

“A backward technoeconomy incapable of providing us the means to satisfy our long and short term needs is at the core of our underdevelopment. Transforming this core into a dynamic and responsive one. . . requires sweeping political, cultural, and economic changes.”

The Technoeconomic Imperative – Science and Technology in Genuine Economic Development*

by

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INTRODUCTION

This paper is an attempt to analyze and synthesize the prevailing ideas, strategies and policies regarding the directions that Philippine Science and Technology should take in the light, or more appropriately, in the darkness of our society's worsening economic and political crisis. After such synthesis, a solution is generated that shall hopefully provide the framework for *genuine, nationalist, science and technology-based, and people-oriented economic development*. This, I believe, should be one of the important, if not the most important, concerns of scientists and technologists committed to serve our people.

Given the above-mentioned nature of this paper, many of the ideas and terms used are by no means original. Many of them are from publications and papers generated by National Science and Technology Authority (NSTA) conferences of the International Development Research Center (IDRC), Science and Technology Policy Instruments (STPI) Project, and the University of the Philippines' (UP) symposia series "Nation in Crisis II", to name only a few.

I believe that the assumptions, analysis, and proposals presented in this paper must still be subjected to rigorous examination and criticism by members of the science and technology (S&T) community, in particular, and all concerned sectors of society, in general. More important, however, is the translation of whatever framework we generate into concrete plans and, ultimately, into effective action. Then and only then will this humble effort be rewarded.

DEFINITIONS AND ASSUMPTIONS

This section aims not so much to instruct the audience on what S & T is, knowledgeable as they already are on several definitions of these two words. It simply is necessary to lay down the premises on which the succeeding analysis and conclusions are based.

There shall also be more emphasis on interrelationships than on boundaries. Such emphasis, I believe, is necessary for a better understanding of the subject matter.

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S & T: Interrelationships and Dynamics

Science and technology are *dynamic processes* engaged in by man to satisfy two basic needs—the thirst for knowledge and the material requirements for human survival and prosperity. S & T was there even before the words biology, physics, chemistry, engineering, agriculture, etc. were coined. However, it did not exist in the same form that we usually perceive it today subjected as it has been to the forces of historical change.

Today, it is useful to define the purpose of *science* as the description, understanding, and prediction of physical phenomena through the use and generation of verifiable theories, laws, and principles. The main (though not the only) output of scientific activity is, therefore, *theory, knowledge, or "software"*. The usual activities associated with science as a process are *Research and Development (R & D)*.

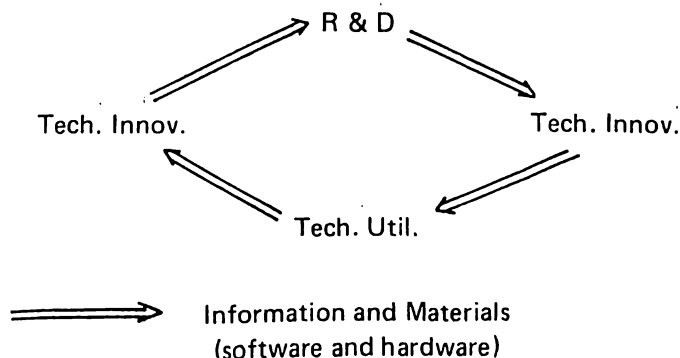
R & D involves the acquisition of new knowledge and the utilization of such knowledge to devise new or improved products and processes. Development in particular includes prototype fabrication, and other pre-investment activities needed to ascertain the technical, economic, and social feasibility of new products and processes [UNESCO 1979].

Technology on the other hand is more directly related to economic activity. It is defined as the use of *scientific knowledge and/or empirical knowhow* for the production, improvement, and distribution of goods and services as well as the satisfaction of other material needs. The outputs of technological activity are necessarily composed of both "software" (methods, techniques, organization, management) and "hardware" (tools, equipment, machines, materials). [UNESCO 1979 and POSADAS 1985] [underscoring supplied]

The core activity of technology is *technological innovation* which seeks to transform the prototype inventions of R & D into a commercial product or process [POSADAS 1985]. Another important activity, I believe, is the *utilization of technology* itself. This is because the actual use of technology in the production process reveals the potentials as well as the problems associated with a particular technology. The second activity can, therefore, provide valuable inputs to the first one and may be as important as technological innovation. [underscoring supplied]

From the above definition we can draw some crucial interrelationships between and illustrate the dynamics of S & T:

- 1) S cannot develop without the required T infrastructure necessary for R & D. Materials, equipment, information, organization, management and of course, financial resources are necessary for the conduct of productive R & D.
- 2) T cannot advance without continuing inputs from S (R & D). Historically, we all know that heat technology was used for cooking and lighting even by primitive men. However, the technological leap was achieved only after its essence was explained by the science of thermodynamics which in turn was based on physics and chemistry.
- 3) Viewed as a dynamic, continuing process, *S & T activities* can be interrelated as follows:



- 4) S is not the only source of T. Empirical knowhow, experience and practice are also valuable sources of technology. In fact, technology was practiced even before the word science was born. How else could man have survived if there existed no means by which needs could be satisfied? This is not to diminish the correctness of statement 2. What is simply being emphasized is that there are other determinants of T aside from S. These influences will be discussed in the next section.

S & T and Culture, Politics and Economics

A positive development in the S & T community is the growing realization that their fields of endeavor are strongly affected by the pervading cultural, political, and economic environment. No less than the National Science and Technology Authority (NSTA) has adopted an environmental analysis approach as a basis for its S & T plans. Foremost among their identified environmental factors are political structures and economic policies. In spite of some variations in the analysis of the present sad state of Philippine S & T, the overriding conclusion is that the status and direction of S & T is largely socially determined. Let us examine these social factors one by one.

Culture is one of the most encompassing of all social structures and mechanisms. Anthropologists and other students of the historical development of culture define it as "the sum total of man's life ways; the ways of thinking and behaving that characterize particular population groups and societies; these include language, general knowledge, laws, government, customs, beliefs, mores, taboos, food preferences, art work, habits and so forth" [Ember and Ember 1977]. Given this definition of culture and the previous definitions of S & T, the inescapable conclusion is that the *process* of thinking, researching, innovating, and producing (which generally correspond to S & T activities) cannot help but be influenced by "the ways of thinking and behaving" (culture). History, in fact, is replete with examples of how the old religious culture blocked the scientific initiatives of Galileo, Copernicus, and other medieval scientists.

Politics is a word that some S & T people will avoid at all cost. This is understandable given our experience with the pettiness, absurdity, and utter lack of scruples of present-day "electoral" or "factional" politics. However, we will not be doing justice to the word if we limit it to such types.

The dictionary definition gives it more respect by stating that politics is "the science and practice of government". Given this definition and considering that in the Philippine case, the national government "has historically accounted for 90 percent of R & D expenditures" [SORIANO 1984] S & T directions cannot help but feel "political" pressure. Explicit S & T policies are laid down by the government through the NSTA while implicit S & T policies (usually the more dangerous ones) are made by other government offices foremost of which is the "import-liberal" Ministry of Trade and Industry, the Ministry of Budget, the Ministry of Finance, etc.

Economics is defined as "the science that treats of the production and distribution of resources". We have already noted earlier that technology's ultimate value lies in its use for the production, improvement, and distribution of goods and services. This inextricably links its development to its utilization by the economic system. Unfortunately, for our case the general assessment is that very few of the outputs of local S & T are being used in economic activity. The majority simply "gather dust in the shelves." This seems to be the trend that the NSTA's "Demand-Pull Strategy", is trying vainly to correct. What is clear at this point is that S & T cannot divorce itself from economic forces.

Hilary and Steven Rose in their book *Science and Society* provide historical examples of how cultural, political, and economic factors greatly influenced the development of S & T. Before citing these, the two writers noted that S also has an "inner logic" that makes "certain types of experiments and their results lead on systematically to others by the steady and persistent application of that body of procedure . . . the scientific method". They were quick to add, however, that

“While the inner order of science is a necessary condition for an advance being made, this does not mean that this condition is sufficient. Resources must also be available. But equally the mere willing of resources will not necessarily promote scientific advance. What society can ensure is that funds, equipment, and trained manpower exist to make a particular discovery possible. At the same time society can also prevent a potential advance entirely by diverting the resources and manpower elsewhere or by establishing an intellectual climate in which particular classes of questions will not be asked. It is in this sense that even the most basic of science that we do is a product of our society.”

The book *Aborted Discovery: Science and Creativity in the Third World* by S. Goonatilake also provides valuable material on the social context of science.

Gradually, we are realizing that S & T problems cannot be solved by S & T solutions alone. There are cultural, political and economic barriers that must be hurdled if we are to see the full development of Philippine S & T.

S & T and (Under) Development

So far we have seen how external factors impinge upon the development of S & T. Let us now take a look at how S & T (or the lack of it) affects the (under) development process.

The word “development” has been one of the most abused, overused, confused, and misused terms of our time. Some of our traditional politicians and technocrats (even big landlord-turned-subdivision owners who call themselves “developers”) find it so easy to use precisely because of its vagueness and seeming unreachability. In this writer’s view, the best way to understand “development” is to confront its sinister alter ego—underdevelopment.

Francisco Sagasti, an engineer-scientist who has extensively studied the S & T situation in Third World countries states that

“Underdevelopment is a phenomenon in its own right. It cannot be studied and interpreted as a stage in a sequential development process, or as an interval in a development continuum along which all countries can be placed, and through which all must proceed in order to become developed. As Celso Furtado and Oswaldo Sunkel and Pedro Paz have shown, underdevelopment, particularly in Latin America, is a consequence of the historical process of industrialization in Europe and later in North America. Development and underdevelopment are thus two facets of the same process of expansion of Western capitalism that began in the 19th century. This process involved the creation and spread of modern technology and the establishment of an international division of labor with a few advanced countries generating modern technology and producing manufactured goods and a large number of backward countries supplying raw materials, cheap labor, and markets. Underdevelopment and development evolved simultaneously; they were and are functionally related and they also interact with and condition each other. These two phenomena must, therefore, be understood as interdependent parts of a single system. The key factor differentiating these structures is that the developed, by virtue of its endogenous capacity for growth—based on technical progress and capital accumulation—became dominant, and the underdeveloped, because of its incapacity for growth, became passive, dependent, and dominated”.

Although Sagasti cited the Latin American context in clarifying the relationship between development and underdevelopment, such explanation fits the Philippines very well, our country also being a former colony of Spain and presently, a neo-colony of the United States of America. Our history, culture, politics, and economics have so much in common with the Latin American countries that we can learn much from their efforts to extricate themselves from the shackles of underdevelopment. This does not mean, however, that we do not have to study our own situation any-

more. Furthermore, a crucial factor, political and military intervention, in the maintenance of the "dominant-dominated" relationship seems to be missing in the above discussion.

Sagasti characterizes an underdeveloped country (UDC) as "dominated, disarticulated, and incapable of providing an adequate standard of living for the majority of its population." He proceeds to define each characteristic.

"Domination implies that the UDC does not have a capacity for autonomous decision-making and that it exercises little control over its own destiny. External factors, beyond the control of the underdeveloped country are the main determinants of its economic, social and even political decisions . . . Developed countries (DCs) have been continuously shifting their modes of domination . . . From the control of raw materials extracted from the UDCs and of manufactured goods they supplied, DCs gained control of a significant share of the productive activities and later shifted to the control of financing, moving at present to control the technology required in productive and social activities. This control is acquired through *direct investment, through licensing agreements, through the provision of equipment and machinery, through the sale of patents, and through management contracts and technical assistance agreements.* The primary vehicle through which these various forms of domination are exerted is *the trans-national corporation.*

Disarticulation means that the UDC does not constitute a homogeneous unit from the cultural, social and economic points of view . . . There is in particular a *high-income social group which is more closely related to the DCs* particularly to the large cosmopolitan urban centers, than to other strata within the UDC . . . This social group exerts a strong pressure toward an imitative diversification of the consumer goods basket . . . *forcing the importation of the technologies* required to sustain a pattern of consumption induced from abroad . . .

. . . the incapacity to provide an adequate standard of living is the most striking of the three. The majority of the world population, which is concentrated in the UDCs of the Third World, has a very low and deteriorating standard of living . . . Shortages in housing, high infant mortality, low life expectancy, malnutrition, lack of educational opportunities, and marked inequalities in income distribution appear to be normal (for the UDCs)." (Underscoring Supplied)

The above characteristics fit our country to a "t". Add to them the political repression employed by ruling elite under the sponsorship of its domineering foreign master to maintain the existing unjust order, and a complete picture of the Philippines is drawn. It is noteworthy, however that the third characteristic is but the *effect* of the first two characteristics. Therefore, any effort at its long-term solution must necessarily consider the minimization if not the total eradication of the other two.

Sagasti intimately relates the three characteristics of the process of underdevelopment to the problem of surplus accumulation "which determines the capacity for endogenous growth." He qualifies this later by saying that "even if the productive system could generate a surplus . . . in order to achieve endogenous economic growth it would be necessary to count on the capacity to transform this surplus into reproducible capital goods with the appropriate technical characteristics. In turn, this capacity is determined by *the scientific and technological level of the country, by the existence of a capital goods industry, and by the effective combination (integration) of both.* Without this capacity, the accumulated surplus must be used to purchase capital goods in the industrialized countries, which would lead once again to new forms of dependency." (Underscoring Supplied)

Finally, he defines development as "a dynamic process of structural change characterized by three factors: sustained economic growth linked to a *viable (surplus) — accumulation process; scientific and technological progress* which would ensure the possibility of transforming the surplus into capital goods with the adequate technical characteristics; and *social propagation of the effects*

of economic growth and technical progress to all sectors of the population.” (Underscoring Supplied).

Thus, we see a concrete, definite, and crucial role for S & T in the development process. While Sagasti had the tendency to situate this role in a purely economic context, we know from the previous sections that there are cultural and political conditions necessary for S & T to play its economic role.

To sum up this section we state the following:

- 1) Underdevelopment is *not* a stage of development. In fact, the roots of the underdevelopment of Third World countries can be traced to the “development” of the advanced capitalist countries which was and is founded on the exploitation of the UDC’s natural and human resources.
- 2) Such exploitative relations are maintained by a system of economic, social, and political domination employed by the DCs on the UDCs. This is further compounded by the disarticulation of Third World countries into highly stratified societies wherein a privileged few reinforce the chains of their nations’ dependence on the domineering DCs.
- 3) S & T plays a crucial role in enabling UDCs to break the bonds of dependence imposed by the DCs and, thus, trek the path towards genuine economic development. Three main ingredients characterize real development:
 - a) Sustained economic growth anchored on a viable surplus-accumulation process;
 - b) S & T capability to transform the surplus into the appropriate capital goods; and
 - c) Social propagation of the fruits of economic and technical progress.
- 4) Tying this section with the previous one, for S & T to fulfill its crucial role, the following related prerequisites must be met:
 - a) A culture supportive of the nation’s S & T efforts;
 - b) The political commitment to break the chains of domination;
 - c) The allocation of the adequate resources for the development of the nation’s S & T capabilities; and
 - d) The commitment of the S & T community to propagate the effects of economic and technical progress to the majority of our people.

S & T Policy and Planning: Technoeconomics

Numerous workshops, fora, discussions, and debates have already been held by the NSTA and other concerned institutions to generate alternative S & T plans and policies. Even the National Economic Development Authority (NEDA) consistently includes elaborate S & T policies and plans in its five-year development plans. The common shortcoming of these efforts, however, is the limitation of S & T policies, strategies, and plans to the traditional scope of S & T activity, i.e., Research and Development (R & D). In spite of the growing realization that:

- a) S & T activities include technological innovation, technology utilization and even the absorption and adaptation of foreign technology (which necessitates technology inflow monitoring).
 - b) S & T development is highly dependent on cultural, political, and economic structures, policies and plans whether explicit or implicit,
- the limitation of S & T policy to R & D policy remains.

What then should S & T policy and planning contain? Sagasti lists the following activities that should *initially* be covered by S & T policies and plans:

- a) Promotion of demand for local S & T activity
- b) Absorption of (selected foreign) technology
- c) Regulation of imported technology
- d) Production of technology (innovation)

- e) Supporting services (education, information dissemination, training, etc.)
- f) Basic and curiosity-oriented research.

Noticeably, activities (b) and (c) have strong politico-economic repercussions and they are areas that S & T planners fear to tread. However, it is precisely the indiscriminate entry of foreign-owned technology that is aggravating our already subjugated (dominated is still too weak a term) position. It is the biggest stumbling block to indigenous technology promotion and technological innovation. For these reasons the control of the entry of foreign technology must be part of policy and planning if local S & T activity is to survive.

The broadened scope of S & T policy and planning that embodies cultural, political, and economic requisites is called "Technoeconomics". It views S & T as an essential component of a genuine economic development strategy. It advocates national control over the utilization and development of the means of production (technology) and the building of the scientific capability to adapt foreign technology that may be deemed necessary for the satisfaction of people's needs.

Concretely, technoeconomics requires the integration of the above directions into:

- a) Trade and Industry policy,
- b) Educational policy
- c) Finance policy,
- d) Legal structures (patents, licenses, etc.)
- e) Natural Resource policy (agriculture, mining, forestry, fisheries, and energy) and of course,
- f) R & D policy.

Such integration requires a solidly nationalist political standpoint founded on a cultural attitude of service to the people.

We are now ready to spell out the above scheme in more detail.

DRAFT TECHNOECONOMIC POLICIES AND PLANS

As was earlier stated there are already existing ideas on S & T development and its role in genuine economic development. These will be acknowledged and examined as they relate to the specific policies and plans to be proposed in this section.

Social (Political, Cultural and Economic) Requisites

Our realization that social factors greatly influence S & T directions and that S & T plays a crucial role in genuine economic development necessitate the advocacy of sweeping changes in the Philippine cultural, political and economic environment. These changes must occur along with initiatives that the S & T community itself must take. The latter will be discussed in the next subsection.

The following presentation does not intend to mechanically separate the political, cultural, and economic spheres of society. In fact, their interrelationships will be obvious. The only purpose of the seeming separation is to systematize and concretize proposals.

Political and Legal Requisites

a. Firm Opposition to All Forms of Foreign Domination

The starting point of any comprehensive effort to overcome our subjugated position is the solid commitment to combat all forms of foreign domination. Four hundred years of Spanish rule and eighty-five years of overt and covert American domination (including three years of Japanese rule) are enough. (In fact, they are too much!).

This commitment must manifest itself concretely through the political leadership's upholding of the national interest in all political, military, and economic treaties and agreements even if this means the abrogation of some.

In the present situation, the political necessity is to reject all US-IMF-WB dictations and to spell out our own terms for political and economic construction. Some Latin American countries have already taken this initiative and we cannot simply pay lip service to such efforts.

The most onerous of the IMF dictations is "import liberalization" which will reduce the remaining local industrialists into importers, traders, and probably sari-sari store operators who will have no use at all for S & T. This imposition must be opposed militantly by everyone desirous of our economic survival and sovereignty.

The above requires that *nationalism* be the cornerstone of any political movement working for genuine social change. The Filipino people must never allow the national leadership to be usurped or monopolized by individuals or groups who do not recognize this political necessity.

The nationalist stance does not necessarily mean the rejection of everything foreign. What it emphasizes is our sovereignty over our human, natural, and technological resources. Concretely, this implies that our national interest and not foreign interest must be the main criterion in the choice of trading partners, patterns of trade, technology to be absorbed and applied, etc.

b. Democratization of Government Institutions

The present "disarticulation" of our society can only find solution if truly democratic mechanisms are present. This means equal access and maximum participation in the decision-making and implementing processes for and by all Filipinos regardless of their socio-economic class. These, obviously, do not exist under the present dispensation where the lower classes are denied the right to free speech and assembly, decent income and working conditions, free education, and health services to name only a few. In fact, what seems to be the rule is the suppression by the state of any effort to win such rights. This is evidenced by the violent dispersal of otherwise peaceful assemblies, harassment and "salvaging" of persons working for people's rights and welfare, and branding genuine people's movements as "subversive".

Given this situation, the only recourse is for the masses themselves in unity with other concerned sectors of society to militantly struggle for their democratic rights. These efforts are evidently directed not towards an elusive ideal but to an urgent necessity — the necessity of survival.

Even from S & T's point of view, as Sagasti has so clearly explained, the concentration of political and economic power in a high-income elite which "through a process of alienation has become part of a global consumist elite which adopts foreign consumption habits and lifestyles . . ." and uses its power force "the importation of the technologies required to sustain a pattern of consumption induced from abroad." Such a situation effectively decreases the demand for local S & T activity, stunts its development, and condemns our nation to economic and political subjugation by the domineering countries.

Faced with the above problems, therefore, a herculean effort by the Filipino masses, joined by the S & T sector and other concerned groups, must be exerted for the political requisite of genuine democracy to be achieved.

c. Review and Revision of All Laws and Decrees Detrimental to Local Industry, Invention, and Technological Innovation

While the industrialized countries continue to protect their economies from imports through legislation, patent laws, tariff codes and other legal structures, our country not only allows the unhampered entry of foreign goods but even encourages such practice. To

reverse this disastrous trend the immediate review and revision of all legal structures pertaining to the inflow of foreign technology is imperative.

These laws do not necessarily mention foreign technology directly but they nevertheless affect it immensely. Specific examples are laws, codes, rules, regulations, procedures governing:

- i) Patents
- ii) Foreign Exchange Transactions
- iii) Tariff Duties
- iv) Licensing Agreements
- v) Foreign Investment
- vi) Imports

All of the above examples effect the inflow of foreign technology and the continuing control of foreign entities over their "transferred" technology (an obvious contradiction). They should be revised towards the direction of maximizing *our* control over the inflow, use, exploitation, and innovation of technology. If additional structures need to be created, then we must not hesitate to put them up if we are to achieve our directions.

For sure, the main objector to these efforts will be the U.S., the IMF-WB, their local technocrats, and members of the business community who amass huge profits from the present onerous legal arrangements. But the fact is other Third World countries, foremost of which are the Andean Common Market Nations (Bolivia, Colombia, Ecuador, Peru, and Venezuela), have taken initiatives towards greater local technological control as early as 1970 (SAGASTI 1979). Even in the Philippine scene, a Presidential Decree protecting the coco-chemical against the importation of competing petro-chemical products was promulgated some months ago.

Therefore, if other UDCs can do it and if our own administration can do it for a crony, why can't we do it for the benefit of local industry and technology?

Cultural Requisites

a. Provision of Quality Education for All

Building up our country's S & T capability does not only mean upgrading the knowledge and skills of the S & T community. Our people as a whole must be able to understand, innovate, and use the processes and products of S & T. This is to ensure that the fruits of our labor will benefit the greatest number of our countrymen and that they, too, can contribute to genuine economic development.

This requisite necessitates restructuring our national budget to give the largest percentage share to education. It is appalling to note that the approximately 30 percent share of education (during the early 1960s) in the national budget has gone down to less than 15 percent in the present time. This trend must be reversed immediately if we ever hope to save our most valuable resource — the Filipino people.

Much is also to be desired of the character of Philippine education. The values of nationalism and commitment to the broad masses must be inculcated if we are to overcome our subjugated state and finally chart our own destiny as a nation.

b. Propagation of a Nationalist, People-Oriented Culture

Aside from education, all other media that propagate and maintain culture must espouse nationalist and pro-people attitudes. This is not an ideal but a matter of survival. Who else will "think and behave" for our benefit but we ourselves.

c. Creation of a Cultural Atmosphere Cognizant of the Value of S & T in our National Life

We have already seen what cultural beliefs and practices can do to stifle the advance of S & T. In the same manner, an atmosphere that recognizes the value of S & T and its crucial

role in our survival and progress is necessary to propel it to the fulfillment of its utmost potential.

Economic Requisites

The scope of this portion includes trade and industry, finance, and natural resources policy for the purposes of completeness and coherence.

a. Trade and Industry

i) Regulation of Foreign Investments to Minimize the Outflow of Capital and Maximize Local Control over Technology

The biggest flaw (and this is an understatement) of Philippine economic policy is our technocrats' stubborn reliance on foreign investments as the main propeller of local industrialization. Foreign investment is equivalent to foreign control. No investor will ever put his/her money in something over which he/she has little control. Therefore, the complete reliance on foreign investment as the basis for our country's economic development essentially means leaving our economic future in the hands of aliens.

The practices of foreign investors that are most inimical to our development efforts are the "smuggling" of capital to their mother country through the repatriation of profits, transfer-pricing, remittances for license fees and royalties, etc. and their continuing control over their technology through technical contracts and patent rights. These practices must be abated through trade and industry policies favoring local surplus accumulation and technological control.

No less than an overhaul of economic thought and practice in Philippine society is necessary to translate this requisite into reality.

ii) Government Support and Protection to Enable Local Industries to Serve as a Foundation for Genuine Economic Development

This was and still is the main strategy of both the industrialized countries and the newly-industrialized countries in trekking the path towards genuine development. We must adopt an economic policy of "national industry first before foreign investments" if we ever hope to establish our own industrial base.

Support and protection must take financial, technical, and legal forms in order to be effective. Forever subsidizing distressed local companies (which is being done for crony corporations) will never work and is, in fact, wasteful if there are no S & T inputs that can improve their competitiveness and productivity.

The Board of Investments (BOI) has been very good at identifying and printing Investment Priority Areas. However, all their efforts are wasted once foreign investors monopolize these areas and their accompanying incentives leaving only the crumbs for local investors.

As usual, the IMF-WB will again be the main oppositor to this direction. They and their local representatives will mouth the overused excuse that "protectionism" breeds "inefficiency". But that is true only if there are no S & T inputs to accompany protectionist measures and if the only beneficiaries of protectionism are inherently inefficient, badly-managed, and graft-ridden crony enterprises.

Therefore, equitable and comprehensive support must be given to local industry to spur our economy's development, the objections of the IMB-WB notwithstanding.

iii) Exploring and Tapping more Favorable Forms of Trade with Countries aside from the U.S. and Japan

There are more than a hundred-fifty countries in the world and yet our non-oil related trade is concentrated with the U.S. and Japan. This situation ties us down to

often unfavorable terms of trade and limits our bargaining power in trade negotiations. We must look for trading partners with whom we can negotiate more favorable terms of trade and more liberal terms for technology utilization and innovation. The possibility of expanding barter trade which minimizes the outflow of precious foreign exchange must also be explored.

b. Finance

i) Stipulation of our own Terms for Meeting our Financial Obligation to the IMF-WB

Some Latin American countries, particularly Argentina and Peru, have taken the lead in rejecting IMF-WB terms for meeting their loan payments. This fine example must be emulated by UDCs if they are to avoid the disastrous effects of IMF-WB prescriptions. The Peruvian formula is simple, they treat the loans as "payable when able" and only with what is *locally* deemed as available for loan payments.

The greatest leverage can be achieved by the UDCs if they band together against the IMF-WB. And our country must join this united front.

ii) Judicious use of Foreign Loans and External Assistance

The "debt trap" we are presently in is further exacerbated by the wasteful and corrupt allocation of borrowed finances. Until now, the Central Bank consistently refuses to give an accounting of how our billion-dollar debts were spent, thus, giving rise to suspicions that they went to a few individuals' pockets instead of to productive projects.

Foreign loans and assistance must be used for strengthening our productive capacity not just for so-called "impact" projects that oftentimes do not even achieve real socio-economic impact. For S & T in particular, foreign assistance may be necessary for the "importation" of scientific knowledge in the form of publications and dynamic technologies that can increase our replicative and innovative capacity.

iii) Specific Allocations to Fund S & T Activity from Business and Industry Taxes and Import Taxes

Taxation has two major purposes: the generation of local financial resources and the encouragement of desirable activities (or the discouragement of undesirable activities). We must tap its two-pronged purpose to the fullest by allocating a specific portion of taxes paid by business and industry to go to S & T activity and imposing taxes on imported products and technology to control their inflow and to bolster the S & T fund. These steps need politico-legal support because, first, all taxes go to the national treasury and the President can allocate them at his own discretion, second, the IMF-WB will surely oppose additional taxes on imports.

Of course, the S & T sector must be able to deliver the S & T services required by business and industry while at the same time working for a larger allocation in the national budget.

c. Natural Resources

i) Sovereign and Judicious Use of Natural Resources

If we hope to avoid the disastrous effects of over-exploitation of natural resources typified by the situation in the famine-stricken African nations, we must put a stop to the wanton destruction of our forests, the rapid depletion of our mines, and the indiscriminate trawling of our aquatic resources.

We have historically been proud of the abundance of our natural resources. In fact, we may have been too proud that we offer them lock, stock, and barrel for foreigners and local big businessmen to exploit and deplete without any regard for the

needs of future generations. All in the name of "export-oriented industrialization". But what will be left to feed the machines of local industry if we have already exported all our raw materials?

The unhampered export of minimally processed materials denies us the opportunity to use S & T to add value to our exports and improve our financial position. This essentially maintains the colonial character of our economy wherein we serve as the DCs' source of raw materials and cheap labor.

Policy and legal structures to reverse the above situation must be implemented immediately for survival's sake.

ii) Integration of Agriculture, Forestry, Fisheries, and Mining (the Primary Sector) with the Manufacturing (Secondary) Sector

As we have already stated, the export of the minimally processed outputs of the primary sector deprives our economy of the opportunity to add value to our natural resources. This practice also hastens the depletion of our mines and forests, thus, endangering our already imbalanced ecology.

Ironically, the manufacturing sector, which is heavily dominated by foreign corporations, imports most of its raw materials. This is not surprising because this enables multinationals to "decapitalize" our economy more subtly by using transfer-pricing techniques. Two blatant cases are the import-dependent drug and detergent industries.

Government technocrats have been confusing themselves with the question of where to put "emphasis" – agriculture or industry? So the past decades have shown extreme shifts from one to the other sector. The answer to the (wrongly formulated) question is to link not only agriculture but also the whole primary sector with the secondary sector. Of course, the most important prerequisite to this is national domination (not necessarily complete ownership) of both sectors, which is the target of the earlier-mentioned political and economic requisites.

Concrete examples of this integration are the production of food-processing and preserving machinery by industry for agriculture and the industrial processing of our agricultural products (e.g., coconut, sugar, etc.) into viable inputs (e.g., coco-chemicals, alcohols, etc.) for the use of other industries (e.g., detergent, energy, etc.).

Evidently, politico-legal and economic policy changes must be made. But most especially, S & T inputs are needed in providing technically-feasible linkages between the primary and secondary sectors.

iii) Genuine Land Reform

The democratization of the ownership of one of our most valuable resources, land, is a must if we are to hurdle the disarticulation that hinders our development. The concentration of land ownership in the hands of a complacent and consumist elite deprives the direct producers, the farmers, of the incentive to use S & T inputs in order to improve agricultural productivity. Why should the latter increase productivity if the fruits of their labor will go to the former anyway? There is no greater incentive than sharing in the ownership of the means of production and the corresponding enjoyment of its fruits.

Aside from encouraging agricultural productivity another positive effect of genuine land reform will be the formation of a larger, more viable local market that national industry can tap. This is a concrete alternative to the foreign clientele of "export-oriented industrialization" which has only made us prey to the vagaries and distortions of the international market.

However, simple sharing of ownership between the elite and individual farmers will not guarantee increased agricultural productivity. After all, the means of pro-

duction is not the land alone but the whole gamut of agricultural technology. This includes finance, farm management, fertilizers and pesticides (which need not be chemical-based), cropping systems, harvest and post-harvest technology, and marketing. How can an individual farmer impoverished and, consequently, deprived as he is of adequate educational opportunities handle all of these? There is a pressing need, therefore, for education, training, financial, and marketing support if the peasants are to genuinely own the means of production. This is not to say that the peasantry is devoid of effective agricultural technologies. On the contrary, there is a wealth of indigenous farm management practices that the S & T sector must systematize, study, and apply hand-in-hand with the farmer.

The above requisites may seem overwhelming. However, no less than a comprehensive and drastic overhaul of Philippine politics, culture, and economics is necessary for the immediate survival and future development of our society.

The Tasks of the S & T Community

Although the role of S & T in the requisites presented were already mentioned in the above discussion, there is a need to highlight the general thrusts as well as the specific tasks that the S & T sector must undertake. All the previous sections have hopefully convinced us that S & T has an important social responsibility to fulfill – *to develop the means of satisfying the needs of our people*. This is by no means an easy task. Nevertheless, all our efforts must be exerted towards the performance of this responsibility.

Three overall thrusts are deemed necessary:

Inculcating a Nationalist and Pro-People Orientation in the S & T Community

- a. Inclusion of and emphasis on the social context and the accompanying social responsibility in S & T education and training.
- b. Exposure of the S & T sector to the actual conditions and the social analyses of depressed urban and rural communities.
- c. Regular interaction through fora and projects, with members of the depressed communities and the institutions that support them.
- d. Conduct of R & D and Innovation (I) projects beneficial to the suffering masses.
- e. Active involvement of the S & T sector in the pursuit of the nationalist political, cultural, and economic requisites vital to society's survival and progress.

Building up the S & T Capability of the Sector in particular, and our People, in general.

- a. Building up our capacity to select and absorb S & T knowledge and hardware. This requires an increase in the S & T and the education budgets to provide *at the very least*: well-equipped laboratories, the newest S & T journals and books and adequate salaries for S & T personnel and teachers.
- b. Working closely with foreign S & T communities especially those of the Third World Nations to obtain "Discriminatory Advice on which Technologies Should be Acquired" [SALAM, 1985] and to enrich our reservoir of S & T knowledge.
- c. Formulation of S & T educational materials that can be appreciated by the majority of our people.
- d. Vigilantly clarifying, verifying, and even disputing statements (whether explicit or implicit) of doubtful scientific integrity but which are nevertheless being peddled in the mass media.

Linking S & T to Production.

- a. Focusing Research (R), Development (D), Innovation (I), and Absorption (A) activities towards the integration of the Primary and Secondary sectors of our economy.
- b. Exposure of the S & T community to the problems of local production thru dialogues and actual projects with Filipino industrialists and agriculturists.
- c. Preferential treatment for local industries in the conduct of R, D, I, and A projects.
- d. Maximizing local benefit in the conduct of R, D and I projects for foreign or multinational entities.
- e. Total (Market, Technical, Financial, and Social) and dynamic feasibility as a framework in R, D, I, and A project development and implementation.

The above list is by no means comprehensive. The S & T sector in cooperation with the peasants and workers, other professionals, nationalist businessmen and industrialists, teachers and students must contribute their ideas to this initial effort at task definition. This can only be possible if we vigorously multiply and expand the ranks of Nationalist and People-Oriented S & T organizations like LIST (Local Initiatives in Science and Technology), FAST (Filipino Alternatives in Science and Technology), and other like-minded groups. The need to organize our sector has never been more pressing.

The call for change echoes across our archipelago. Not only must we need it, we must initiate it.

CONCLUSION

The present political and economic crisis is historically rooted in the colonial and neo-colonial maintenance of our underdeveloped status. A backward technoeconomy incapable of providing us the means to satisfy our long and short term needs is at the core of our underdevelopment. Transforming this core into a dynamic and responsive one, however, requires sweeping political, cultural, and economic changes.

The main task of the S & T community is to provide the S & T inputs that will restructure our technoeconomy into its desired form. This in turn requires building up the S & T capability of the sector and of the country, linking S & T to production, and working with the other progressive sectors towards the attainment of the political, cultural and economic requisites.

The immediate task of organized scientists and technologists is to propagate the technoeconomic analysis of our underdevelopment and draw the all-important role of S & T in any sincere effort towards social change and economic upliftment. In the light of the present proliferation of political activity, we dare say that no political candidate, party or movement is worth its salt if it does not recognize and adopt the Technoeconomic Imperative.

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