centered adaptations.

We offer as a hypothesis that in economies like those of East Africa where structural transformation is difficult to achieve and agricultural labor has low opportunity cost, the technologies that tend to result in cumulative change should be labor-intensive and capital saving. Such technologies should have the following characteristics:

(I) They should be highly divisible and neutral to scale so that they can be readily incorporated in small-farm systems.

(II) They should be easily adapted to local manufacture, easy to monitor. maintain and replace.

(III) There should be an "efficient sequence" in the adoption of complementary technologies which improve the performance of the parent or initial technology.

(IV) They should be adaptable to the labor-intensive farming system.

Field Testing of the Cumulative Hypothesis:

We have asserted that technical innovations which pre-determine the farming operations are less efficient than those which remove farm bottlenecks and thereby serve the farming system. In a sense, we are saying that technical innovations are "good servants" but "bad masters." What conditions make technical innovations good servants? Let us briefly review three contrasting farm experiences in East Africa, one from each country.

The Teso of Uganda:

Export agriculture, based mainly on the production of cotton by smallholder cultivators, is the backbone of agriculture among the Teso in Eastern Uganda. Cotton was introduced into Teso in the first decade of this century, essentially as a fiscal measure, to raise revenue. It was soon followed with ox-plough, which was quickly adopted and remains the main farm implement today.

Although cotton output rose steadily from 10,400 to 30,800 bales between 1915 and 1935, and nearly doubled between 1935 and 1965, yet the gains in productivity were limited. This was hardly surprising in view of the limited genetical break-throughs in cotton breeding. The early achievements in cotton output resulted from the expansion of acreage, an expansion made possible by the introduction of ox-plough that removed the cultivation bottleneck created by the hand hoe.

With limited land, the traditional method of cotton expansion used by the Teso is no longer possible. Output must depend increasingly on raising productivity through early opening of land, timely sowing with the right plant population, and the use of insecticides, for insect and pest control. The highest response to insecticide applications are achieved with early sowings. The present staggering of cotton sowings throughout the planting season largely reflects the need for spreading labor requirements and easing seasonal labor bottlenecks. Since the Teso farmer has not acquired the equipment to cope with these labor bottlenecks, such yield-increasing innovations as correct spacing to attain optimum plant population, row-planting of the finger millet crop, and inter-row weeding have not become general husbandry practices. There is, therefore, a strong case for improving the supply situation with respect to key farming inputs, particularly in the area of "intermediate" technology. In view of many regions in Uganda economy where intermediate technology can make substantial contribution to farm output and productivity, ploughs, bullock carts, seeders and other simple ox-drawn equipment which are complementary to existing resources of labor and land, and have very small foreign exchange content, can be produced locally.

One of the critical bottlenecks in Teso agriculture is labor. The introduction of the plough eliminated an important bottleneck, labor for land preparation, but it created a series of other bottlenecks. The agricultural

experience in Teso demonstrates the familiar proposition that it is of limited use to till and sow a larger area to cotton if the subsequent weeding and picking still have to be carried out by hand operations. The two innovations of the 1950's and 1960's--the introduction of tractor hire units and the group farms based on tractor mechanization were no answer to the labor bottlenecks created by the plough. In our view, both innovations have failed to meet the criterion of efficient sequence of technical innovations, and consequently their limited contributions to Teso economy is not surprising.

Rapid agricultural development is sustained by cumulative technology. Where a wide technological gap characterizes an economy, development tends to be most erratic. Cumulative technology is fostered by "efficient sequence" of technical innovation processes which are mediated by imaginative farm policy on the one hand, and a receptive farm population on the other hand. The concept of "efficient sequence" of technical innovations implies that agricultural administrators must recognize when a viable technical innovation creates a number of bottlenecks which must be relieved by subsequent technical innovations. The farmer also must learn to exploit technical linkages which have embedded economic component. As we have already pointed out, the gap of over forty years between the introduction of the first plough and any serious effort to make other ox-drawn equipment available is a serious violation of the "efficient sequence" of technical innovations.

Geita District, Tanzania:

Geita district, in Mwanza Region of Tanzania, illustrates a lesson in development where the initial technological breakthrough is yet to achieve a momentum. The major environmental problem in Geita was tsetse fly, which limited livestock and human population, and confined what population there was to cleared areas along the shores of Lake Victoria. Economic development in the district was made possible by control of tsetse fly and settlement of a large immigrant population. Settlement was not possible without fly control and this, in turn, required the establishment of a large enough population density to prevent regeneration of the habitat required by the fly. The early immigration of Sukuma into what was then West Mwanza district, starting in the 1930's, led to retreat of the fly and was subsequently supported by government program of bush clearance and water development.

Like Teso district, Geita is a major cotton producing area. In 1947 the district produced about 5,000 bales of cotton, and in a decade later (1967), production reached 71,000 bales, approximately 18% of Tanzania cotton crop. It is now estimated that about 20-25% of Tanzania cotton crop comes from this district.

Technical achievements affecting agriculture in the district are essentially centered around cotton production. The agricultural research for Geita and other areas in Western Tanzania is carried out at the Western Research Center at Ukiriguru. Until recently, the major emphasis at this Center was on cotton. Improved cotton material, which reduces the risks for the small farmer, has made substantial contribution to the economy of the area. Besides the emphasis on the timeliness of sowing, tie-ridging, both as a soil moisture and a soil conservation measure, has been advocated since 1940's. The campaign has

not been successful, because in the higher average annual rainfall regime of Geita district, the yield advantage of tie-ridging is likely to be uneconomic. Besides, tieing of ridges clashes with other farm operations at the busiest period of the year. As long as the operation is carried out by hand hoe, unaided by any intermediate technology, tie-ridging, whatever its technical values--as a soil saver--will not win general acceptance.

Kisii District - Kenya:

Unlike the two cases examined, Kisii agricultural experience represents a model of "cumulative change." Although the rate of change has varied over time and still varies between the highlands and the lowlands, the cumulative character of the process is striking. Most rapid change has occurred in the last two decades (1950-1970) when research and government policy have had the most profitable innovations to offer to the farmers. Long before high value cash crops were introduced into Kisii highlands, the major concern of the extension staff in Gusiiland centered around soil conservation methods. Soil conservation was preached as an end in itself. It was not until the early 1950's, when soil conservation became an instrument of achieving higher cash income, that the enthusiasm of the farmer was really aroused. "Saving the soil," apparently for its own sake, is a crusade that hardly makes sense to any farmer, African or non-African.

The cumulative character of the agricultural innovation process in Gusiiland is reflected in two important areas: The "efficient sequence" in which innovations have been introduced and adopted and the characteristics of the individual innovations which tend to make them "self-spreading."

An "efficient sequence" of innovation refers to the rational order in which tested and economically proven innovations are introduced into a particular farming system. The assumption is that the appropriateness of different types of innovations and the readiness with which they will be adopted is related to the phase of development as it affects the economic feasibility and the socio-psychological attitudes that help determine the outcome.

The spectacular agricultural achievements in Kisii highlands, especially in the last fifteen years, lend validity to this proposition. It was in 1952 that pyrethrum was introduced into the area. By 1959 about 11,500 farmers were producing about 275,000 lb. worth of pyrethrum flower on about 5,200 acres of land. Pyrethrum proved so profitable that it was able to provide the capital which made investment in tea possible, beginning in 1957. The introduction of tea necessitated the improvement of communications as what became known as "tea" roads were built. The receipts from tea and pyrethrum made subsequent investments in exotic cattle possible. Introduced in 1963, exotic cattle have prompted farmers to ensure that enclosures are stock-proof and that wells are provided to facilitate stock watering and satisfy domestic needs. Exotic cattle demanded a new level of technical competence in management; rotational grazing, regular purchases of feed concentrates, and regular spraying against ticks. An artificial insemination programme was accepted as part of the "exotic cattle" complex and this implies contact with the veterinarian staff. "Tea fertilizer" is becoming increasingly popular because tea is looked upon as a profitable crop. These cases emphasize that the "demonstration effect" of one successful technical innovation tends to encourage

the acceptance of subsequent innovations and that the sequence in which these innovations are introduced is critical if a cumulative impact is to result.

The traits associated with the individual innovations helped to promote their adoption. Each innovation was able to fit into the farming system in which limited availability of land is an important consideration. The traits which are considered include risk, profitability, reversibility and divisibility. These traits help to account for the pattern and rate of adoption of the newly introduced crops and the farmers' present attitudes towards them.

Risk and profitability are obvious. The lower the risk involved and the more profitable an innovation, the more acceptable it becomes. Although the rate of adoption of new techniques and innovations is governed largely by economic feasibility at the farm level, one of the major contributions which technical change makes to early-stage agricultural development lies in reducing some of the risks which the farmer is called upon to bear. In the case of exotic cattle, the provision of wells, a stockproof enclosure, a regular spraying regime and the artificial insemination programme, are technical innovations that tend to reduce farmer risks besides contributing directly to profitability. The criteria of "reversibility" and "divisibility" are most critical for farming systems with limited land. Reversibility refers to the extent to which a major factor such as land can be reverted or restored to status quo ante if an innovation like tea, pyrethrum, or passion fruit proves uneconomic. The criterion of divisibility refers to the extent to which an innovation like a new cash crop or farm input can be adopted in small units. Gusii farm structure would lead one to expect that the more readily reversible and divisible an innovation, the more compatible it would be with the farming system. In other words, compatibility between successful innovations and Gusii farm structure rests on two important criteria of the former: their neutrality to scale and their high degree of reversibility. Compatibility does not necessarily guarantee rapid diffusion which is essentially a function of profitability.

There is keen competition, in the recent past, between passion fruit and pyrethrum for the limited land available. Both farm enterprises are relatively easy to establish and for a brief period (1964-1967), were competing with maize for available land. The competition between pyrethrum and maize for land, especially with the recent introduction of higher-yielding hybrid varieties, indicates how technical and economic factors influence the farmer's rational decision on the allocation of his scarce resources. This supports the hypothesis that a more efficient "innovation sequence" has been followed in the Kisii than in Teso or Geita. This efficient sequence helped to make the Gusii in the highlands more receptive to change than the Gusii in the lowlands.

The first cash crop which was introduced in the highlands in 1953 has all the attributes which make an innovation "self-spreading." Pyrethrum involves a low risk because the initial investment is small, it has high profitability, is more easily reversible than tea or coffee, and is quite divisible. The initial profits from pyrethrum were so striking, relative to maize, its only competitor at the time, that the diffusion of this innovation was very rapid. By the time tea was introduced, farmers had accumulated "risk capital" which promoted investment in tea. The relatively high initial development cost

involved, and a long waiting period between planting and bearing, were more than compensated for by high profitability. Because the crop proved quite profitable, its "demonstration effect" stimulated wider acceptance. An important factor in the profitability of tea is the operation of Kenya Tea Development Authority which separates the post-field production stages, in which economies of scale are critical, from the farm level operations which are relatively neutral to scale.

Like tea, the adoption of exotic cattle was made possible by accumulated farm incomes and its rapid diffusion, the function of profitability. The initial investment in exotic cattle is high, about $140 to $200 per beast, but the high risks associated with the enterprise have been drastically reduced by modern technology. But the profitability of exotic cattle is so well-recognized by farmers that a conversion from low-risk, low profitability items like indigenous cows to high-risk, high-profitability items like exotic cattle is increasingly being made.

Summary View:

The central question of this seminar is built around the problem of isolating the conditions which make technical process in agriculture a cumulative one. It is argued that the choice of technology should be governed by the prevailing farming systems. By defining the characteristics of East African agriculture, it becomes clear that intermediate technology has an important role to play in this system. There is no assumption that other kinds of technology may not be used, or should not be evolved. The implicit assumption is that if economic policy must address itself to the majority of the population in the economy, then, the fact that 80 to 90% of East African population derive their living from agriculture, either directly or indirectly, becomes a policy issue that cannot be ignored. The debate in development literature about whether the unimodal strategy or the bimodal strategy should be adopted, obstructs the fact that in terms of technology, both strategies could be justified since they are addressed to different types of farming systems which can co-exist in the same economy.

The case for intermediate technology, particularly its contribution at the early phase of agricultural take-off, has been well-documented for the American economy of the 1850's. Danhof (1969 pp. 278-289) summarizes with historic conviction, the part played by horse power and its associated complexes in this period of American history. While recognizing the contributions made by other factors in increasing the productivity of American agriculture in the 1850's, the effective application of horse power to numerous farming tasks occupied a central place. The successful use of horse power in harvesting, by the reaper and mower, removed a serious bottleneck and completed the technology based on animal power. In Danhof's words, "the resulting integrated technology of agriculture was well balanced with labor requirements for the successive steps of cultivation. Adoption of the new system depended upon availability of the implements and upon the advantages that could be obtained from their use." It is precisely the lack of technical responses to the bottlenecks created by the introduction of the ox-plough in Teso agriculture that limited the impact of the basic ox-plough technology.

The common assumption that the major problem in international transfer of technology rests with the traditionalism of the small cultivator should be critically re-examined. Jones (1960) has collected and brilliantly analyzed the evidence that dispels the myth of the "tradition-bound" African cultivator. Both Guy Hunter (1969) and Bairoch (1964-73-74) have indicated the complicated problem of choice-making facing developing countries in the field of technology. Bairoch shows that the following factors, rather than traditionalism, limit the international transfer of technology:

(1) The nature of modern technology which is developed to deal with the bottlenecks identified in the economy of the producing society.

(2) The large amount of investment per worker associated with modern technology. Bairoch estimates that in the 19th century, the average capital investment per worker in the U.K. was equivalent to four months' wages; and six to eight months' wages in France. In the U.S. in 1953, the investment per worker represented 29 months' wages, and L.D.C. of today it is 350 months' wages!

(3) The rising level of educational and professional competence required of workers who must man the new technology, a level of education and training that may be unrealistic in L.D.C.'s.

These are good reasons that compel us to re-emphasize the contribution which intermediate technology can make to the kind of economy we have in many parts of Africa.

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Global Development and Underdevelopment

by

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A lecture given on March 15, 1973, Seminar Series on Technology and Development, School of Engineering, Howard University.

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GLOBAL DEVELOPMENT AND UNDERDEVELOPMENT

by

George L. Beckford
University of the West Indies

Thank you very much, Dean Pierre, and a special thanks to Mrs. Henson of this faculty. It is a fitting end to my visit here.

I wish, for about an hour and a half, to speak on what I call "global" development and underdevelopment. Mrs. Henson actually suggested that I should speak on "Underdevelopment in the Caribbean: Persistent Poverty Revisited." Well, I will deal with it. Persistent poverty is in the course of what I have to say. But as Dean Pierre indicated, I want to broaden the discussion to a more global situation. Before presenting the substance of my presentation, I want to put forth some caveats. The first caveat is that any analysis that has to do with human society cannot be totally objective, whether the subject is engineering, or economics, or sociology, or what have you. The question about emotionalism and objectivity is a false question. Toward the end of the lecture I want to deal with the question of technology, development, and underdevelopment; and then I will illustrate the point I wish to make about emotionalism and objectivity.

All right, I know that it is difficult for you to follow me because I am a Jamaican and I speak like a Jamaican. I will try to speak slowly for the non-Jamaicans in the audience. This is difficult for me, but I will try. I will also try to speak slowly because I am an economist by training, but what I have to say has more to do with philosophy and psychology than pure economics.

The title, as I suggested earlier, is "Global Development, Underdevelopment, and All That." Engineers are human beings. Doctors are human beings. Economists are human beings. All of us are human beings. Now what is wrong with human society in the middle of the 20th Century is not people, but bureaucracies and institutions. Bureaucracies and institutions impede people in every society. If I had the time today, I would deal with the whole structure of world society, including the Soviet Union and China. Unfortunately, I don't have the time to cover the whole sepctrum, so I'm going to concentrate on the international capitalist system. Capital and capitalism are bad things insofar as they involve exploitation. If man exploits mans, if woman exploits man, if man exploits woman, if any human being exploits any other human being, then you don't have a decent society.

For a personal example, I had a difficult time coming here because of the Embassy of the United States of America located on Duke Street in Kingston, Jamaica, and America's Ambassador, Mr. de Roulet. However, when I got on the Pan American aircraft yesterday, I was treated like a person. The stewardesses gave me everything I asked for. White Americans, right? (The only thing I have to complain about my treatment yesterday is that when I left PanAm in Miami and went aboard National Airlines, I asked the stewardess what was the end of play score in the cricket match in Barbados, which I really wanted to know. She looked at me and said, "I don't speak Spanish.")

All right, that is one example: the American Ambassador versus the Pan American stewardesses. I'm trying to make the distinction between people, institutions, and bureaucracies.

The second example is Kingston, Jamaica, versus Portland, Jamaica, for the Jamaicans--the rest of you have to excuse me. When the European white people came to the New World, I read in the history books that Jamaica was described as a land of wood and water. On leaving Jamaica yesterday, when I looked over Kingston, all I could see was haze, dust and dryness. Now this point is very important, and I'm coming back to it in the last section of the lecture on technology. Because what is technologically important for human beings to live like human beings is to have a balance with the natural environment. They cannot live without water unless they are camels, and I am not a camel, all right?

The third example I want to give is the United States versus the Caribbean. In the Caribbean we have Puerto Rico copying Manhattan and the development patterns of Manhattan--"asphalt jungles" of concrete, steel and glass, in a tropical environment where we are supposed to have fresh air. We are messing it up now. Jamaica has followed. Trinidad has followed the Manhattan example. Where will we end up eventually? Shall we create a new Manhattan in the Caribbean where people live in chicken coops which is what skyscraper apartment blocks really are? Or should we create cities in the Caribbean where people can live like decent human beings with grass and trees and water, and ponds with fish and birds, and chickens running up and down the place?

The last caveat I want to make before I begin the formal lecture is about the question of racism. I am told that I am a racist. In a sense, I am; and in another sense, I am not. I am a human being. If the world treats me like a black man, then I must respond like a black man. I am a racist in that sense. I am not a racist in the pure sense. I believe that all human beings are dignified people, and I don't care what color a man is--red, blue, black, pink, green, anything. We are all human beings, and I respect every individual as a human being. But if society in the middle of the 20th century treats me in a certain kind of way, I will come to respond in a certain kind of way. In that sense, I am a racist in reaction to a racist world.

I want to apologize for giving Caribbean examples. I also want to apologize for saying things which some of you may think are funny. After you laugh, I want you to think about them. Some of what I have to say in

this lecture may be familiar to some people; some of it may not be to other people. I ask those who are familiar with some of the points to bear with me.

In my opinion, my humble opinion, the objective of all social analysis must be people; and when I use the term social analysis, I am not talking about the social sciences narrowly conceived. I am talking about engineering. I am talking about medicine. I am talking about anything that has to do with human beings. I am talking about the fact that the central location in our minds must be people--everything, including technology, to be useful must be for people.

I want to start the lecture about development, underdevelopment, and overdevelopment with a concentration on what I call technology and man. I am using man in the global sense, including woman. Technology must serve man if it is to be useful, not vice versa. If technology is in command of man, then man is nothing, and technology is in control.

The second introductory point has to to do with the question of materialism. Materialism is important insofar as it provides the necessities of life to make it possible for people to live like human beings. Materialism, in my opinion, is not important if it is going to create bottlenecks to human progress. Materialism is important if we use our natural resources and technology to ward off malnutrition among the people of Jamaica. Children in Jamaica die of malnutrition. Materialism is important in that context; not in terms of providing luxuries for me, brandy, when I feel like it, and so on.

In other words, the second point I'm making about materialism has to do with what a society and a people have to do in terms of adjusting their consumption objectives. If water is their consumption objectives, then they will do anything to get water. If their consumption objectives are to drive long cars with plenty of chrome, then the society will tailor its technology to achieve that end. If your consumption objectives are to give every human being within the society decent meals with sufficient protein, carbohydrates, and fat intake every day; to live in a decent habitation; to wear comfortable clothes, then you will tailor your resources to meet that objective. So materialism is a good thing and a bad thing, depending on the context.

The third concept that I want to introduce is the concept of physical development. If people are to live like decent human beings, then the concept that they have of physical development must be tailored to facilitate the welfare of the people. I am getting into a little bit of difficulty here because I do not know any country in the capitalist system which I can use as a reference point. I am not well traveled. I don't know about countries outside of North America and the Caribbean. I've never been to Africa. I have been to England, once in 1968; so I don't know. I have a notion of physical development--and in my terms, the only countries I can think of within the international capitalist system which may have achieved this are places like Sweden and Finland, where attempts are being made to integrate urban and rural living.

Now, as I say, I make this point very cautiously because I have never been to Sweden. I have never been to Scandinavia. Let us come back to the New World. This is where I was born--on this side of the Atlantic, and this is the part of the world that I know. I don't know the Old World. Now, I am told from the history books that when the Europeans invaded the New World in the 15th Century, they had two views of what they saw. One was the Caribbean, wood and water, blue--pretty; green, the color green. The other view was of highland America where the indigenous Indian populations of the New World had established high levels of civilization--the Aztecs, the Mayans, and the Incas--gold. The rest of the New World interested the Europeans only to settle in farming situations to get away from the oppressive feudal situations existing in Europe.

So what we have in the New World today are three culture spheres, as the social anthropologists so rightly describe them. One is Indo-America, which corresponds roughly to highland America, the home of the indigenous Indian population. Geographically, this sphere from Mexico in the North to Paraguay in the South, is the home of the Aztecs, the Mayans and the Incas. The second culture sphere is Euro-America where the majority of the people who live in that sphere are European peoples, coming out of a common situation--Canada, the U.S., excluding the South, Argentina, Uruguay, Chile and Southern Brazil. That area, Euro-America, I prefer to describe as Grey America--G-r-e-y America. It has no color. Indo-America, the indigenous Indian population has the color gold. Afro-America, with plenty of wood, plenty of grass, plenty of water, has the color of green. I think that colors correspond to people.

Gold has a certain excitement about it which corresponds to the historical experience of the indigenous Indian populations who were organized in highly developed societies; societies which were more developed than the barbaric Europeans who invaded those countries in the 15th century. The Aztec empire, the Mayan empire, the Incan empire, was something that Europeans had never known about before they came here--gold. The valleys, the plains, the mountains of the Caribbean were beautiful indeed before the Europeans came.

Having introduced certain concepts, I now want to make a formal statement, and the statement that I want to make here today has to be clarified for the social scientists because I am using certain terms which have become popularized by both social scientists and the popular press, and these are terms which create a great deal of confusion--terms like development, and underdevelopment. In my statement this afternoon, I want to concentrate on what I call "global" poverty and "global" prosperity. That is to say, that my analysis this afternoon will not try to explain pockets of poverty in rich countries, and pockets of prosperity in poor countries. We can deal with that on another occasion.

Whay my analysis will try to do is explain why, among large groups of people--in political science terms, a nation-state-- in sociological terms, a social community--we find, on the one hand, global prosperity; and on the other, global poverty. In short, I'm not trying to explain this afternoon why you find pockets of poverty in America and pockets of prosperity

in Jamaica. My analysis this afternoon is devoted to trying to explain why America is "rich" compared to Jamaica when both these countries entered the international capitalist system at the same time.

Why is Jamaica poor compared to the United States of America, excluding the South? That is what my analysis will try to do today. In this connection, I want to define three terms: development, underdevelopment, and a new term, which I call overdevelopment. What does one mean by development? In my opinion, the term development has significance only if it extends the process whereby a people, any people, master the environment in which they live to produce goods and services for improving their own welfare.

In that connection, development does not seem to occur anywhere in the international capitalist system, except perhaps as I have stated before, in Scandinavia. There is a lot of underdevelopment in the Caribbean. Underdevelopment depicts a situation in which people have not mastered their environment to produce goods and services for their own welfare. The question then arises, why does underdevelopment occur? We will come back to that in a minute.

The third concept that I want to introduce is a new theoretical one--that of overdevelopment. Overdevelopment exists in a situation when people have allowed technology to bypass the transformation of resource inputs into the production of goods and services for the welfare of the people. The example is the United States of America where you have technological overdevelopment and human poverty; where you send people to the moon while black people starve. Where you create all kinds of super-institutions universities, etc., while the Amer-Indians are locked up on the reservations. That is technological overdevelopment and human underdevelopment.

The results of technological overdevelopment--and I'll just summarize technological overdevelopment, because I don't know the United States that well, and then go on to the underdevelopment case--have international implications. Technological overdevelopment, as it exists in the United States, means that technology has run ahead of man. It means that the transformation of the society's resources into the output for the welfare of its people is secondary to technological advancement. The result internationally is that a country like the United States of America ends up dropping atomic bombs on Asian people, killing off Vietnamese people, and in the next round will kill off the Caribbean people because technology has run ahead of man in this overdeveloped capitalist situation.

Obviously, something is wrong with a society which has developed such a high level of scientific technology to put a man on the moon yet tolerates material poverty among significant proportions of its population--Amer-Indians and Black people. Something is wrong with that society which can achieve so much technologically and have so much spiritual poverty. That society is a sick society, and the sickness derives from technological overdevelopment as I have defined it. So much for the United States.

I want to deal with the question of underdevelopment globally with particular reference to the Caribbean. I am not relaxed because I am not accustomed to speaking so slowly, and in this accent.

How many people in the room are engineers--scientific engineers? What I want to do is going to involve a little science. I want to, in photographic terms, make a snapshot picture of the Caribbean economy. What we call in mathematical terms, a matrix--and a matrix is no big thing, really. A matrix is really a snapshot, something that gives you a picture of a situation at a point in time, as compared to a moving camera. I want to make two cases of the Caribbean economy. When I say the Caribbean economy, here, I'm talking about Afro-America; so although I'm focusing on the Caribbean, I really include the American South, the Northeast of Brazil, and so on. Two cases--one is the case of the slave plantation, and the other one is the contemporary situation.

The slave plantations finished in the Caribbean in 1838--that is, the English-speaking Caribbean, but it went on in the Spanish-speaking Caribbean until the 1880's. Now, what I want to do is present a picture of the economy of the slave plantation in the form of a matrix. Of course, the important sector in the plantation is the sector which is producing goods and services, mobilizing the resources of the society to produce output, whether it is sugar for sale to England, cotton, tobacco , or what have you. What other sectors existed in the slave plantation economy? None, really, when you come to think of it. The government sector was run by the planters. They collected poll taxes from themselves to build roads to move their produce out to the wharves. The only other sectors that had any significance were the subsistence sectors--the Maroons, the run-aways. Black men left the plantations and went into the hinterlands to produce food for their own consumption, subsistence, right?

We, in the contemporary period, in drawing up a social accounting matrix, always think of households--so we put in households. Whereas, in fact, there was no household sector in the slave economy. The reason is very simple. To have a household you have to have people. Who are the people who made up the slave society? The slaves were not people. The slaves were capital. The owners of the means of production of the plantation lived abroad, in England--Europe, wherever they lived, or in the case of America, in the Northeast, not in the South. There were managers of the estates, who were called attorneys; they were temporary residents. So who was left? Nobody.

The only other sector one has to bring into the matrix is what economists call the rest of the world; and the rest of the world in the slave case was the particular metropolitan country to which the colony was attached. In the case of Jamaica, it was England. In the case of Martinique, it was France. If it was Louisiana, it was New York or New England--that was where the finance capital came from.

Okay, so we have a general outline of what we are doing. As in any matrix, of course, you have to have rows and columns, so we put in plantations, government, the maroons, the households, and the rest of the world. All right, a matrix for the non-social scientists is a picture of transactions between different sectors of the economy. I'm a farmer. I produce so much. I sell to you. You are a food processor. You pay me so much for it and we have an

account. It is a national social accounting. When we do this to the slave case, where do the value transactions occur? The value transactions occur in one sector--the plantation sector. The maroons, the runaway slaves, don't sell to anyone and can't sell to anyone because by definition, their existence outside the planation is "illegal." So since they cannot have transactions with anyone, they have a subsistence economy within the maroon community--within the runaway community. So, in terms of the national account, we have nothing in the maroon sector--no transactions with the rest of the world, with nobody, but themselves. You grow cassavas, you eat them. You raise goats, you eat them. You raise chickens, you eat them. You grow bananas, you eat them. You grow what you want to consume.

A lot of what I say this afternoon is an oversimplification because you cannot treat a subject like this in one and a half hours, right? So, for example, although the maroons had specialization and division of labor within the maroon community, they did not trade outside the colony. Some people among a particular runaway colony would be carpenters. Some would grow food. Some would catch fish. Some would build houses, while some would build and repair furniture. Okay, "X's" mean transactions. The plantation had transactions with itself. How? Well, the slaves planted the food in the provision grounds when their labor was not needed to produce sugar, or tobacco or cotton, right? In addition, the plantation is linked with a merchant banker in the metropole. Whether it was England as in the Jamaican case; or New England in the case of the U.S. South--you had the merchant banker to finance capital--we will deal with this when we come to the contemporary period.

All right, so you have financial capital, and you have internal inputs. The slaves, when they were all not required to work on the plantations, had to chop down wood to make buildings--slave quarters, great houses; had to plant food for their own consumption and so on. So the plantation has a lot of transactions with itself. Now the external series of outputs was to the rest of the world, of course. So we have a big "X" here.

All right, the government "X" is a collection and is really not "X," because it is collecting from itself. Right? The government consists of planters. The planters charge one another poll taxes on the slaves they have and use that same money to build roads for the plantations. The government, of course, has no transactions with itself, and the rest of the world receives profits and interests from the plantation sector.

I left out one account which is important--the savings investment account which is the capital account in economic terms. Now, the reason I left it out is because it didn't really exist. In other words, the non-resident account is an investment where the capital account received from the plantation. The non-resident capital account paid to the plantations an amount and received from the plantations another amount--another transaction. And that is the slave case, economy-wise. Okay, there is nothing complicated about that, because what is important are the values of the transactions; so all you need to do is look at where all the "X's" are. All right, that's the economy. We have no other "X's." So much for the slave case.

We come to the contemporary situation, and that is a little more complicated. If you get the notion of the slave case, then you are all right.

If you don't get it, then you are going to be in trouble when we come to the modern case because the contemporary Caribbean economy, and the Afro-American economy is a modification of this, where the plantation occurs in a new and "more modernized form." The picture of the Caribbean economy today, and when I say Caribbean, I'm talking about Afro-Americans and the American South, the Caribbean islands, right down to the northeast of Brazil--the picture today is one of a society and economy in which there is a dramatic fracture between resources and people.

The economic situation now is not very different from what it was then. For example, a socks company in Trinidad imports duty-free raw materials--everything for manufacturing socks. Right? Not stockings, you know, socks. The company set up the plant and hired ten people. It imported, duty-free "socks-blanks." Now does anyone know what a "socks-blank" is? It is a sock which is complete, except that the toe is open. All that that company does is to stitch up the toe. Now, I don't know how much income could be generated by stitching up a sock, but I doubt that it is very much. In other words, the value added and the income generated by this kind of activity in the Caribbean is close to nothing. What is worse, is that the whole of Afro-America has been going through that change. So that, whereas for example, in the late 1950's, American firms outside of the South migrated to the South of this country to exploit the labor of black people in Georgia , and so we find that in the 60's, the same firms are moving from Georgia to Jamaica, Puerto Rico, and Trinidad.

All right, what has made matters worse in Afro-American colonies, or Caribbean colonies, is the problem of finance capital in the overseas sector. The banking system throughout Afro-America is a product of the international capitalist system. The result is that the capital of the society is not available for its residents because what generates capital is productive activity. So we have productive activity going on here which does not become available to the residents. When the bauxite companies...Let me explain for the non-economists, okay?

In any productive activity, you meet your costs and what is left over is profit. Profit can be dispersed in one of three ways. The first charge on profit in the modern economy is taxes--company taxes, royalties, etc. The next charge is to the owners of capital. If you have shares in the company, you want some dividends. So some of the profit is paid out in the form of dividends to shareholders; and the third part of the surplus is reinvested in the company to create future profits. Now how is the surplus distributed through the overseas sector? Taxes accrue to the government. The profits are paid out to the shareholders of the metropolitan corporations through the productive sector of the overseas economy in the forms of dividends or retained by the company for reinvestment. So that this portion remains in the overseas sector. If Alcoa makes some money and wants to invest more money in Jamaica in expanding their mining activity in Jamaica, they do it out of profits. But and this is a very important point, they do not have to do it in Jamaica. They can do it in Guyana, in Guinea, in Ghana, in America, in Scandinavia anywhere they want to do it.

If you live in America and you have shares in Alcoa and you have shares in Reynolds, then every year you get a piece of the action in Jamaica. Now the important part is this part. The retained profit which is reinvested, in a normal economic situation, goes back to create more economic surplus. In the Caribbean situation, it does not necessarily, because Alcoa can shift the funds out of Jamaica to wherever else they want to expand capacity depending on their judgment of the international political situation. If the workers in Jamaica look as if they are behaving badly, then they ship out. Okay, so that takes care of the productive activity in the manufacturing sector vis-a-vis the society, investment and capital formation.

The other aspect of the banking system which is pernicious to the development of black people in the Caribbean largely defined, is what the whites themselves do in relation to the residential sector. That is to say, that people in the Caribbean actually save money. It is a miracle how Black people could really save anything out of the meager income that we make scratching out a livelihood on the hillside.

It's less than four generations since emancipation and notice that black people got not one farthing from emancipation--no compensation for having been held in bondage. Black people gained legal freedom in the middle of the 19th century--in some cases towards the end of the 19th century, and look at what they have achieved! The planters just let the people go, brother--not a penny, not a resource base. People can only produce if they have resources; input is equal to output. The output of the society is equal to the goods and services that the society uses its input to produce. The inputs are simple--land, labor, capital and technology. Without land, capital and technology, what are we left with--our own blasted labor; and look at what black people have created out of labor in less than four generations.

If there are any economists in the room today, you'd better listen. This is a very important point. When black children go to school and their parents cannot buy enough clothes for them to change every day, and the mother washes the clothes at night and irons them in the morning before they go to school--that is an investment--the investment of labor in the creation of human capital, and that is how black people have managed to survive. That is why I am in Washington, D.C. right now.

The irritating part of the exercise is that insofar as black people have the confidence to trust the banks to put their savings there, it does not revert to us, and I'm using the word "bank" here in the broadest sense of the whole financial sector--banks, insurance companies, building societies, etc. The formal part of the financial intermediation is controlled in the overseas sector by foreigners throughout Afro-America, including the American South. To be sure, Black people had to develop their own informal banking arrangements in the residential sector, so you have building societies, burial scheme societies so when you die you can get a decent funeral, sou-sou (partner), and all kinds of things. The fact is that too many Black people in the fourth generation since emancipation, too many of us who have earned incomes as a result of the investment of our forefathers in our education, have put our savings not in the informal banking institutions, but in the formal ones. The result is that the majority of income generated in the residential sector finds its way back into the commercial banking system. So a peasant farmer from the hills of Jamaica

who puts his money in a savings account in Barclay's bank may find that his savings have been invested in Rhodesia or South Africa. The simple reason is that the banking system is a part of an international capitalist system and what Barclay's is interested in is not food for the children of Jamaica, but profits on their investments. Now, it is more profitable to invest in gold, or diamonds or tobacco in Rhodesia or South Africa than to produce milk for the children of Jamaica; and the banks invest in Rhodesia and South Africa because their business is not the health of children but making money. All right, so much for the banking system which is a part of the whole overseas sector.

The real problem of Afro-America, and the Caribbean in particular, can be summarized in the following way. The contemporary situation locates the bulk of the society's resources in the overseas sector; the concentration of capital, of natural resources, of technology, is in this sector, and the concentration of people is in the residential sector in which the only productive input of any significance is labor.

All right, I'm not interested in the production side from this point on. I think that is clear. What I'm interested in is the consumption side--a decent living for everyone. Look, I know that in the United States the first thing people start to think about is communism, capitalism, or some other "ism." Let me tell you something--I have no interest in "isms" -- neither capitalism, socialism, fascism, or any other "ism." What is important to me as a social analyst, are people. I think that communism can be good or bad. Capitalism is always bad, because capitalism is based on exploitation. Socialism can be either good or bad, depending on the particular situation.

We have all kinds of socialism--socialism in England, state communism in Russia, people's communalism in China, and African socialism in Tanzania. They are not the same. Just to give you an example, I, for one, abhor the bureaucratic state capitalism of the U.S.S.R., whereas I admire the people's communal socialism in China. Right? On the one hand, in Russia, you have some high-income, "social elites" living in the cities and planning for the peasants. That, in my opinion is bullshit. In China, you have a society which is built on the communal organization of people at the level of the village and what you end up with in the two situations is very different, let me tell you. In the Russian situation, you end up with large-scale industry, manufacturing steel in great big factories in a very impersonalized situation, whereas in China, you get rural steel works based in the community, smaller in scale, equal in cost of production, but of a more human aspect. That kind of organization is superior to large-scale organizations that de-personalize, de-humanize, de-tribalize, "de-" everything to people.

All right, now I am going to present the matrix on the contemporary situation and then I'm going to end up dealing with technology specifically. Okay, for the contemporary Caribbean situation, I want to make a distinction between what I've called the overseas sector and the residential sector. Now, keep in mind one thing. In the overseas sector, if you are going to put across this schematic information, you have the traditional plantation, and you have new plantations in the form of mines, tourism, savings investments in capital accounts, and I want to do a trick which is not done in an economic presenta-

tion. I want to move the rest of the world from the right hand side of the matrix into the overseas sector, so bear with me. The arrows are going to be pointing to the overseas sector because the rest of the world does not belong to us.

From the residential sector, we have real manufacturing activity, which is not based on sewing up socks, but which is based on making fine furniture out of bamboo, or mahoe, or whatever; making a nice suit or dress--real manufacturing activity. Then, as a result, you have the rest of the distribution, the consumption; and then, of course, we now have households, since we don't have to run away again. In the residential sector is the bulk of the people, as I said before, but in the overseas sector is the bulk of society's resources. Since the overseas sector is a part of the rest of the world--the metropole--then one would expect to find a concentration of transactions of the economically productive activity in the overseas sector.

If you were to arrange the values of economic transactions between the sectors as I have identified them, you will find that the bulk of the transactions are in the upper left-hand corner. In other words, the major value is in the upper left-hand corner. All right, let's take the traditional plantation. Take the land producing raw sugar. Grow the cane to produce it. They put it in their boats, take it to England, refine it in their refineries and sell it. So, they deal with themselves. Alcoa and Reynolds came along, dug out Jamaican bauxite, put it in their own boats and carried it to Louisiana, or wherever they carry it to in America to make aluminum. When the boats are coming back to Jamaica, they put caustic soda in them. That is, caustic soda manufactured by their subsidiaries in America. So, everything stays in the corporate family. All right, so they are together. We, the people, are also together, but we have no resources.

You also have values in the lower right-hand corner, but the values in the lower right-hand corner are small compared to those upper left-hand values. It is not because black people are stupid, but because black people do not have any resources to make the values any bigger. So what do we do about the values down here? The zeros don't mean zeros. They mean a small amount compared to up here. So we find down here small values. Small values down here mean that the bulk of the population of our society is earning low incomes and their low incomes result from the absence of the basic productive resources from their control and modification because the bulk of the resources are in the upper left-hand corner. Likewise, we have business transactions between the overseas and residential sector but we find these values are, by and large, insignificant.

When Alcoa, or any other company, wants to expand their capacity in Jamaica, they have to invest in Jamaica to build the capacity. So they hire Jamaican labor. They have to buy Jamaican construction material. It does not make sense to bring cement from the U.S. when you can buy it at Rockfort. So, you buy Jamaican building material. You hire Jamaican labor to put up the factory and transport the building materials from the production site to the construction site. So the man driving a truck gets work, right? But I am saying that the kinds of transactions between the overseas and the residential sector are much smaller. All right, so much for the contemporary situation.

Finally, I would like to relax everyone and get away from the narrow confines of matrices, economics, etc., to return where I started--which is to bring the discussion back to human beings--people, and if you like, a philosophy of life. The last points I want to make are under the general heading of technology, education and social change. There are significant and important relationships which we ought not to forget between resources and technology. Unlike the impression given in popular literature, the natural resources of a society are not given. The natural resources of a society can be increased, maintained, or depleted by people; and the way in which people determine the natural resource base of the society is through knowledge.

What, in international capitalist terms, is described as research and development--R&D--the engineering faculty of Howard University, like the engineering faculty of any university, like the medical faculty of any university, like all other technical faculties of any university, must utilize knowledge for people. When I say that natural resources are not used up, the point is not easy to illustrate. They tell me that Jamaica is small. Jamaica is small in one sense, and it is not in another sense. Jamaica is small today because (a) Jamaica's resources do not belong to Jamaica, and (b) the knowledge that Jamaicans have about their resources restrict the amount that we could do with those resources even if we had control over them. For example, the plains of St. Elizabeth could produce twenty or thirty times its current output of food if we could put water on the plains. It is a large and beautiful plain; and if we could just...let's assume that we could take the salt out of the seawater at a reasonable cost and pour it across St. Elizabeth, then we could feed the whole of America--yams, cocoa, tomatoes, lettuce, and all kinds of good food. But the fact is that we do not have the water. The fact also is that we are not doing any research on the matter. The University of the West Indies, where I teach, is one of the most backward, colonial institutions of higher learning in the world. I make that statement with an extremely heavy heart because the University of the West Indies is being financed by Black people of the English-speaking Caribbean.

What a social engineer does, and all of you are social engineers, whether in medicine, engineering, or the social science, depends on his view and his conception of life. I'm saying that experts who recommend the Western kind of development for Jamaica have a view of the world based on Manhattan, London and Paris. I do not have that view of the world. I have never lived in Manhattan, or London, or Paris, so I have a different view of the world. I've lived in two places in the metropole. For five years I lived in Montreal doing my undergraduate work and I lived for three years in San Francisco.

Now, San Francisco is the only city in the world that has been declining in population. San Francisco is a village with 750,000 people, but San Francisco is the most important city that I have known in this country. I don't know New Orleans. I don't know a lot of places. I've been to Atlanta once, and Atlanta is beautiful, you know--nice, everyone

is nice. But San Francisco is a very interesting part of European United States--750,000 people and the place has character! You think I joke? The next time you go to San Francisco, ask someone for the New York Times. Ask a white man, a San Franciscan, and he will say to you, "What? I don't know anything about that, you know, brother. The New York Times!" --- 750,000 people! The only city I know of where population has been declining in the post-war period; and as the people move out of San Francisco they go into what is called the Bay area, which is physically quite beautiful and they live in a nice environment. They have woods, brown grass, and the houses match them. So, the people live comfortably. I'm not saying that San Francisco is a model city, mind you. I'm not saying that. I'm just telling you about my experience.

My conception of physical engineering planning for a country like Jamaica would not be this at all. It would be, as I said earlier, to try to bring the country to the city. I don't like the words "city" and "country." My conception of physical engineering would be to try to bring urban life to rural people, and to bring rural life to urban people. So I would conceive of Kingston remaining pretty much as it is. Indeed, I would recommend the de-population of Kingston by moving out the government sector and making the commercial interests stay there and eat the pollution. I would put the civil servants somewhere in the mountains. So my conception of the physical engineering of my own country would be to maintain Kingston just at about what it is now and to create new towns all over Jamaica--towns, not cities, all over Jamaica. Towns in which we can bring rural life to urban living and occupations, and urban life to rural living and occupations.

Now, in each of these towns that I conceive of for my country there would be within the town itself, the scope for certain types of rural activities, such as market gardening--planting food such as tomatoes, lettuce, etc. in your backyard, or some mango trees and coconut trees; sufficient of that green and blue that I spoke of earlier--forests, grass, water, lakes, birds, fish, ponds for the children to enjoy themselves. So you have a town that is different from Manhattan. You can't grow anything in Manhattan. I mean the only market gardening you could do in Manhattan is to produce some ganja in a bottle, and the only open space and water in Manhattan is Central Park. Really. There are millions of people packed in there, you know, packed up in that one town. No, I don't want that kind of development.

At the same time that you are generating the "urban centers" throughout the countryside and integrating rural life into the urban occupants, you are also bringing the the town to the country--not in the traditional sense of simply saying that you've got to provide them with electricity or moving pictures, but in a real sense, in that around the towns would develop areas of rural activities of one kind or another. The very existence of a town in a region like this indicates that the social infra-structure for living must exist--clean water for domestic and industrial use, etc. If electricity and water are available in order to promote the industrial activity of the town, and you have proper organization of government and politics, then the farmer over here will have it, too.

My second point is very important. I say, if you have the proper organization of government and politics, then the farmer over here will have it, too. This is because the historical situation that we left in the initial stage of the slave plantation has generated industrial activity in the countryside throughout Black America without dispensing any of the benefits to the rest of the community. You travel throughout the Caribbean today, for example, and you see a sugar estate which has electricity, water, etc., yet the peasants living there are still operating with kerosene, tank water, and a donkey. So, the second point is important in the sense that you can have the physical location of these amenities in the rural areas as we have had in the past. Therefore, one has to have good government and politics, right? We must not forget the social organization of these institutions. I think that that is very important.

The second aspect is using the resources of the country for the benefit of the people. Unlike the popular notion that we are a small country and have no resources, we have plenty of resources--depending on what output you want to produce. All of us like good food, good clothes, good housing, good liquor, good everything, right? So, we have hills; we have plains; we have all kinds of trees; all kinds of grass; and all kinds of people. The question is what kind of social engineering in a sense of resource utilization one feels is important in a given situation.

In other words, I like a good house, right? The house must be good, but not in the Manhattan sense of plenty of concrete, glass and steel, but in a tropical sense. I would like to live in a big, open structure, with bamboo, mud, anything. I don't care, but it must be open with big ceilings so the air can pass through. It must have a lot of yard space so the pickaninnies can run up and down, and the wife and I can drink liquor in the open air on a Sunday morning. In short, the second aspect that I'm talking about that we should bring into our analysis, is the Manhattan man versus me in terms of physical life. The first was the conception of life.

Next we have input and resources. What kind of output do we want to produce. I mean, a bamboo house, built properly, structurally and aesthetically is equally as attractive as one of concrete and steel. In fact, it is more attractive. So what do we have of our own? Do we have output from our own resources, or output aped from other societies? Do we want decent milk for our children to drink instead of imported powdered milk from Canada and New Zealand. In other words, do I want fresh milk for my children or milk imported from New Zealand? Do I want clothes that are synthesized, made out of all kinds of artificial materials, or do I want a nice cotton shirt?

If the society adjusts what I call its value system and preference hierarchies to the realities of Black people, then we will have enough resources to produce the kind of output that can give all of them a beautiful life in which we can all live as brothers and sisters. Thank you.

Problems Relating to Human Factors in Transferred Technology in African Countries

by

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A lecture given on March 27, 1973, Seminar Series on Technology and Development, School of Engineering, Howard University.

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PROBLEMS RELATING TO HUMAN FACTORS IN TRANSFERRED TECHNOLOGY IN THE AFRICAN COUNTRIES

by

Raimi Ola. Ojikutu

Introduction

The last two decades marked perhaps the real beginning of an increased transfer of technology from the developed to the developing countries in Africa, Asia and Latin America. The demand for technology transfer by the less developed countries and the response by the developed countries were encouraged at the end of the Second World War when it was felt that technical assistance to the less-developed countries could help stimulate their economic development and improve their productivity in both the agricultural and industrial sectors. Today, the less-developed countries rely more on technological innovations for the exploration and exploitation of their natural resources, for the development of new industries, for improving agricultural productivity and the quality of agricultural land, and for many other purposes aimed at finding solutions to their economic and social welfare problems. Technology transfer to Africa, Asia and Latin America is not limited to the producing countries in Europe and North America; today Japan has become one of the biggest exporters of technology to the less-developed countries, and China is beginning to make its presence felt among the nations exporting technology to the developing countries.

For the African countries, the impact of technology transfer varies considerably from one country to the other, depending on the level of economic development, and particularly on the degree of industrialization, mechanization of agriculture, as well as other institutional developments. In terms of these developments in Africa, it has been possible to measure not only the progressive changes brought about by technology in transforming the traditional economy from subsistence agriculture, crafts and petty trading to several and diverse modern urban enterprises, but also the economic growth itself in both the private and public sectors. However, thus far, for most of the African countries it is difficult to express in both qualitative and quantitative terms the changes taking place as a result of these technological innovations in terms of their social benefits to the population at large. Furthermore, the adaptation of the African communities to the newly adopted technologies is little studied, let alone understood, for the purpose of future planning and economic development. Nevertheless, the African countries continue to put their faith in technology as the ultimate answer in finding solutions to their multitudinous problems.

Therefore we need to look at technology transfer and analyze its effects, not only in terms of its economic advantages in helping to develop the untapped resources in the developing countries, but also in terms of its impact on the community, the environment, and the transformations it may cause in the ecological setting of the developing areas. Considered from these perspectives, the impact of transferred technology to the African countries will be seen more as a major vehicle of CHANGE--a change that is reflected in all aspects of life of the community as well as in the environment and the ecology of their habitat.

If development therefore means to change, we could perhaps ask ourselves several questions: In the process of development, how much is the society willing to sacrifice in tradition and culture and what do they want to retain in their old way of life? What is the goal of the ultimate desired change? What kinds of reactions will such changes set in motion and what will be the response of society to these reactions? Is the desired change really necessary or could there be an alternative, and etc.?

Advances in science and technology today, and the rate of technology transfer between the producing and the receiving countries hardly permit modern day planners, particularly in the developing countries, to ask these types of questions, or even to make any detailed study of them--due to the insatiable demands by social, economic and political pressures for progress! The rapid changes set in motion by the advances in transferred technology in the developing countries along with the lack of cultural adaptation to such changes because of the process of cultural lag in instititutional arrangements as well as the slow response to changes by the community, etc., often set in motion a series of conflicts observed today in many of the developing countries including those in Africa. Such conflicts are seen at the sociological level in changes in the traditional behavioral patterns of the community, e.g., between the older and younger members of the community--in the division of labor, e.g., the traditional role of the male and female in the society--in family structure, e.g., the extended vs. the nuclear family--in the role and responsibility of the individual to the society, e.g., will it be the society first or will the self come first, etc.

Technology transfer which ranges from the introduction of new farming methods to the construction of steel mills and hydroelectric plants, is causing new patterns of internal migration and settlement, introducing new methods of food production and distribution, substituting urban heterogeneous communities for simple tribal life and customs in rural areas. Other problems include: overcrowding and the formation of squatter settlements in the urban areas by the migrant population from the rural areas; changes in disease pattern between rural and urban areas within the same country; ecological imbalances as a result of population pressure on the available land as well as resources. There is a background of endemic diseases such as malaria, bilharzia and parasitic infestations often causing physical debility, thereby influencing the adaptation of both rural and urban populations to industry and machines. Nutritional inadequacy and unbalanced diet are sometimes accompanied by frequent sickness and the inability to cope with the demands of heavy industry. The new technological innovation also has its effects on the population structure, density, growth and distribution pattern. Where infrastructural social and welfare services are inadequate to support the growing urban population on whom technological innovation usually makes its greatest impact (the case in many of the African countries), two ominous effects occur: much environmental-related ill-health of the population and continued deterioration of the environment. The ecology and land-use in the area are affected, not to mention other aspects of the biotic and the physical environment. I hope to illustrate further some of these problems through some of the changes that are now taking place in Africa as a result of the impact of technology transfer for development in agriculture and industry in an attempt to raise the standard of living and the quality of life of the population in different parts of the Continent.

Mechanization of Agriculture

The African agricultural worker has always had to contend with his physical environment and the various bacterial and parasitic hazards special to his work. In recent years, however, two further types of hazards have been added: (a) the machinery hazard due to the increasing use of mechanical contrivances in agriculture; and (b) the toxic hazard due to the almost universal use today of weedkillers and pesticides.

For some time, mechanization of agriculture and the introduction of modern farming methods as a means of developing and improving agricultural productivity have been accepted in Africa. In some cases, cottage and small-scale industries based on rural subsistence economy are also being encouraged and developed in small towns and rural areas. The mechanization of the peasant agriculture has, however, not met with great success in many of the developing African countries. Where small farm settlement schemes have been introduced, the trend shows that the peasant mode of production, characterized by small-holdings, simple techniques of production, and in many cases bush-fallow system of cultivation are still the basis of the African agricultural system for both export and domestic commodities. Produce for export crops and for domestic food crops is cultivated in the same area and in the same farm unit. The application of new technology has met, in many areas so far, with the resistance of the traditional farming methods and habits.

The stock example of the parasitic hazard is the infection of the worker in irrigated fields, e.g., bilharzia, schistosomiasis, etc. The hazards from agricultural machinery are many, ranging from the simple traffic accidents involving tractors, to the "factory type" accidents with complex machinery used for harvesting in plantation type agriculture. Much of the machinery used on the farm is perhaps more dangerous than the equivalent machinery used in factories: (a) because there is no strict supervision of the machinery on the farm as there is in the factory; and (b) because by the nature of their location on farms, many of the agricultural implements and machines are often not well guarded.

The agricultural worker is usually one of a small group, but sometimes works on his own. He serves no apprenticeship, unless he is one of the lucky ones who has attended an agricultural college. He has to learn the hard way. Government agricultural officers are concerned with better and more efficient production; they have little time to spare in training the worker on his own safety and how best to avoid the hazards of his job. In many of the African countries, the inspection of mechanized farming equipment is not possible because the farm does not rank as a Factory, and therefore, is not covered by the various Factory Acts. The reason for this is because the laws governing Labour or the Labour Codes, in at least the ex-British colonies in Africa, have followed the British Labour Laws very closely, and have remained unchanged since independence. There is, in other words, no regulation governing farming conditions, at least with regard to the protection of the agricultural worker on the farm against farming hazards.

Toxicological Hazards

Toxicological hazards probably rival the machinery hazards on the farms in Africa today and in many areas it is gradually becoming the number one hazard in African agricultural practice in the attempt to raise agricultural productivity. The most striking hazards are those from the insecticides and pesticides. Evidence of the ill effects of the use of these chemicals on both man and animal is now beginning to emerge from many of the African countries, although more systematic documentation of these effects is still needed. Here again we have a great paradox, and rather sensitive questions must be asked in order to find answers for their solution. The industrial countries are introducing regulations and controls to limit the amount of DDT in imported products. The situation in Africa and in other developing countries appears to be quite different. The Africans regard DDT as a necessity to get enough food and to have protection against diseases. It is reported that agricultural products from the less-developed countries are containing high residues of DDT and may be impossible to sell these products to the industrial countries with low-tolerance levels against DDT. For the African countries, agricultural products are important for export in order to earn foreign exchange for development purposes. The situation is therefore very gloomy. We have a DDT dilemma.

On the health side, the use of toxic materials poses perhaps the greatest problem in modern agricultural practices in Africa today. For instance, the effects of toxic materials on the skin is often forgotten, and therefore the danger is greater in the tropical African countries where workers sometimes wear the minimum of clothing while working in the field, and have considerable areas of the skin exposed to contamination. In some of the African countries where modern agricultural practices and mechanized agriculture are already advanced, the farm worker is likely to come into contact with toxic chemicals all through the farming year. The seed being sown probably has to be dressed by the worker with some toxic fungicide. When the seed grows in the field, it may be sprayed by some selective herbicide to kill off unwanted weeds. Months before harvesting, the crop may be sprayed, probably several times by toxic pesticides. Later, it may be necessary to spray the grown crops with a defoliant to kill off the unwanted foliage in order to make harvesting easier. The harvested crop may have to be treated with insecticide to prevent insect infestation during storage or with some anti-growth hormone to prevent sprouting. Finally, the stored up crop itself may produce toxic gases which also must be treated. The need for African agriculture to produce more cash crops for export and for foreign exchange will continue to play a significant role in the extent to which modern agricultural practices are emphasized and encouraged in order to increase productivity. The need to protect the employed agricultural worker in the field should become a first priority concern and must be seriously considered if the African countries continue to adopt new methods in agricultural productivity.

The Environmental Hazard

Little can be done to reduce the adverse environmental hazards. The African farmer in the field cannot avoid the sun. The acute environmental hazards may be avoided, however, especially those associated with high temperature and humidity. Any heavy worker in a warm, humid country faces the risk of possible heat illness. The stress of the environment on the man working intensively on a cash crop under a non-indigenous manager should not be overlooked. Basic principles of working in a warm environment discovered by the traditional peasant African agriculturalists are often ignored or even sometimes stigmatized as "laziness." Men often work through

the hottest parts of the day, and are discouraged from taking any rest pauses. An operator of a tractor driving his machine in the sun without a canopy may absorb from the sun as much heat as he would produce when walking at four miles per hour. This heat must be lost, and almost certainly, it will have to be by evaporation. A man driving a tractor therefore needs considerable quantities of water, and he himself very often does not appreciate this. "Clumsy" driving and "avoidable" accidents leading to tractor breakdown may well be a manifestation of unwitting, though so-called "voluntary" dehydration, leading to deterioration of psycho-motor performance and, in some cases, to a minor degree, of circulatory failure. This is particularly a problem in inland areas where there is a continental or desert climate. The idea that a man born and bred in the tropics will naturally have a greater heat tolerance than a man born and bred in a temperate climate is quite misleading. The climate imposes just as severe a strain on the indigenous population as on the alien individual.

The high work rates expected are not always physiologically possible. To avoid being stigmatized as "lazy" or even for a worker to avoid losing his job, some men, both in agricultural employment, as well as those employed in hot manufacturing processes in industry, often attempt the high work rate and become unduly fatigued and so become inefficient--or they are forced to take a rest, sometimes become absentees, or even become sick. Here again we are faced with the conflict when the time-honored traditional agricultural practices are compared with the demands of modern mechanized agricultural practices, or to the recommendations of a fatigue physiologist. Sometime the conflict is irreconcilable. For instance, when the actual method of cultivation is considered--using a "Movement Study"--this may suggest that the traditional hoe cultivation is inefficient, but does this mean that it should be abandoned or changed without understanding first of all if such a change is actually necessary, or understanding the needs that such a method of farming serves among the people using it? Is it not likely that if we look at the overall area cultivated, it might be acceptable? On theoretical grounds, it is probable that there is an optimum area to be cultivated by any given technique by one man. An agricultural "Efficiency Index" could be calculated showing the ratio of food calories produced to energy and maintenance calories expended. The ratio will go up with the area cultivated as the "overheads," i.e., maintenance calories are constant, but when too big an area is cultivated, there is fatigue, inefficiency, and more work calories are expended for a given cultivated area. It is therefore possible to visualize a situation where calorie cost of cultivation is only barely covered by the calorie value of the crops harvested.

The nutritional status, apart from the health condition, of the worker, whether in agriculture or industry, becomes a critical factor which may affect his working capacity at vital times of the work cycle. Man, like a machine, must have the right fuel and the right working conditions for him to show his maximum efficiency. This is the case whether the man works with machines or depends on his own energy resources. The lure of cash crops, whether cocoa, ground nuts or diamonds, is a potent cause among other factors responsible for inadequate nutrition among many communities in Africa today. It is contemporary history how, with the opening up of Sierra Leone for diamond digging, the agricultural output of the country fell so much that rice had to be imported for the first time in the annals of the country's history. Rapid industrialization in many of the African countries and the attraction of increased earnings it has for the rural population in the urban areas is

depleting rural agriculture of its young males, and equally of its agricultural potential.

I have necessarily concentrated on using the case of agriculture in Africa to illustrate the impact of technology transfer on the changing African society because agriculture is still largely the basis of African existence and economy. It is around agriculture that about 80 percent of the population living in the rural areas organize their live. It controls their social organization, their cultural values, their attitude toward life, family, child rearing, etc. All these are affected by the introduction of any new technology--be it the building of a dam, roads, construction of a steel mill, hydroelectric plant, the introduction of new farming methods, establishment of new industry, or even the application of new knowledge. What I have discussed in relation to the effects on the population of introducing new technology to improve African agriculture is also true in similar ways to the effects of introducing new ' chnology to develop new industry or any other type of technology for development.

Industrial Development

Many young African farmers from the rural areas are now migrating to the urban industrial centers in search of jobs in industries that are developing rapidly in many of the African countries. The problems of Man/Machine relationship are little understood by many of the African planners or by the migrant labor from the rural areas. The importance of the nature of the work environment in industry in relation to health, efficiency and productivity has hardly received adequate attention, if at all, in many of the African countries. How man is being affected or even damaged in his day-to-day contact with his work environment and by the machines he uses needs to be studied. The recognition of this has led to the establishment all over the world of ergonomics laboratories where the problems of Man in relation to his working environment are being investigated in every detail.

Today, no such laboratory exists in Africa south of the Sahara, with the exception of South Africa. The ultimate aim of all these institutions is to determine the optimum conditions for efficiency, which could be interpreted to mean the "comfort" conditions. To determine how these conditions can best be realized, and if this is not possible, to lay down the maximum deviations from the comfort conditions permissible and compatible with reasonable efficiency. In the United States, particular attention has been paid to defining accurately the actual "comfort zones" for men in different circumstances. In England the Medical Research Council's Industrial Hygiene Unit investigates the environmental conditions in mines and factories and advises on how to improve them. The Applied Physiology Department of the London School of Hygiene and Tropical Medicine is even interested in such everyday environmental problems as the housewife on washing day and the postman's load and the distance he has to carry it. In Germany there is an institute for work physiology. If the African countries opt for increased industrialization as a means of raising their economic standards, these are some of the questions they must resolve before it is too late.

They must look into the problems of industrial hygiene, and of applied nutrition; fatigue, and sickness due to fatigue or working conditions, e.g., physiologically determined absenteeism. Studies in these areas by the technologically advanced countries have been directed at the problems of industry in developed countries, and have ignored the tremendous range of problems encountered in tropical climate countries as in Africa in which the population may be anthropometrically or functionally different from that of the machinery-exporting countries. It is necessary therefore to explore the possibility of adapting

a wide range of industrial equipment and simple tools to meet the requirements of workers who will use them in a new and different environment in Africa and in other developing countries.

The effects of the present trends in development programs in Africa, and the changes required in terms of adaptation of the population to new technologies, need to be carefully examined and analyzed for future development orientation. Planners often lay more emphasis on the economic pay-offs of any development program. No doubt this is necessary, but to neglect the human factor in such development programs or to make it secondary to economic considerations, can only negate the very aim of development, which is: to improve the conditions and the quality of life of the people. (This has already been shown in many instances.) In other words, as long as the health and the social welfare of the community are not considered an essential part of economic investment along with investment in developing the industrial and the agricultural sectors of the economy in Africa, such a development program will continue to be faced with the critical situation of realizing its goals. The health and economic progress of the developing African countries are closely linked to the condition of the ecology and the environment; this fact creates all the more reason why greater emphasis should be placed on the condition of the environment in particular than ever before.

At every turn the problems of African development and technology and their effect on both the community and the environment must be looked upon as interdisciplinary problems. It is only to be expected that the biological, medical, and engineering sciences should have an important part to play, and few people will doubt or not appreciate the contributions already made by the social or cultural anthropologists. But that the sociologist should be brought in to interpret renal function, or that the pathologist should be linked up with soil erosion may be a surprise to some. It is also within the framework of recorded meteorological data that even the physiologist has his role in planning, hence the importance of the meteorologist.

I must end this lecture by recalling a conversation between an official and an agricultural officer about the low milk yield of the Fulani cattle. The official asked, "Surely it must be possible to get a more productive strain." The officer replied, "Certainly, but the milk production is limited by the grazing, and that is governed by the rain, which is beyond our control. It does not matter how many or how few cows you have on the job, the total milk production will remain the same; you cannot get more milk from the same amount of grass." The officer may not be quite right, of course, but he pointed out a moral nevertheless; a moral that we should all take to heart: that there are some things we cannot change. It is not our task to change, however, but to point the way towards getting the best out of these immutables, and to demonstrate that even though we will not get more milk, there are still some advantages to be gotten by changing the breed of our cows.

Technology and the Environmental Crisis

by

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A lecture given April 3, 1973, Seminar Series on Technology and Development, School of Engineering, Howard University

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TECHNOLOGY AND THE ENVIRONMENTAL CRISIS

by

Barry Commoner

I'd like to talk about the ways in which the technology developed in the United States affects the environment and whether or not such technology is practical for developing countries. This issue came to a head during the United Nations Stockholm meeting last year. Half way through the process of putting it together, the conference organizers realized that they had to pay attention to the concerns of the Third World. What were those concerns?

Many of the Third World representatives thought that just as they were beginning to be in an economic position to reach out for programs of development, they were being told that development itself was bad. Just as they were becoming interested in purchasing new products, they were being told that the environmental crisis was a result of intense production and large technology; the new goods were inevitably polluting the environment. They thought that this conference was simply a political ploy to stop development. It didn't help to clarify the problem when some agencies, such as A.I.D., began to cut back on development support.

Another source of antagonism was the fact that some people at the conference said that pollution was a manifestation of over-population. The people in the Third World recognized very clearly that if this were the case, then they were the guilty ones. They were concerned that the conference was simply another ploy to get them to control their population.

The reason I mention this is to show that the Third World is very conscious of the interaction between development and environmental problems. This is not simply an international problem. You can think of the urban ghetto as a place that needs developing: it needs houses; it needs schools; it needs jobs. Many of the poor in this country are concerned that environmental problems may be solved at their expense.

Some people in this country blame pollution on affluence. They say we're all using too much food, too many clothes, too many electric can openers and so on--and that's why we're polluted. That explanation doesn't sit very well with a poor person who really isn't worried about can openers and having too much food or too many clothes. So, the issue is really the same, whether we're talking about the Third World or the poor in this country.

What I'm going to try to do is to analyze environmental issues in the United States, looking at the factors that cause the problem in order to see how they impinge on questions of poverty, population, and social justice. Is the environmental crisis a problem that we have to think about only in ecological terms, or is there an organic connection between this and other social problems?

Natural Ecological Cycles

The environment is simply the earth's thin skin--a few miles of air, surface waters, and the soil. This is the place where living things exist on the planet. The reason we have to identify the physical and chemical environment as a place where living things are is that it turns out that living things are responsible for most of the physical and chemical problems of the earth's surface.

Let me give you a simple example. The fact that there's 20 percent oxygen in the air is the outcome of the evolution which produced green plants. All of the oxygen molecules in the air were produced by green plants. But the moment oxygen appeared in the atmosphere, it was possible for evolution to produce oxygen-utilizing organisms--a new form of life. You have the old form of life that produces oxygen and the new form of life that uses it-- a dependence of one living thing on the other, mediated by the environment.

It is a curious fact that no living species can survive on earth without other living species being present. I also want to point out that the physical properties of the earth's surface are also dependent on this interdependence. For example, the ultraviolet flux coming from the sun, if it reached the earth's surface, would prevent any living thing from surviving. We can survive on the earth's surface despite this because there is a zone of ozone in the upper stratosphere. Ozone absorbs ultraviolet light. Thus, the sun is surrounded by a screen. The ozone itself was generated from molecular oxygen. Before there were green plants, there was no molecular oxygen. There was no ozone, and the earth's surface was bathed with intense ultraviolet light so that no living thing could have emerged from the surface of the earth. The first living things, we now know, appeared under a thick layer of water where they were protected from ultraviolet light. As they developed, they changed the physical attributes of the earth's surface and allowed living things to emerge and survive on the land.

What I'm trying to suggest to you is the complicated interactions, generated during evolution, between the biological inhabitants of the earth and the chemical and physical nature of the earth's surface. The result is that we now have cycles of interdependence.

The soil cycle is a typical ecological cycle. The chemical content of a crop is eaten by man; man converts it to organic matter in his wastes; the wastes are deposited on the soil where they are converted by bacterial activity to a very complex polymer material--humus. This breaks down gradually through bacterial action to form inorganic nutrients which are taken up by the crop, completing the cycle. Similarly, in the water cycle, we have fish releasing organic wastes; the wastes are oxidized to inorganic nutrients; and the nutrients are taken up by the green plants--the algae which the fish eat.

These are natural, stable, closed systems. There are two ways to disrupt such a system: one is to cut it and the other is to stress it. As long as you stay inside the cycle, it's stable. Let's say, just for the sake of argument, that you suddenly had an overgrowth of algae because the water temperature increased. There would be too much algae and too few nutrients. If that happened, the fish would eat more because there would be more to eat. Having eaten more algae, they would produce more waste, and the waste would produce more inorganic nutrients. The cycle would correct itself.

But suppose you began to put organic waste in from the outside. It takes oxygen to convert that to inorganic nutrients. If you put in too much waste, you can use up all the oxygen. Now the bacteria can't convert the organic wastes and the whole system breaks down because these bacteria die, and the organic material secretes humus. That is precisely what we have done by our engineering techniques--our handling of people, food and wastes.

We move the crop to the city because that's where most people are and that's where they have to be fed. The city then simply becomes a place for converting food into sewage, which we then dump into the water. This overburdens the water cycle and also breaks the soil cycle, because the nutrients do not come back to the soil.

We've domesticated the process. Instead of dumping organic wastes into the water, we put sewage into tanks with bacteria and we bubble air through, converting the organic wastes into inorganic nutrients. The nutrients then enter the water cycle and disrupt it. Why? Because if you put in more nutrients, the algae grow heavily and form thick layers. The light is coming from above so the algae down below have an exponentially decreased light exposure. They then cannot produce as much oxygen as they should. They die and release organic matter, destroying the whole intention of the sewage system which was to prevent the dumping of organic wastes. In other words, what a modern sewage treatment does is to eventually convert one form of organic matter into another, with the algae as an intervening medium. That's exactly what's happened in Lake Erie.

Meanwhile, the soil cycle has lost nutrients. The agricultural technologists have a solution for that problem: they put in artificial fertilizer. But what they forgot is that the humus is responsible for the efficiency with which the crop takes in nutrients, because the humus makes the soil porous. When the humus is decreased, plants take in nutrients less efficiently. One result is that some of the excess nutrient now drains into the water, adding to the stress on that cycle. I'll return to this later. What I wanted to show you is that changes in our technology have disrupted two major ecological cycles. Now, a lot of people say that the only answer is to take the people and put them back on the soil; some people say that we've got to turn the clock back. However, you don't need to be against technology to be in favor of ecology. You analyze the problem and ask the question, "What is it that people do in the natural cycle?" What they do is to produce organic wastes. Well, why take people and put them back on the soil when all you want is their sewage? Instead, you introduce a technological innovation--a sewage pipeline to take the sewage from the city back to the soil where it belongs, and reconstitute the cycle. It's actually being done experimentally in Illinois using train carloads instead of pipelines. This is what I would call ecologically sound technology--technology which takes cognizance of the laws of chemistry and physics, and the laws of ecology.

Technology and Pollution

Let's now analyze some of the reasons for pollution. The problem really began after World War II. Most pollution levels have gone up enormously since that time. The population has gone up by about 50 percent and the GNP has gone up four-fold, but this doesn't account for the order of magnitude increases in pollution. I want to start with food, particularly the use of nitrogen to grow food.

In the U.S. as a whole there was a 7.48-fold increase in the use of nitrogen fertilizer between 1949 and 1968. In 1949 we used about 11,000 tons of fertilizer per unit of crop production; in 1968, we used 57,000 tons of fertilizer per unit of crop production. Since that time, we've also reduced the acreage that we're using to produce food. We're using fertilizer to intensify the per acre yield. This is a technological change--using fertilizer instead of land. Since one of the laws of ecology is that everything has to go somewhere, the nitrogen which does not go into the crop goes into the water. Nitrate becomes a problem biologically if there is too much in the water and you drink it. It can be converted to nitrite in the gut and nitrite interferes with the operation of hemoglobin. If a pregnant woman drinks too much of it, she can get a blue baby. It's a serious problem. We're studying this in detail in Illinois. In many cities there, drinking water must be taken from rivers for nitrate purification.

Some people say that the reason for pollution of the environment by agricultural activities and the use of pesticides and fertilizers is the growing affluence of the American diet. That's simply nonsense. It turns out that with respect to food consumption, we are not more affluent in the United States today than we were back in World War II. We are all consuming now about the same amount of food per capita as we did then. These are overall data. You might think we're eating better now, even if it is the same amount of food. It's true that meat consumption has gone up relative to other sources of protein, but vitamin consumption has actually gone down.

In 1960, fertilizer use was about half of what it is now. However, we were within 15 percent of the yield. So between 1960 and the present, we've doubled the use of fertilizer for roughly a 10 to 15 percent increase in yields. Immediately you ask, "Why are the farmers in this foolish situation?" This excessive use of fertilizers is not because of an increased production in food per capita, but because we've switched from a technology of using lots of land and little fertilizer to a technology of using less land and a lot of fertilizer. Then you have to ask the question, "Why has that switch been made?", and the answer is very simple: it pays the farmer to use fertilizer. Fertilizer is cheap--he puts it on, and that's what brings him over his break-even point. The tragic fact is that changes in American agricultural technology since World War II have forced the Illinois farmer to pollute the water in order to make a living.

Let me give you another example--phosphate detergents. Phosphate is a natural substance in sewage wastes, but since the 1930's the amount of phosphorous entering surface water and sewage went up seven-fold. Phosphate is one of the nutrients that over-stimulates algae production and causes pollution. Thus, we've had algal overgrowth since that time, and the question is, why? You can account for it by the phosphorous sold in detergents which contain phosphates. Then the question arises, "What's the good in detergents?" It's absolutely essential that you look for the ultimate economic good. You have to ask "Why are detergents good? What do they do?" Their ultimate good is that they clean. The question now is: "Are we more affluent with respect to cleaning? What has happened to the technology? How much pollution are we now producing per clean shirt?" And the answer is very simple.

We've made our cleaning technology anti-ecological. Our per capita use of cleaners is about the same now as it was in World War II. I think it is generally true that we are about as clean now as we were then. But, we now use a different cleaner. Soap has been pushed out out of the market, and detergents have taken over. As a result, we now use 19 times more phosphorous per pound of cleaning than we did before.

Everytime you wash a shirt, you are putting a much heavier stress on the environment than you did before. In addition, the phosphorous used in detergents isn't pure; it is always subtly contaminated with arsenic. This means that unless you want to make chemically pure phosphates for detergents, we will put an order of magnitude more arsenic into our water.

Now let's look at another product: fibers. Fiber production per capita in the United States has been about constant since World War II, but cotton and wool have been displaced by synthetics. Again you get the same good per capita, but you have to ask, what's the environmental cost? Everybody talks about solar energy, and how wonderful it would be if there were some new, economical way of converting solar energy into a usable form. Well, the cotton plant does exactly that: it manufactures cotton fiber with solar energy. Synthetics, on the other hand are made from non-renewable resources, like petroleum, using energy. Their production uses up these resources and also pollutes the air. The argument is sometimes raised that we would also use gasoline and fertilizer to grow the cotton. Recently we calculated the amount of energy used to produce cotton in the United States. We found even with the worst modern technology for making cotton--in Arizona, where the fields are irrigated by running pumps, where the crop is fertilized and sprayed with pesticides--it still takes twice as much energy to make a pound of nylon as cotton. So again, the real reason for the additional stress on the environment is the change of technologies.

Chlorine production has gone up in this country because chlorine is widely used in synthetic reactions. Since mercury is used in the production of chlorine, this is one of the reasons for the mercury problem in the United States. We've got a lot more mercury going into water as waste from chlorine alkali plants because we're making detergents instead of soap, and nylon instead of cotton.

Now, let me quickly deal with the automobile. We now get 14 miles per gallon instead of 15--the present value is way, way down because of the exhaust devices. It's now down to around 10 miles per gallon. The horsepower has gone up sharly. This drop occurred at the time of the introduction of the old compact cars, which then grew larger--they kept the same names, the cars just got bigger. Now, of course, there's going to be a new drop. But you see there has been a rather sharp increase in horsepower, and as any engineer will tell you, the proper technology for getting an efficient high horsepower engine is to raise the compression ratio, which they did. But what the engineers forgot was that when the compression ratio goes up, the temperature of the combustion process goes up and the result of that is that the oxygen and nitrogen in the air taken into the cylinder begins to interact, producing nitrogen oxides and they get out through the exhaust; the sunlight hits them;

they become reactive, and that's the source of smog.

And here, you have the technological basis for our present smog engines. I think it's clearly true that if we were all driving pre-war cars, the same number of cars, the same miles operated today, there would be hardly any photochemical smog in the United States. This engineering conversion has produced smog generally. Again, there is an interesting economic question, and why is this so? The reason, of course, is that it is economical. It was Henry Ford who said that mini-cars make mini-profits. One reason is that much more profit is made on accessories than on the car, and the bigger the car, the more accessories.

We are now traveling about twice as much per capita as we did in 1946. But is this an increase in affluence? I don't think so. Most trips are taken for a distance of five to ten miles, and an overwhelming number of miles traveled simply move people between place of residence and place of work.

This means that the increase in the number of miles traveled per capita is largely the result of the change in the design of the city. Take St. Louis, for example, a classical case of decay in the inner core spreading out like a fungus throughout the metropolis. Every morning the whites get up in the suburbs and get in their cars and drive to the center of the city where they work. The blacks wake up in the center of the city, get in their cars (because we have no mass transit), and they drive to the suburbs to work in the Chrysler factory, or in suburban homes as domestics. This is taking place because we have allowed living places and working places to be separated by a whole series of social practices. The average distance traveled between work and residence by a black in the United States is about 20 percent longer than for whites.

This raises another general point: as long as you have problems of social injustice which <u>enforce</u> changes on our technology-- and I consider the design of our cities to be technology--which don't take into account the use of resources and the impact on the environment, we are going to get increased stress on the environment.

I now want to talk about power. Figure 1 shows the labor and power productivity of U.S. industry. Value added is simply the economic value contributed by the industrial process. Now, if we measure the value added per unit of labor over this period of time, it's gone up from $4 per man-hour to $8 per man-hour. This is the vaunted rise in labor productivity which is the be-all and end-all of technological change in this country.

LABOR PRODUCTIVITY AND POWER PRODUCTIVITY
OF U. S. INDUSTRY

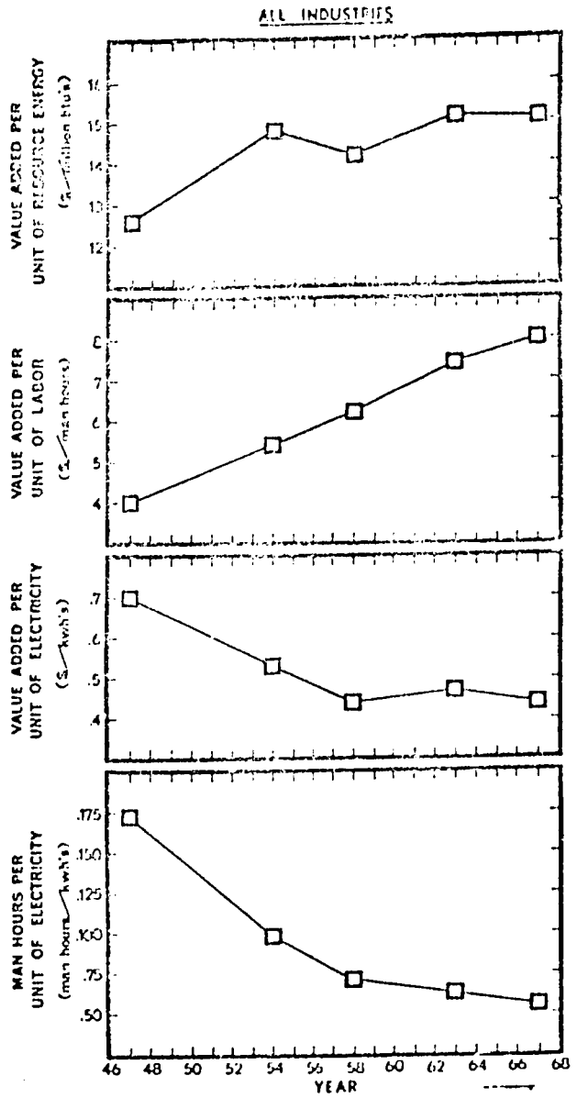

Figure 1

What about the productivity of electricity--the dollars of value added we get per kilowatt hour? The more electricity we use, the more pollution there will be. In 1946 all U.S. industry got 70 cents of value added per kilowatt hour; by 1968, this had dropped to 45 cents per kilowatt hour. In other words, U.S. industry now gets less economic return per unit of electricity, and therefore per unit of air pollution, than we got previously.

It turns out that industry has used electricity to displace labor. There are good reasons for this. Labor is very expensive. Also electrons don't go on strike; they come to work on Monday, and they don't cause trouble. As a result, we generally have squeezed labor out of our productive enterprise. Most of our technology has been designed to use less and less labor to produce more goods. The problem is that we raise labor productivity at the expense of using resources, which is wasteful and environmentally unsound. This has a lot to do with whether or not our technology is useful to the Third World.

We produce as much protein, bricks, new cars, socks, shoes, major appliances, steel, total freight, etc., as we did 25 years ago. Per capita production has not gone up with the population; we are not more affluent with respect to freight, food, clothing, houses, etc. But we have changed the way we produce these products.

Let me take total freight as an example; it's hardly gone up at all compared to population. However, truck freight has gone up faster than the population, while railroad freight has gone up slowly compared to the population. In other words, we've displaced railroad freight with truck freight. It takes six times as much fuel to carry a ton-mile by truck as it does by rail. We've transformed the way in which we carry freight in a counter-ecological way. Soap consumption has gone down; detergent consumption has gone up. Natural fibers have been displaced by synthetics. In other words, the vaunted transformation of U.S. technology that the Third World is supposed to want has not increased the goods received per capita. What it has done is to displace one form of technology by another, and largely for the sake of squeezing manpower out of the process and replacing it with machine power.

This makes no sense at all for the Third World. The Third World has lots of labor power. Why should it want a low-power productivity technology? The Third World produces natural materials, like natural rubber. Why should the Third World adopt the technology of making synthetic rubber? Why produce detergents when soap can be made? The character of our technology has been determined by the character of our economy, and it does not match the needs of the Third World.

Population and Development

I want to discuss the population problem briefly because it is relevant here. What we hear over and over is that the Third World will develop when it controls its rapidly increasing population. In other words, the notion seems to be that the way you raise the level of an economy is by reducing the population, which will raise the ratio of goods per capita. Then you will have affluence.

The historical fact is precisely the reverse. In technologically advanced countries the rise in technology preceded the drop in the population. I'll come back to that in a moment.

There are very complex factors involved in population. Normally, if the birth rate goes up, the population increases; if the death rate goes up, the population decreases. However, it is also true that if the death rate goes down the population may decrease. Why? Because infant mortality accounts for part of the death rate. Now, obviously, there are children who have not been desired, but most children are produced because they are wanted. That desire for children increases the birth rate, but desire for children is in turn affected by the death rate of children. In many societies what people want is two surviving sons. Now, if half the children that are born die, people know they may have to have ten children in order to have two surviving sons. Therefore, as long as infant mortality is high, the desire for children results in a high birth rate. When infant mortality drops, the birth rate will drop and the population will drop.

Some people think that if the population increases, that reduces the standard of living. However, when the population goes up, you get more people who can work and stimulate economic activity; this allows educational levels to increase. And it's well known that as educational levels go up, the age of marriage goes up, and that reduces the birth rate and reduces the population. So, it is not necessarily true that you have to regulate population size by cutting the birth rate or raising the death rate.

Perhaps the best way to illustrate this is with the example of the Industrial Revolution in England. Before the Industrial Revolution, England had a constant population--the death rate was high; the birth rate was high. With the development of agricultural and industrial technology, the standard of living rose and the death rate dropped. In the beginning, children worked in factories because it was the only way families could survive. With the low standard of living, children were economic assets. As the standard of living rose, it was possible for a family to take the children out of the factories and put them into schools. The schools were needed because as the standard of living increased, the technology became more complicated. The child became an economic liability rather than an economic necessity. Consequently, people had fewer children.

When we tell the Third World to lower its birth rate in order to advance its technology and standard of living, we're telling them to do precisely the reverse of what the Western countries did. It's no wonder that this is a political statement, not a demographic statement or a statement of technology. It is no wonder that the Third World is resisting this idea because they are beginning to understand that they are following on the same course as the developed world.

People never ask why the birth rate is high in developing countries. What is the history of these countries? It turns out that the countries where the population explosion has occurred are places which were colonies. What is a colony? All a colony is, of course, is a place that provides raw materials for the growing technology of an advanced country.

Indonesia is a good example. When the Dutch moved into Indonesia, the population was in balance with a high birth rate and a high death rate. The Dutch brought in engineers and doctors; they built roads and created communications systems. The standard of living rose: the death rate dropped and the birth rate remained high. Indonesia started off on the first stage of the demographic transition. The second state is dependent on a continuing rise in the standard of living. But the Dutch took resources out of Indonesia. They took the wealth generated by this growing population and shipped it to Holland, which enabled the Dutch to go through their demographic transition and bring their population into balance. Their standard of living rose from Indonesia's resources. However, by taking the wealth generated in Indonesia away from the Indonesians, they took away the motivation for going through the second stage of the demographic transition. The death rate remained relatively high--the infant mortality, particularly.

This tells us that the population explosion is the consequence of colonialism. The advanced countries have simply built their technology on the use of resources from the Third World. We all know that the Western countries exploited the labor resources of the Third World. But there's another form of exploitation: they forced a population explosion on the Third World by starting the process of the demographic transition without allowing it to complete itself in its natural way.

What does this mean about the relation between the Western World and the Third World? At the beginning of World War II, we began to turn our backs on the Third World as a source of raw materials. In Bangladesh, for example, after the fighting and the floods there, the jute production went down. The American rug manufacturers developed a synthetic backing for their rugs, and now the jute industry in Bangladesh is in trouble. In effect, what the Western World has done is to exploit

the colonies and their people, impose a population increase, and now when the countries are economically independent, the advanced countries don't want to buy the soap or the cotton or the natural rubber. This is the tragedy that we have created.

Finally, I suggest that the obvious strategy for the Third World to adopt is to say, "We'll rescue you from your petrochemical industry. But, you'll have to buy our cotton goods, not our cotton; you'll have to buy our tires, not our rubber--we're not going back to the old colonialism." Incidentally, Malaysia is now starting to manufacture cotton goods. India could profitably manufacture an attractive line of cotton clothing and introduce it into the United States as natural clothing. The Third World could use their natural resources to provide a way out to the Western World. That would mean a whole change in our economic outlook.

The issue of social justice has to be faced in this country, as well. Let me just finish with one remark. It is well known that black students generally are not as interested in the environmental problems as are suburban whites. Should they be? Yes, in this sense: So long as there are poor in this country, it will be the poor who suffer most from environmental degradation, and the solutions proposed for it. It costs $500 to put an exhaust device on a car. A $500 increase in the cost of a $2,400 car that a poor person needs in order to get to work is a very serious increase. If you are buying a Mercedes Benz, it doesn't mean a thing. To say that we're passing the cost along to the consumer is simply to say that we are making the poor carry the burden for the technology that we developed.

I'll give you another example. According to census data on air conditioner use, families in the poorest classification--$3,000 a year income and less--use one-quarter as much air conditioning as people in the richest category--$15,000 a year income and more. We all know that air conditioning heats up the environment. This means that in our cities rich people who have air conditioning are warming up the environment, making it hotter for poor people who can't afford air conditioning.

In sum, the question of relating technology to development comes down to basic social issues--providing justice among the rich and poor at home, and among the rich nations and the poor nations of the world.

Economics and Technology of Development

by

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A lecture given April 5, 1973, Seminar Series on Technology and Development, School of Engineering, Howard University

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ECONOMICS AND TECHNOLOGY OF DEVELOPMENT*

A Perspective

Over the last two decades the developing countries in Africa, Asia and Latin America achieved on average a rate of growth of output which is arithmetically sufficient to accomodate their growing population and to allow for a modest increase in their living standards. This statistically observed growth did not bring satisfactory progress in development; malnutrition is common, illiteracy and wealth is severely skewed and the gap between rich and poor countries is widening both relatively and absolutely. Even to achieve this modest rise in standards of living, a tremendous mobilization of resources was necessary. In the developing countries of Asia, Africa and Latin American annual investments, during the last decade, amounted to some 15% of these countries' national incomes. On average, 80% of these investments was financed from their own resources and 20% from international assistance. 1/

The net flow of financial resources from developed countries (both official and private) to the less developed has been substantial; amounting to some $120 billion over the period 1956-68. In 1968, the net official and private flow of development assistance has been estimated at over $12 billion representing 0.5% of the donor countries' gross national product. On average a quarter of this flow was in the form of grants. The financial cost of these capital and technological inputs to the less developed countries, as a result of two decades of borrowing, has been rising sharply. Total recorded foreign debts of the less developed countries stood at $47.5 billion in June 1968.

The reverse flow of debt service payments on official account amounted to $4.7 billion in 1967. These payments have been rising over the last ten years by some 17% annually, and are fast approaching a situation where the outflow is equal to the gross flow of new lending. The Pearson Commission estimates that the developing countries of South Asia and the Middle East would reach this position by 1977 and in Africa and Latin America well before that if the flow of lending remains at the 1965-67 level. Even an optimistic increase of 8% annually in the flow of lending would mean that between 60 and 90 percent of new borrowing would be utilized for debt service payments. Export performance of developing countries in the sixties, in spite of annual growth of slightly below 6%, has led to a steady decline from over 30% of total world exports in 1960 to less than 20% in 1968.

1/ "Partners in Development," Report of the Commission on International Development, 1969, pp. 27-31.

* Transcription of a lecture delivered to the School of Engineering, Howard University. The views expressed in this paper are those of the writer and do not necessarily represent the views of the World Bank.

The behaviour of these basic variables, which help portray the pattern of international development, leads to justifiable anxiety. Simple and sophisticated extrapolation of recent trends indicate a worsening in the relative position of developing countries, an increasing gap between rich and poor countries at an alarming rate, and a declining support for more aid at less burdensome terms. But, perhaps more important is the observation that despite all the mobilized effort, the economic achievements of the past two decades have by-passed the vast majority of the people in developing countries. This is particularly true of the 60-70 percent of the population who live in rural areas. But it is also true of the majority of the urban populace. Subsistence wages, unemployment and deteriorating levels of urban services are the results of slow economic growth and rapid migration from the countryside.

It is becoming increasingly accepted that development cannot be a viable process unless and until its social dimension is effectively pursued A truer definition of development is for a country to achieve a rising but more equitably distributed income, a higher literacy rate, better nutritional standards, a rate of growth of employment opportunities commensurate with the growth of labor force and an improvement in all those economic and social elements which determine the profile of society, its ability to absorb relevant technologies and the quality of its life. These arguments have inspired a dialogue which cautions against the consequences of pursuing these objectives, claiming that they are incompatible with economic growth; that the first priority is to increase the size of national income before worrying about the pattern of its distribution; that the implied development strategy is emotionally inspired rather than realistic, sound and feasible; that the resultant delay in introducing modern technology, though admittedly less labor intensive, would perpetuate the technological gap between advanced and developing countries. In short, the trade-off, it is argued, between the pursuit of economic growth and the achievement of a wide-spectrum of social and economic development, is large enough to justify a watering-down of social aspirations in favor of purely economic objectives.

One cannot brush aside these arguments for they do contain some isolated elements of truth in varying degrees. They are not, however, based on a penetrating understanding of the totality of the development process. Let us not ask whether growth or social justice provide a more viable approach to development. Let us ask how to achieve that type of growth whose social impact is both real and widespread. The international experience of the past two decades provides some important guidelines to the diagnosis and prescriptions for this most relevant question of the 1970s. Few would disagree that the development path has hitherto been uneven, slow and ineffective in terms of both the growth of income and the social welfare of the vast majority of the population.

To be candid, in the pursuit of the so-called growth-oriented development strategies, planners have in the past erred in three important respects. First, there has been a tendency to assume that the rate of growth is determined almost exclusively by how much a developing country invests. We have viewed development as a process of capital accumulation in the form of new factories, new irrigation works and the expansion of economic infrastructure. The emphasis on new ventures has competed successfully in the bid for governments' attention, for scarce technological, administrative and managerial skills and for the use of domestic reousrces and foreign financial and technical

assistance, to the detriment of existing production capacities. A close appraisal of the economic situation in many developing countries clearly indicates that the near-future growth potentials relate not so much to the need for higher levels of investments as to the need for intensifying efforts to apply newer technologies in order to improve the productivity of the land and the use of the existing capital stock. Enough evidence exists to show that better utilization of established capacities, which require disproportionately less investments per unit of additional output can prove far more productive than the creation of new capacities.

Secondly, there has been an over-reliance by many countries on industrialization to spark the growth process. This approach led to the concentration of industrial investments in urban centers, which were already endowed with some of the required infrastructure, provided ready markets, and had higher political visibility. The industrialization strategy was strengthened by its apparent relative ease and glamour, in contrast to the more obvious difficulties and longer time span involved in modernizing a traditional agriculture, building an extension service and credit and other institutions, educating the farmer, confronting powerful vested landowning interests, and so on.

There have been some success stories of industrial growth, but the failures have been too many. In numerous cases the new industrial urban complex operates inefficiently, at high production cost, low employment impact and excess capacities. Yet, profits are artificially jacked up, supported by protection barriers paid for by society to provide entrepreneurial incentives. In most developing countries, the industrial sectors have contributed less than one or two percentage points to the overall growth rate. Nevertheless, industry and its related infrastructural requirements continue to get the lion's share of investment allocations. Economic policies are geared to the industrialization priority, and even government expenditures for social facilities and services are directed disproportionately to urban dwellers. Moreover, the political power of urban agglomerations and organized industrial workers helped increase their share of government attention and of national income. In most of the poorer countries, the increased urban share has been at the expense of the rural sector. But then, the peasantry lack political organization and articulateness, and physically, they are far removed from the center of political and economic decision making.

Thirdly, there has been a tendency to over-emphasize the adoption of costly modern technology. Intermediate technology, it has been argued, deprives developing countries from the competitive edge they must acquire to lessen their costly dependence on the imports of even their most basic requirements. Of more significance is the emerging costlier financial dependence resulting from the need to import modern know-how and technologies from advanced countries which has overtaxed the system of international technical assistance flows. Foreign experts, many of whom are not sufficiently oriented to the environment of developing countries, are increasingly faced with the problems of helping these countries absorb ill-suited technologies. In many cases, these technologies are designed for differently structured economies and factor cost relations. The results all too often are much lower yields in terms of output, income and employment than these technologies have produced for the advanced countries

In short, the pursuit of growth-oriented development strategies has not produced the hoped-for acceleration of economic activities which would enable a subsequent improvement in welfare and equity. Over-emphasis on technologically advanced, urban-oriented investments has not proved to be an efficient catalyst for growth, let alone equity and social justice. On the contrary, they have created a tremendous burden on domestic and foreign resources. They have increased the pressures for lower consumption and lower social welfare in order to generate a large enough domestic surplus to provide the required financing. International assistance has flowed generously in support of this effort. But it will have to gather a much faster momentum if it is not to be pre-empted by the reverse flow in honoring the resulting obligations. The scenario, no doubt, can continue for some years. But the impact, in terms of the living standards of two billion people, will remain as marginal as it has been over the past two decades.

A Restatement of the Development Problem

The oversimplified financial approach, dominating the international development dialogue does not sufficiently take into account the major bottlenecks limiting the full utilization of the natural and the human resource potential of developing countries. The approach is based on a number of economic "identities", of which the following are dominant in the literature and in the philosophy of the existing development institutions:

$$I \cdot K = \Delta Y \quad (1)$$

$$S = I \quad (2)$$

$$S_d + A = S \quad (3)$$

$$Y - C = S_d \quad (4)$$

These identities state that the growth of income (Y) is proportional to the magnitude of investment (I) and to the statistically observed output-capital relationship (k); that these investments equal total savings (S) which originate domestically (S_d) as a residual after consumption (C) and are supplemented by foreign aid (A). This approach over emphasizes the magnitudes of the variables without sufficient emphasis on the institutional and other "catalytic" agents necessary to establish the dynamic relations of, and to justify the logic behind these identities. In other words, the guiding philosophy has implied quantitative rather than qualitative objectives. While the former are certainly significant, the latter have proved to be, in most developing countries, the core of the development problem.

Let us rewrite some of the above identities in "physical" terms:

1) Given

(a) the scientific assessment of the country's development potential,
(b) the right choice of investment projects,
(c) the successful choice and application of technology,
(d) the economic procurement of machinery,

$$I \longrightarrow \Delta Y$$

(e) the adequacy of infrastructural services,
(f) the availability of production and managerial skills,
(g) the assured supply of raw materials,
(h) the appropriate study of market outlets,
... etc.

and, 2) Given

(a) "perfect" financial institutions to mobilize domestic savings and provide investment capital,
(b) unit elasticity of supply of entrepreneurs in the public and private sector,

$$S \longrightarrow I$$

(c) continuous supply of implementable projects to use up available investment funds,
(d) "acceptable" social and political investment climate,
(e) adequate foreign exchange to finance import requirements
... etc.

The neglect of the catalytic agents required to justify the equality sign in our economic identities represent the heart of the problems facing developing countries. There has been a noticeable tendency to implicitly disregard these problems, and concentrate on the magnitude of the variables on both sides of the equations. It is not sufficient for planners to look at the level of their national incomes, to visualize the possibility of a higher level at a future date, to subtract the two magnitudes and to calculate the capital required to bring about the projected increase. Nor is it sufficient for planners to look at their country's balance of payment and to project the trends of exports and imports in order to determine the required level of international support to cover the widening resource gap.

Let us leave the economic planners' offices and seek a better understanding of the causes and the remedies of poverty in villages and towns. This is not an invitation to visit isolated pockets of poverty. But to get closer to understand the way of life of some one and a half billion people, who represent more than one-half of the combined population of the developing

world. The majority of this population is in every respect economically and socially deprived. It is their fate which determines the ultimate success or failure of the international development effort.

We need to talk less about the savings-investments gap and more about the life of these people and the urban-rural income gap. We need to embark on the analytical thought process which can deal with the widening technological gap and the rising unemployment gap as effectively as we have developed monetary and fiscal measures to redress the trade gap. We need to agonize less about the trade-off between growth and welfare, and more about the type and content of growth which can truly change the lives of the majority not just the few. We should not be seeking a strategy of a simple redistribution of incomes by taxing the rich to finance social services and to subsidize the poor. We should be seeking a strategy aimed primarily at the reallocation of new resources in a manner capable of a rapid maximization of production along a growth path that is humanly, not just economically rewarding.

The present development institutions in the developing countries themselves are not oriented towards the pursuit of quality goals of development with new insights, new strategies and new emphasis. The World Bank has recently spearheaded a concerted effort to expand its role in mobilizing capital and allocating it for enhancing the productive capacity along these lines. The Bank's resources are not unlimited; but the real limitation on the Bank's role, and indeed on all of these "quality efforts", is the identification of the potential areas of action and the appropriate institutional mechanism for their implementation. To overcome these limitations, operational planning requires multi-disciplinary institutions to be established within developing countries to work along three main directions, (a) identification and evaluation of exploitable resources, (b) improvement of technology in existing production facilities, and (c) modification of the legal and institutional framework to impart the needed flexibility in implementation.

This task cannot be left to Government departments. It should be recognized that in its present form the <u>institution of government</u> in most developing countries is a fairly recent phenomenon. Financial and administrative procedures are mostly inherited from colonial administrations and are geared to ensure (often unsuccessfully) against overt fraud in a narrow legalistic-audit sense. Ministries are overburdened by the day-to-day routine of simple governmental operations and the maintenance of law and order. By design and evolution, a ministry in most developing countries is a narrowly conceived administrative unit in its early formative stage, not a development and entrepreneurial institution even in the remotest sense. The modern concept of the role of governments, not only as guardians of law and order, but also as active initiators of social reforms and economic development programs has caught many of these countries at the very early stages of transforming a tribal, non-cohesive society into a nation governed under the rule of law administered by a central government - a sufficiently burdensome task.

Moreover, development and productive exploitation of resources must be based on reliable and comprehensive research. This maxim, though widely accepted, is easier to articulate than to apply. Most developing countries have a plethora of resource data, spread among ministries in closely guarded files, much of which is based on rough estimates, informed guesses or partially completed surveys. This welter of often insufficient data seldom provides a realistic basis for sound project preparation and evaluation. The proposed institution at the heart of a country's development machinery should be assigned the task of digesting and assessing the relevance, use and improvement of existing resource data, and of selecting and adapting the most relevant technologies. The entrepreneurial capacity to prepare, evaluate and initiate these investments has been declining, due to social and political factors, in many developing countries. The proposed development institution should participate in the preparation of the complex of projects and decisions necessary to satisfy the wider development objectives. It should be action-oriented and should deal not with intangible aggregates, but with specific technological, social and economic data.

It might be relevant to express this concern in the form of some examples of actual experience in the Aswan Region of Egypt. A milk sterilization and pasteurization plant was built in the Aswan Region at a cost of $1.4 million, following a decision taken by the central Government, before the Regional Planning/Development Authority was established. The supply of milk in the region was not ensured as the cattle population is very small and scattered. As a result the plant could not be operated (the degree of utilized capacity was only 5 per cent) and a decision was taken to dismantle the plant and to have it reconstructed in a milk-producing region. The decision was economically justified but politically unacceptable to the local authority, with understandable reasons. The Agricultural Development Centre of the Regional Planning Authority was consulted with a view to resolving the economic-political conflict. The study carried out by the centre may best be illustrated with the aid of the following diagram.

The diagram has four axies and four quadrants showing the interdependence of four relationships -

(a) The relationship between cultivated area and output in quadrant I shown along the line OB.

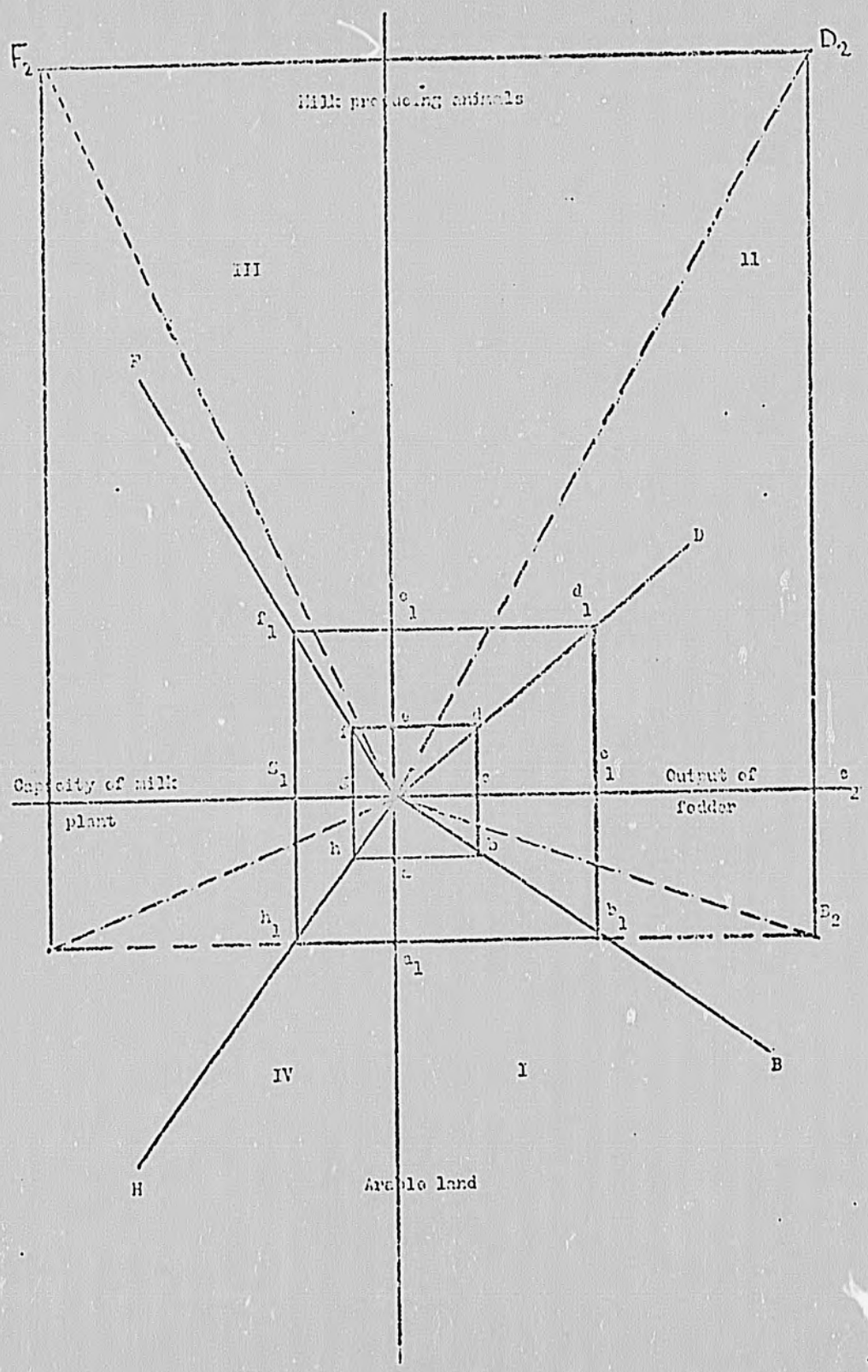
(b) The relationship between output of fodder and the number of milk-producing animals in quadrant II shown by the line OD.

(c) The relationship between the number of milk-producing animals and the milk plant capacity in quadrant III shown by line OF.

(d) The relationship between capacity utilization of the milk plant and the fodder growing area shown in quadrant IV by the line OH.

The then existing situation is shown by the rectangle (h b d f), drawn on the basis of the above relationships. The fodder growing area

Figure 3


F2
D2
Milk producing animals
III
II
F
D
c1
d1
f1
f
d
c
c1
S1
S
Capacity of milk plant
Output of fodder
h
b
h1
b1
B2
a1
IV
I
B
H
Arable land

amounted to Oa, producing a quantity of fodder amounting to Oc, which allows the feeding of Oe milk-producing animals, the milk of which would result in operating the milk plant at capacity Og.

The traditional solution would be to increase the fodder growing area say to Oa_1 (which is three times as large as Oa). Given the prevailing relationships, the plant utilized capacity would be augmented to Og (about 15 per cent). While this would still be uneconomical, the solution represents a maximum expansion in fodder cultivation as the arable land in Egypt in general and Aswan in particular is limited. Any increase in fodder cultivation, beyond this area, would be at the expense of other crops, essentially sugar-cane, resulting in a fall in the capacity utilization of the sugar plants.

The Authority's solution attempted to change the basic land, production, animals and milk production relationships. Applied experiments with various varieties of fodder crop were undertaken and new types of fodder were imported. Hawaiian Napier grass was introduced successfully to replace the centuries-old Egyption fodder (trifilium Alexandrinum). Napier yield per acre proved to be six times as high as the traditional fodder, and to possess equal, and in some respects higher, nutritional values. Its cultivation was generalized locally after a programme of extensive agricultural work. The new relationship between land and fodder production may be illustrated in terms of the Chart by the dotted line OB_2 which gives an output of Oc_2 (against Oc_1) from a cultivated area Oa_1.

The second basic relationship subjected to experiment relates to that governing the output of fodder and the number of milk-producing animals. The search was directed towards experimenting with various breeds of cows, buffaloes and goats which would produce the highest milk yield per unit of feed under Aswan conditions. The most successful results were obtained from Anglo-Nubian goats, a breed that originated in Nubia some one hundred kilometers south of Aswan, and was exported to Scotland and greatly improved. Milk yield per goat amounted to some 50 per cent of the milk yield of an average cow in Egypt, while the feed input per goat is about 10 per cent of that of a cow. A programme of breeding Anglo-Nubian goats was implemented, and as a result the relationship between fodder and animals shifted, in terms of figure 3, to the dotted line OD_2 and OF_2; which enables the milk plant to produce at full capacity.

The approach could be generalized in input-output terminology in the form of changing the technical coefficients in such a way as to maximize the productivity of both the capital and the input complex.

The second example relates to the research undertaken for the maximum utilization of the High Dam potential for irrigation water and power. The High Dam has one of the highest yield among all major dams in the world in both irrigation and power per cubic metre of water. The Volta Dam in Ghana is utilized for power only, with very little irrigation component. Other dams are constructed to serve irrigation requirements and little or no power is generated. The High Dam is a truly multipurpose dam. Nevertheless, research was directed towards achieving optimum yields in all its potential uses.

Figure 4

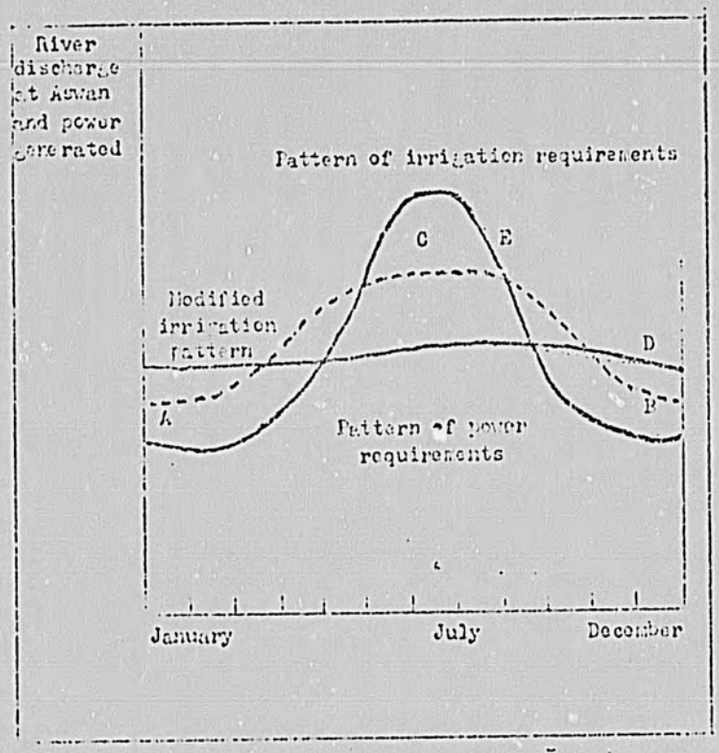
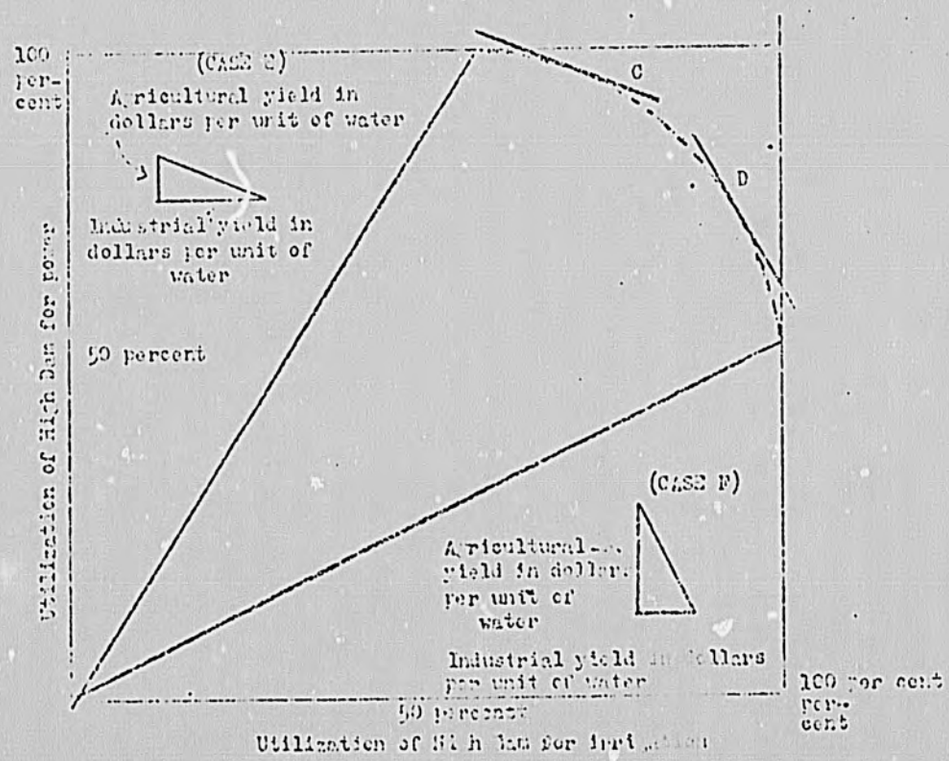


Figure 5



The discrepancy between irrigation requirements and industrial requirements raises the question of finding the best balance between irrigation and power production. This question cannot be answered properly without a systematic examination and a sound economic analysis of the interdependence of the different national development sectors. The level of agricultural development is directly influenced by the irrigation capability of the High Dam. The mode of operation of the High Dam will be affected by the nature of the irrigation requirements. The increased capability of the UAR's electric power system will influence the level of industrial development. The shape of the industrial load curve will affect the mode of operation of the entire power system. The co-ordinated operation of the UAR's hydraulic and electric power systems will not only influence the level of agricultural and industrial development, but will also affect their design and structure.

The following diagrams might help illustrate the research content in this regard. In figure 2 the pattern of irrigation requirements for agriculture reflects the seasonal demand for water, particularly for rice and sugar-cane. From the equation $E = F(D,H)$ where E is power generated, D is discharge and H is head, and assuming H not to be a restricting factor (to isolate the consequences of discharge variations), the pattern of supply of power generated would be similar to that of irrigation requirements. Demand for power does not show seasonal variation of any consequence. As a result gaps A and B reflect excess demand for power and gap C reflects excess supply of power. Four solutions are possible:

(a) To choose industrial development of seasonal activity to match the seasonal power production pattern. This is not feasible as the magnitude of power is some 10 million megawatt hours, and the industrial capital required to establish industries capable of utilizing that magnitude is too large to allow it to operate only seasonally;

(b) To change the pattern of irrigation requirements, as shown by the dotted line in the above figures, through alternative crop types and rotation. This would not lead to the disappearance of the gaps but would help diminish the magnitude of excesses;

(c) To accept the hypothesis that although the High Dam is a multi-purpose project, preference is given to its agricultural potential. The resulting excess capacity in its power potential would therefore be a policy-dictated constraint;

(d) To accept the hypothesis that preference is to be given to the maximum utilization of the High Dam power potential along the curve E in figure 4. The resulting decline in the utilization of its agricultural potential would therefore be the alternative policy-dictated constraint.

The optimum solution would probably encompass all four alternatives and an additional infinite number of alternatives in varying degrees as may be seen from figure 3.

The horizontal axis represents the utilization of the dam for agricultural purposes. The vertical acis shows the degree of utilization of the power potential. Because of non-complementary aspects of the two factors, i.e., seasonal irrigation patterns and stable firm power, it is almost impossible to achieve 100 percent efficiency for the two purposes. A hypothetical case would be a 100 percent efficiency in irrigation and say 70 percent efficiency in power. This case is shown on the diagram as point 'A' (alternative c above). Another extreme case would be where 100 percent efficiency in power is obtained while 80 percent can be achieved for irrigation, as shown by point 'B' (alternative d above). The curve joining A and B represents all possible combinations. The choice of the optimum point depends on the yield per unit of water of agricultural output vis-a-vis the yield per unit of water of industrial production through utilization of power. Such yields again depend in the case of agriculture on the location, crops, values, yield per acre, water requirements of each crop and so on. In the case of industry, the yield depends on the type of industry, its location, comparative advantages, price, export markets, etc.

This is shown in figure 3 by the two cases 'E' and 'F'. Case E, where industrial yield per unit of water is higher than that of agricultural yield in a proportion illustrated by the relation of the base to the adjacent of triangle E. The solution in this case would be point C on the curve BA obtained by the tangent parallel to the hypotenuse of triangle E. This solution would give a higher proportionate emphasis on power utilization than on agricultural utilization of the High Dam potential.

Case F, where industrial yield per unit of water is lower than that of agricultural yield in a proportion illustrated by the relation of the case to the adjacent of triangle F. The solution in this case would be point D on the curve BA obtained by the tangent parallel to the hypotenuse of triangle F. This solution would give a higher proportionate emphasis on agricultural rather than power utilization of the High Dam potential. An over-all model combining all these factors, where the number of variables is understandably great, has been completed. The brain which will eventually run the dam is a complex scientific institution whose objective is the maximization of the national economic yield of the High Dam.

Perhaps the single most important observation from these two examples is that no developing country can prosper simply by the importation of research results. Developing countries need to institutionalize their growth process on the basis of developing their own scientific community and of establishing effective relations between their research institutions and the potential developmental use of the results produced by these institutes.

Anticipated Changes in Development Approaches

by

SAMUEL C. ADAMS, JR., Assistant Administrator for Africa, U.S. Agency for International Development

A lecture given April 17, 1973, Seminar Series on Technology and Development, School of Engineering, Howard University

Prior to his appointment as Assistant Administrator for Africa, Dr. Adams was the U.S. Ambassador to Niger (1968-69), and had previously served overseas for sixteen years in the foreign aid program. He was also the U.S. Representative to the Fifth Special Session of the United Nations General Assembly. Dr. Adams received his Ph.D. (Sociology) from the University of Chicago (1952). In 1957, he received the Arthur S. Flemming Award (honoring ten outstanding young men in the Federal Government), and in 1972, he received the Rockefeller Award for Distinguished Public Service.

ANTICIPATED CHANGES IN DEVELOPMENT APPROACHES

by

Samuel C. Adams, Jr.

Ladies and gentlemen, I welcome this opportunity of visiting with you. I hope for the next few minutes to share with you some ideas about "Anticipated Changes in Development Approaches." Dr. Walker kindly introduced me by calling attention to a number of happenings in my life. You have not, I hope, been intimidated. The events of my career in development assistance tell you that I've been a very fortunate person. Perhaps, for this occasion, it is only relevant for you to know that had I been able to stretch my imagination a thousand-fold on my first overseas assignment, I would not have anticipated so varied a career nor anticipated the changes in foreign aid I have seen occur.

Some time ago I read with great fascination Dean Acheson's book, Present at Creation. I have thought much about U.S. development assistance programs and especially our foreign aid in Africa. Certainly, for U.S. aid to Africa, I feel that perhaps I was almost "present at the creation." The foreign aid programs in which I have worked over the years appear to have become very bedeviled and troubled, particularly so in recent years. Nevertheless, you may be surprised that to get to work each morning, I have not had to wake myself up reciting a litany which says, "Gee, am I enthusiastic; isn't this exciting; my, but I am enthusiastic!" No, I have found my involvement in development assistance a continuing and compelling challenge in its own right and quite sufficient to capture the enthusiasm which I have aimed to bring to the program.

With some thirty years of working at home and abroad on problems of development assistance, my experience may best be seen as folk lore in anticipating changes in approaches to development assistance over the next two decades. Many of the initial development approaches and rationales of early foreign assistance programs have largely come full turn. Over the past years our assistance efforts have matured and changed. We have learned to do our business better, and hopefully, more effectively. Programs of assistance have been changing to be more responsive to the needs of developing countries.

Within the past two decades, developing countries themselves have come to wear new faces. This change in country situations and definition of development problems is very fundamental in shaping approaches to development assistance in the near future.

Let me recall what the situation was like when I first became a participant in technical assistance to developing countries. I began some 13,000 miles from home--in a setting where the people, the sights, the sounds, the language, the history, the culture were strange to me. Though I had a Ph.D. from the University of Chicago, I was at best, as I thought of myself then--a humane, dedicated amateur.

Development assistance agencies are now almost totally unlikely to recruit "the amateur." They require a more sophisticated category of specialist. There is now a greater advance in the state-of-the-art then when I was hired as a Mass Education Advisor. At one point, our Agency recruited for 1600 different job categories. Now, for the most part, we tend to be focusing our attention on the highly trained technical generalist, on program managers, project managers, and program designers. The employee may have his roots in a functional specialty--for example, education, agriculture, health, rural development. He is unlikely to perform singularly in his separate discipline. Instead his work on specific tasks may be multidisciplinary. Increasingly, the role of the program manager, program designer, and sector strategy approaches become basic to the aid-giving process. The same is true for a more collaborative and less direct style. One can anticipate further changes in development assistance approaches within the next decade will not be merely a repeat of what has occurred in the 60's.

In contrast with the decade of the 60's, U.S. foreign assistance programs began in the 1970's with a lack of domestic support. Congressional concerns in both the House and the Senate clearly reflect very real dilemmas. On October 29, 1969, Congress, as you may recall, acted to end foreign aid. Shortly afterwards, when they realized the implications of what they had done, they subsequently arranged for continuation of the program. But, I guess Foreign Aid has since been something like Humpty Dumpty who fell off the wall. We really haven't been able, as yet, to have the program reconstituted in new ways or put back together in a less precarious state than before the period of October 29, 1969.

For this entire fiscal year, we will find ourselves having operated on "continuing resolutions." Many questions exist in the minds of members of Congress. Also various government officials, including those within A.I.D., the Department of State, and other government agencies ask very serious questions about the kind of rationale which should now apply to our foreign assistance approach. On the domestic front, many persons are less sanguine about overseas efforts to eliminate poverty. They believe that even our own domestic efforts or so-called "monolithic social programs" for doing away with poverty and other reforms have failed and that similar efforts to end poverty in the least developed countries through foreign aid programs will be likewise unsuccessful.

Whatever the form or the shape foreign assistance efforts may take in the future, renewed constituencies must be formed. Those constituencies must be satisfied about a range of questions. On the domestic scene, public concern is caught up with problems of inflation, unemployment, deteriorating inner cities, etc. Given these domestic concerns, what will be the receptivity to foreign aid programs over the next few years? These factors will certainly have an impact and will pose problems for development assistance in the future.

More positively, the tremendous breakthroughs in science over the past years may have a significant influence on changes in development approaches. Particularly, achievements in the bio-chemical and physical sciences promise, within the decades ahead, better means for meeting problems of nutrition, health, and human resource development. Developing countries, hopefully, will come to share and make more use of advanced science and technology for arriving at solutions to their problems.

Scientific and technological solutions applied to needs within our domestic economy should be challenged to meet similar problems in developing countries. Look, for example, at the concern that we and developing countries share with the fashioning of low-cost health delivery systems. Certain breakthroughs here at home may have considerable meaning for resolving the same problem in the LDC's.

Similarly, mutually beneficial results may occur when looking for solutions to the problem of mass education. To provide educational experiences for large segments of their population, LDC's cannot rely, as in the past, upon learning systems which call for major investments in classrooms and increasingly costly facilities. Invariably, such educational models tend to be at costs which most developing economies cannot afford. We face identically the same situation here at home. Our attempt to resolve some of the very urgent problems related to manpower training, education, rapid skill development for large portions of minority populations, dislocated groups, etc., remain unresolved. These are arenas of major concern to both LDC's and advanced nations. They represent clear opportunities for more innovative applications of scientific and technological ingenuity.

Also, it is not hard to imagine science and technology turned towards fashioning, for LDC's, equipment, transport, tools, training devices for use in local merchandising and production systems. I am not suggesting a further dependence of LDC's upon the application of labor-saving, capital-intensive technologies from rich industrialized countries. Rather, I suggest such possi-

bilities as fresh opportunities for application of science to problems of countries that are barely at the margins of an industrial revolution..

Development approaches relevant for LDC's in the future, however, cannot simply be the transfer of labor-saving, capital-intensive technologies of developed economies. To do so would require LDC investment of at least $3,000 or more for each new job created. Few of these countries could advance at such costs or satisfy needs to maximize employment for increased productivity. One would find such cost would result in vast unemployment. Thus, there is a requirement for technologies which poorer countries can afford and operate themselves, that maximize new job creations and employment at costs which are not burdensome to their economy.

A further influence likely to shape the character of future development assistance approaches will be the increasing dependence of advanced economies upon developing countries for basic raw materials which enter into the interdependence of trade. These changed relationships will result in greater concern about interdependence between LDC's and other world economies and about the balances or imbalances in trade relations with Africa.

Current trends show that there are some reversals in merchandising accounts which no longer favor the United States. There has been a heightened interest in increased U.S. exports, in the competitiveness of U.S. products, in efforts at cooperation with developing countries in Africa and other parts of the world. We are consciously aiming to be in a better position to adequately compete with other nations. Other nations likewise are seeking trade opportunities and find it in their interest to improve their relations with developing countries in areas of trade and technological exchanges.

It would seem likely that in the coming years a large percentage of traditional efforts in development assistance approaches will come to be shared by the major private trade entities. I anticipate that LDC requirements for transfers of technical assistance may become part of the pursuit of trade, with critically needed raw materials from LDC's an essential element in the mutuality of exchange.

Increasingly, goods and services to be transferred from the U.S. to LDC's may come from U.S. research on generic problems, e.g., research to increase protein content within basic foods. Already the Lysene content of sorghums has been increased and experiments are now underway to extract protein from seeds with a high oil content--for example, coconuts and peanuts. This process

will allow a country to provide its people some three and one-half pounds of protein from coconuts at costs comparable to one pound of other protein, such as non-fat milk. Peanuts can provide ten pounds of vegetable protein in the form of milk-soluble proteins. A country would need to sell a similar amount of peanuts to purchase one pound of milk protein. A number of developing countries have had to become major importers of dried milk and milk-soluble protein to compensate for the protein deficient diets of their population. The process just described would provide an opportunity for developing countries to do something significant to improve the nutrition of their people. The research and technology that developed this process can, in turn, also provide manufacturing opportunities to meet mounting requirements for jobs in these countries.

By 1975, other trends will also be underway which will affect future approaches to development assistance. By 1975, it appears likely that the United States will be giving a smaller proportion of its resources to official assistance than any other "development assistance" country, except Italy. This is not to suggest that there will be a general lack of humanitarian concern. One yet finds that there is a major outpouring of American concern for humanitarian problems. Where there has been need for immediate responses to crisis situations,e.g., the problems that arose in Bangladesh, the earthquake in Mexico, and other disasters, there has been an immediate outpouring and reaction on the part of the United States. The U.S. public supports responses to clear requirements for assistance in humanitarian contexts.

The numbers of direct-hire U.S. government employees will be fewer. Moreover, U.S. foreign assistance, in response to domestic attitudes and Congressional views, will focus more selectively on what is called "priority development problems" in the following sectors: food production and nutrition, population and health, education and manpower training with particular attention to problems of employment and income distribution. You might wonder how this differs from U.S. assistance activities undertaken in the past. It differs significantly by the decrease in the number of sectors which the United States will attempt to give assistance. It also represents a greater concentration of efforts. Monies available for research and development assistance abroad will be concentrated within the delimited number of sectors. This is in contrast to earlier attempts where, rather immodestly, we looked at virtually every problem the developing country faced, trying to see if there was something that the United States could do about it.

Assistance approaches within limited sectors anticipates greater participation, cooperation, and involvement of domestic institutions, private voluntary groups, businesses, and universities.

University and private voluntary agencies are already being called upon to assist in carrying out our technical assistance programs and development activities abroad. However, changes of U.S. Foreign Aid in the direction of greater concentration cannot be abrupt. A large amount of funding, of course, will be used to complete activities already in progress.

This reorientation in the operation of assistance activities can be illustrated by looking at changes in the Africa program over the past three years. Three years ago we had some 350 projects in Africa. Now as we move into FY 74 we are likely to have fewer than 105 projects. The 105 programs carry a larger level of funding than the 350 projects. This has required greater attention to program design; a different range of management requirements; and concentration around certain core development problems. A large number of these projects will be carried out jointly with other donors as a part of an overall multidisciplinary approach.

The trends in reorientation of the Agency's approaches to development assistance are fully consonant with a letter sent last year by sixteen members of the House Foreign Affairs Committee to the President. This letter indicated their views on restructuring U.S. aid to developing countries. As they saw it, bilateral foreign aid should take the following shape: (1) it should concentrate on sharing American technical expertise, services, and industrial goods rather than money transfers or capital investments; (2) it should concentrate on functional sectors, such as food production and rural development, population and health and nutrition education, or manpower and public administration; (3) it must allow planning to be the responsibility of each sovereign country--a responsibility which many less developed countries are increasingly capable of discharging themselves; (4) it should provide only for undertakings submitted by the host country and which involve masses of people trying to help themselves; (5) it should be channelled increasingly through the private sector, and finally (6) it should have a single agency of the United States responsible for coordinating all U.S. development-related interests.

The tremendous change in the capacity of the developing countries to handle their development problems is clearly observable in any of the LDC's. This fact is evident everywhere, regardless of the situation. While there has been some unevenness in the extent to which this capacity has been developed, there is not, as far as I know, any developing country situation where there has not been some appreciable progress in the capacity of the country to work out its own development problems. Also, there has been a very significant attitudinal change in the LDC's about how they manage their development problems and their relationships with other nations.

Very clear indications of the significant LDC changes in attitudes about the external world appeared in an article in the New York Times. This article called attention to a theme emphasized today in so many developing countries--the "arrogance" of developing countries and their stress on self reliance. The article referred specifically to efforts on the part of the Arab countries and other developing nations to have greater self-sufficiency in food production. It also mentioned the disillusionment and anxiety felt by many of the developing countries over the sharp slackening of foreign aid.

Concurrently, within LDC nations there is a growing sense of nationalism, i.e., a greater emphasis on nationalization and the growing force for Africanization. Everywhere there has been a concern with the problem of increasing indemnities and the desire for debt rescheduling. Quite often pressures for increasing indemnities are associated with misuses of investment or the problems of foreign aid which did not accomplish the things which they anticipated would be accomplished.

Change in relationships between donors and LDC's requires special review. When I first went overseas to work in development assistance activities in Africa, most external aid came from the former metropoles. The United States, however, did come to occupy a place as a major donor. Now the major resource flows and the number of donors has increased substantially. The World Bank has become a major influence on anticipated changes in development approaches.

The diversity of sectors in which the World Bank has chosen to become involved has grown over the years. The World Bank has, in various periods, expanded its concept of activities regarded as "bankable." Initially, the Bank almost totally and uniquely focused on capital projects. They either financed dams, power plants or built highways, bridges, etc. Now the World Bank gives increasing attention to agricultural development, rural development, tourism, problems of income distribution, education, health, family planning, employment generation, etc.

Amongst the various donors, any sense of competition which existed earlier is being increasingly replaced by patterns of joint financing of projects, consultative groups, and reviews of development strategies. Mr. Pompidou's recent visit to Africa clearly emphasized that France, in contrast to earlier situations, now wants and encourages former recipients of French assistance to seek cooperation from other donors.

France, other European donors, the World Bank, Canada, and the U.S., find it necessary to work in sundry groups and in consortium arrangements. This process is becoming more frequent. A persuasive argument for greater donor cooperation and more collaborative styles in development assistance approaches is the fact that the costs of development is now greater than any one donor can supply and the processes for obtaining assistance are much more sophisticated. There was a period when a country could say, "I need," and reasonably anticipate that something would happen. But the instances in which this can occur are becoming fewer.

Programming of assistance activities tends to be in larger units and within the focus of basic sector analyses. A single advisor on a technical assistance programming assignment is not presumed to know enough, understand enough, have enough insight, skills and knowledge to singularly advise governments of several countries on how they might reorganize their total educational system. The multidisciplinary aspect of development problems will generally involve a range of skills and knowledge which goes beyond the capacity of a single advisor. The idea of the individual specialist presumed to be an expert in the range of development problems has given way to the organization of critical masses of talent to engage in research and experimentation on basic development problems.

Finally, in the past, we attempted to have each U.S. financed activity or project bear a special A.I.D. identity. More and more we attempt to have programs implemented through host country institutions, either national or regional. For example, now we provide grant financing to the African Development Bank to undertake feasibility studies and the initial preparation of engineering drawings. The African Development Bank negotiates with its members to determine priority projects. Similarly, now most A.I.D.-financed undergraduate training of Africans is managed, with A.I.D. financing, by the Association of African Universities and draws more and more upon universities in Africa.

In conclusion, I ask each of you to anticipate development assistance approaches by stretching your imagination. For Africa, no problem has greater urgency than the finding of long-term development solutions to the ever-expanding problems of less-developed countries just on the threshhold of reaping the benefits of twentieth century technology.