

**SCIENCE AND TECHNOLOGY POLICY IN ZAMBIA, 1964 - 1989:**

**ITS GENESIS, DEVELOPMENT AND FUTURE PROSPECTS.**

**BY:**

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**DIPLOMA ED., B.A. DEVELOPMENT STUDIES (UNZA)**

APPROVAL

This dissertation of **Weston Nephias Mkondo Mafuleka** is approved as fulfilling part of the requirements for the award of the degree of Master of Arts in Political Science by the University of Zambia.

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DECLARATION

I, Weston Nephias Mkondo Mafuleka, solemnly declare that this dissertation has been done by myself and that it has not previously been submitted for any degree at this or any other university.

Signed:.....

Date:.....

APPENDIX

MINOR CORRECTIONS REQUIRED

- On the cover and the title page, the name of the author should be spelled 'Mkondo'.
- Page 1, line 11, spelling of 'cannot'.
- Page 2, line 4, spelling of 'cannot'.
- Page 3, footnote 3, spelling of 'Praeger'.
- Page 13, footnote 18, to read: International Development Research Centre.
- Page 24, line 8 from the bottom, to read: Technology, Development and Advisory Unit (TDAU).
- Page 24, line 7 from the bottom, spelling of 'college'.
- Page 49, line 2 in second paragraph, spelling of 'explanation'.
- Page 59, line 15, to read: Swedish International Development Authority (SIDA).

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The Management of the President's Citizenship College deserve my tribute for allowing the college secretarial staff to print this dissertation.

Finally, I should pay homage to my wife, Christine who shouldered the burden of looking after the family during the two years of absence from home.

ABSTRACT

The effects of science and technology pervade all aspects of contemporary society. Economic and Political interactions among states are skewed in favour of those national societies which have made greater strides in science and technology.

This study advances a proposition that Zambia can markedly reduce its dependence on developed nations if she can pursue a vigorous explicit science and technology policy. Such a policy should aim at building a firm scientific and technological infrastructure as a take-off base for achieving local scientific and technological capability.

The study is divided into six chapters. Chapter one covers the theoretical framework which includes problem identification, rationale, objectives, literature review, hypotheses and methodology. Chapters two, three, four and five discuss collected data. Chapter six deals with conclusion and recommendations.

The major finding of the study is that Zambia's science and technology policy between 1964 and 1989 has partly been implicit and partly explicit. While the human resource scientific and technological infrastructure has been developed, its retention has not been appreciably successful. Efforts towards constructing the physical scientific and technological infrastructure have brought out significant positive results, yet economic constraints have adversely affected the whole policy.

Tentatively concluding, the study observes that central planning and co-ordination of Zambia's science and technology policy became more pronounced after the establishment of the Ministry of Higher Education, Science and Technology in 1983, as well as the birth in 1988 of the Science and Technology Sub-Committee of the Central Committee of the United National Independence Party (UNIP).

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## CHAPTER 1

### I N T R O D U C T I O N

Science and Technology policy studies are conducted in developing countries in general, and Zambia in particular, as an effort in these states to reduce dependence on developed nations, especially in the field of commerce.

During the period of economic depression, the ability of developing countries to import manufactured goods is always reduced by the fall in their exports of primary commodities, and the increased real burden of servicing their foreign debt. These experiences have always induced a strong desire for self-sufficiency and economic independence, and hence the need for industrialisation.

Industrialisation, however, cannot occur without the role of science and technology. Developing nations do acknowledge that richer nations of Europe, North America and Japan transfer technology to them. But most of that technology is either under turnkey arrangements, inappropriate or static. This makes it imperative for developing countries to acquire dynamic scientific and technological capacity to enable them not only to assimilate, adapt and diffuse foreign technology, but also to be able to develop endogenous technology, as a way of reducing dependence on the advanced countries.

The Lusaka Chamber of Commerce, writing on the mining industrial development of Zambia, agreed with the above views when it noted that among Zambia's imports in 1973 "the share of machinery and transport equipment jumped from 27 per cent to 41 per cent. Thus the trade pattern showed a shift in favour of capital goods which was necessary to build up and expand the industrial base of the economy."<sup>1</sup>

The economic performance of Zambia is indeed primarily dependent on the mining industry, especially copper. But the government has not neglected other sectors of the economy, manufacturing for instance.

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1. Lusaka Chamber of Commerce, *Industrial Zambia*, Vol.2

But even in this sector Zambia's economic capability is dependent on foreign technology, and until Zambia can press for real transfer of technology from developed nations our reliance on foreign advanced nations cannot be reduced. This observation was made by Jonathan Chileshe after studying the operations of the Livingstone Fiat Motor Assembly Plant where he doubted that "the extent to which Zambia benefited from the large size of the project is debatable. Fiat deliberately avoided manufacturing spare parts in Zambia as that would endanger the jobs of Italians in Milan. Fiat's behaviour in Zambia differed considerably from that in similar operations in the more industrially developing countries of Latin America or in Yugoslavia, where definite transfers of technology were insisted upon and received"<sup>2</sup>

The problem of import substitution strategy exemplified by the Fiat Livingstone Motor Assembly Plant typifies the nature of static technology transferred to developing countries by advanced nations. Recipients of such technology are taught routine skills of assembling components which are already made elsewhere and are made available only for assembly in the forward linkage sector. Backward linkage sectors - the crucial sectors that deal with designing and development of the car's components-are left in the mother country of the Fiat Company. Zambia cannot reduce her technological dependence on richer nations with such type of industrialisation strategy in place.

Modern technology has been found to be more viable an answer for relative autonomy in economic industrial development in developing countries. Valentine Musakanya, then Zambia's Minister of State for Technical Education in 1970, preferred modern sophisticated technology to backward intermediate technology as he wrote: "I would say that the (Schumacher) school has been moved by sentiments not far from paternalism and a feeling that the best is not too much for the developing countries. Their people are not yet capable of either understanding or employing modern technology and, there-

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2. Jonathan Chileshe, Third World Countries and Development Options: Zambia, (1988), Vikas Publishing House PVT Ltd. India P. 172

fore, must be taught methods a few centuries old. Otherwise it would appear that intermediate technology is a prescription for a backward child. If modern technology has proved to be an imposition, many parts of Zambia the so called intermediate technology will be equally an imposition ... technical education and skills provide the wherewithal for meaningful existence, self-realization, survival and creativity ... the most modern technology must constantly be taught"<sup>3</sup>

Musakanya was making the preceding reaction to the views of Schumacher an expert on development from Europe who had been invited by the Zambian Government to offer advice on developmental issues. Schumacher advocated intermediate rather than modern sophisticated technology to raise incomes for the people of the Third World, and for those of Zambia in particular. The insistence by Musakanya that the most up to date technology must be taught in Zambia was an admission that Zambia was still a very long way to go to achieve endogenous technological capacity.

The lack of Zambian endogenous capability in Science and Technology was also highlighted by the International Labour Organization (ILO) which conducted a survey to identify causes of Zambia's economy being under pressure. The ILO noted, among other reasons, that "the shortage of spare parts and supervisory personnel has affected levels of production and productivity both directly and also through impairing maintenance work. A vicious circle is thus set up whereby low profit levels lead to reduced availability of spares and inputs, which increase unit costs and further reduces profits. Insufficient maintenance is a particularly serious problem as it might result in a rundown of productive capacity with long-term negative repercussions"<sup>4</sup>.

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3. Valentine Musakanya, in Alistair Young, Industrial Diversification in Zambia, (1973), Praeger Publishers, Inc. P. 286.
  4. International Labour Organisation, Basic Needs in an Economy Under Pressure, (1981), United Printers, (Addis Ababa, p.195

As a result of the realization of the crucial role that science and technology play in various dimensions of national development, scientific and technological concerns have become political issues "to which all nations pay the greatest attention precisely because the ability to use the resources of science is now an essential component of a country's economic and political strength"<sup>5</sup>.

The development of an endogenous science and technology capacity cannot, however, be achieved "unless the political system is willing to support technological activities, way beyond the mere lip-service which most governments pay"<sup>6</sup>.

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5. Jean Ladiere, "The Challenge Presented to Cultures by Science and Technology", UNESCO, (1977), p. 19.
  6. Isaias Flit, "Struggling for Self Reliance in Science and Technology - the Peruvian Case", Development Dialogue, No.1 (1979), p. 39.

The seriousness of a nation's commitment to the development of science and technology can be indicated by its science and technology policy. In general terms, a science and technology policy can be defined as "the deliberate effort to influence the direction and rate of development of scientific knowledge, the application of financial resources, administrative devices and education and training in so far as these are affected by political authority".<sup>7</sup> This study examines two types of policy:

- (a) Implicit policy and
- (b) Explicit policy.

An implicit science and technology policy is here regarded as one where it is implied, assumed or believed that the nation can make scientific and technological advances under conditions where science and technology objectives, decisions relating to funding, training, employment and retention of the scientific community are made by individual scientific and technological institutions. These institutions are without a central political policy co-ordinating body. As such the plans of separate institutions have no recourse to felt national science and technology needs. Since central backing is implied rather than expressly initiated, individual institutions pursuing such science and technology policies, according to UNESCO, "lack any direct budgetary powers to effect positive control in the implementation process"<sup>8</sup>.

Maurice Lamontagne uses the terminology 'pluralist model' to refer to what UNESCO calls implicit policy. He notes that in such a model "government agencies with important policy and regulatory missions generally tend to over emphasize their own research functions. Research organisations, like others, seek to accomplish their missions completely by themselves; striving for self perpetuation leads to growth and autonomy not a move toward co-operation and co-ordination. Like all organisations, government research agencies tend to be defensive rather than self-critical".<sup>9</sup>

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7 Edward Shils, Criteria for Scientific Development: Public and National Goals, (1968), The MIT Press, London, P. (vi).

8 UNESCO, "Trends of Science and Technology Policies in the Countries of Africa", Science Policy Studies Document, (1974), UNESCO, P. 17.

9. Maurice Lamontagne, A Science Policy for Canada, (1973), Vol. III Information Canada, Ottawa, P. 618.

On the other hand, an explicit science and technology policy is here referred to as one with a central, political policy co-ordinating body which deliberately takes and monitors the implementation of decisions as regards the following parameters:

- (a) Specific and flexible science and technology national objectives which are centrally formulated.
- (b) Funding of scientific and technological activities based not on patronage but on national, determined political commitment.
- (c) Conducive tax decisions relating to the export and import of technology, e.g. equipment, machinery and technical information.
- (d) A legal device backing the policy.
- (e) Training, employment and retention of the scientific community.

Guided by the preceding distinction between an implicit and explicit policy, the study investigates the following problem.

#### STATEMENT OF THE PROBLEM

Has the Zambian Government, between 1964 and 1989, formulated and implemented a significantly explicit science and technology policy regarding the development of Zambia's scientific and technological infrastructure?

#### THE RATIONALE OF THE STUDY

The significance of the study arises from the premise that it will serve as a vital source of information, suggestions or advice to be considered by the policy makers in the political leadership, for instance those in the Ministry of Higher Education, Science and Technology and in the Central Committee of the United National Independence Party (UNIP) where a science and technology sub-committee has been formed.

Further, it is hoped that the findings and recommendations herein contained will prove useful to managers of government industry and private entrepreneurs who are ardently interested in enhancing their knowledge and practice of various facets of science and technology policy. Scholars, particularly in development studies, are likely to find the results of this study intellectually stimulating.

#### OBJECTIVES OF THE STUDY

- (a) In reference to the preceding parameters on explicit science and technology policy, the study investigates whether or not such a policy has existed and to what extent it has been implemented to develop Zambia's scientific and technology infrastructure.
- (b) The study further investigates new policy measures which have been adopted by the Zambian government to develop endogenous scientific and technological capacity in the context of Zambia's economic crisis.
- (c) On the basis of the research findings, recommendations will be made.

#### LITERATURE REVIEW

The development of scientific and technological infrastructure has lately been recognised by many developing countries as the necessary foundation upon which to build a nation's endogenous scientific and technological capacity. Gilbert Mudenda and Raj Bardouille define the concept of scientific and technological infrastructure as that which "comprises a community of local scientists and engineers, a national capacity for carrying out engineering consultancy, and a national information system and mechanism"<sup>10</sup>.

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10. Gilbert Mudenda and Raj Bardouille, Technological Development and Educational Policy: The Case of the Mining Industry in Zambia, (1978), International Institute for Educational Planning, Paris p. 213.

Mudenda and Bardouille's work looks at technological development and educational policy with focus on the mining industry in Zambia. While their work is highly informative, it does not deal with the adopted national policy on science and technology such as that pursued by the Science and Technology Sub-committee of the Central Committee of the United National Independence Party.

The Zambian Government's efforts to make a prelude towards the formulation of a Science and Technology Policy were demonstrated in 1967. In that year, a working party to advise the government on the establishment of the National Council for Scientific Research was set up. Its objective was to collate information about organizations in both public and private sectors which were already carrying out scientific research in Zambia. The working party made an inventory of the scientific centres existing in Zambia at that time, but no reference to specific science and technology policy was made.

Another attempt to study issues of science and technology in Zambia was made after the formation of the National Council for Scientific Research. The Council, between 23rd and 24th February, 1978, conducted a national symposium in Lusaka. Several people contributed papers to the symposium. In some of those papers mention was made of important policy issues such as the training of scientific and technical personnel, equipping scientific and technological centres and workshops, as well as local capacity to absorb foreign technology. Particularly more close to policy issues was the contribution by Silangwa who feared that though acceleration of training high quality indigenous research staff could be promoted in Zambia, braindrain made retention of the community of Zambian scientists difficult to achieve. Silangwa's work could not be substantiated by figures to show how serious the phenomenon of braindrain was to Zambia at that time. That aspect of his work fell short of empirical evidence. This study seeks to collect some of the most up-date quantifiable data to prove the seriousness of the reverse transfer of technology (also known as braindrain).

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In 1979, in the 'National Paper for the United Nations Conference on Science and Technology for Development', The National Council for Scientific Research repeated the call for the need to develop a viable scientific and technological base in Zambia. The Council pointed out that the dearth of well trained science and technology teachers in secondary schools and technical colleges created a situation where the physical infrastructure there can not be utilised to the full. The N C S R itself aptly put it as follows: "At times the adequately equipped laboratories and workshops of some secondary schools and technical colleges become inadequately used because of lack of appropriately qualified teachers".<sup>11</sup> By 1979, Zambia had been independent for 15 years. If by then the country had not yet trained enough teachers, something must have gone wrong with those who plan enrolments for students in scientific and technological fields. If the shortfall was the result of the reverse transfer of technology, it is the issue which was not addressed by the United Nations Conference on Science and Technology for Development. In this study that problem is adequately addressed.

One of the journals concerned with Zambia's Science and Technology issues is the 'Zambia Journal of Science and Technology'. It is the brainchild of the National Council for Scientific Research. Published quarterly, it deals in feature topics and research results. "It is devoted to the publication of research articles, bulletins and notes in all fields of science and technology".<sup>12</sup> The fields referred to are, of course, those that are of immediate curiosity to the scientists and technologists, as they pertain to the theory and practice in the laboratories and workshops. The Journal has no views directly relevant to policy making in line with the outlined parameters on page 6.

The Zambia Association for Science Education (ZASE) also publishes literature about Zambia's science and technology affairs. The Association's bulletin contains many scholarly articles which have bias towards the school science and technology curriculum, rather than a tilt towards overall national science and technology policy concerns. A careful study of .../

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11. NCSR. NATIONAL PAPER for the U.N. Conference on Science and Technology for Development, (1979), NCSR, Lusaka. P. 26.

12. NCSR, Zambia Journal of Science and Technology, Vol.2 No.1

several copies of the bulletin reveals one general aim running through: "the Bulletin will be the news organ of the Association. It will carry news items of interest to members and, we hope potential members. While long articles of a scientific and, or educational value will not be excluded, the emphasis will be on short items of news value to science teachers in Zambia".<sup>13</sup> Thus teaching methodology and explanation of certain topical concepts in science constitute the major elements of the literature.

In 1985, Virginia Pumulo Muyatwa wrote a thesis on 'Appropriate Technology in Agriculture: The Case of Zambia'. Muyatwa provided very illuminating information regarding the meaning of the concept of appropriate technology. She looked at four factors which she termed criteria for appropriate technology. These are: the foreign exchange content aspect, the environmental pollution element, the employment factor and the climatical environmental factor. It is not the goal of this study to explain in detail what each of these criteria means, but it is important to mention that each of these criteria has a tangential reference to 'tax decisions for exporting and importing technology'. This parameter, found on page six of this study, is one of the most important factors upon which science and technology policies are made. For example, to discourage those types of technology which pollute the environment or require the use of foreign-based raw materials, high tariff duties may be imposed if such technology is imported. Pumulo, however, makes the objective of her study very clear as she writes: "the aim of the study is to examine the notion of appropriate agricultural technology as it relates to the Zambian case".<sup>14</sup> Pumulo's work therefore does not deal with issues of Zambia's national science and technology policy similar to those set out in this study at page 6.

Samuel Chipungu has also written a book about the state and how technology has affected segmentation of the Zambian society in rural areas. Chipungu asserts that the economic and political policy decisions of the state to provide hardware and software technology to various groups of people in rural areas gave rise to the process of .../

13. ZASE, Zambia Association for Science Education Bulletin, Vol. 1 No. 7 Feb, 1970, P.3.

14. Virginia Pumulo Muyatwa, Appropriate Technology in Agriculture: The Case of Zambia, (1985), (M. Phil. Thesis), P. 11.

peasantisation. Out of that development were born several social strata, for instance the rich, middle and poor peasants. The technology provided varied according to historical periods. For instance in 1930 some groups of the peasantry were provided with ox-drawn ploughs, of course through loan schemes. This went on until 1963. After independence in 1964, richer peasants were provided with tractors and technical information on how to apply fertilizer or use certain chemicals to kill crop pests. Thus Chipungu's literature "focuses specifically on the impact of technology and the role of the state on the process of peasant differentiation. Here, it is hypothesized that the formation and reproduction of the different strata of the peasants (rich, middle and poor) was largely determined by the economic and political interests of the state vis-a-vis the peasantry and the ability of the peasants to adopt new productive techniques during the specific historical periods"<sup>15</sup> Chipungu does not deal with Zambia's policy concerning the development of infrastructural services such as the community of scientists, engineers and technologists and the development of physical infrastructure in which the scientists, engineers and technologists work, for instance research centres, technical workshops, laboratories etc. The parameters set out to achieve the development of the preceding human and physical infrastructure for Zambia's science and technology are outside the coverage of Chipungu's literature. Further, his study-time span goes back to 1930 and ranges up to 1986. This study, while concentrating on the guide set out by parameters on page 6, has a time span ranging between 1964 and 1989.

The significance of laying down a firm scientific and technological foundation for a country to achieve relative autonomy in various developmental fields was also observed by Norman Vig. He studied science and technology policies in British Politics. Norman enlightens us that science and technology policy issues, as regards the development of scientific and technical infrastructure in Western Countries, were initially the domain of individual capitalist institutions. But the victory or loss of a war elevated or relegated national status. Resulting from that national, emotional feeling,

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15. Samuel Chipungu, The State, Technology and Peasant Differentiation in Zambia: A case of the Southern Province 1930 - 1986, (1988), Historical Association of Zambia, Lusaka, PP. 5 - 6.

governments later took up as a principal concern the issue of science and technology policy being co-ordinated from the centre. Thus Norman continues to note that as a result of deliberate central government effort to develop the country's scientific and technological infrastructure, Britain was, on the eve of the Second World War, able to train 5000, qualified scientists per year. These, according to Norman, "included an estimated 2500 scientists, mostly with first university degrees, and perhaps with an equal number of technologists".<sup>16</sup> What Norman does not tell us about are parameters relating to retention or incentives which were created to retain the growing number of the British community of scientists, engineers and technologists.

Another scholar of science and technology policy whose views are in general agreement with those of writers from developing countries is Oldham. He stresses self-reliance in a nation's science and technology fields as one of the most paramount issues to be vigorously addressed. He looks at local capacity in science and technology as "the determination to achieve the ability to make one's own decisions about all aspects of how science and technology are going to contribute to development".<sup>17</sup> Science and technology local capacity, he further contends, should mean not only to make one's own policies, but having the ability to implement them.

The ability to implement science and technology policies can partly be demonstrated through production of goods as planned and executed by the citizens of a particular nation. Production does not depend only on human technical know-how, skills and production techniques possessed by the scientific and technological community of a particular nation. It also depends on the physical facilities (research laboratories, technical workshops, factories etc) where scientists, engineers and technicians work. This is the reason why Dean Genevieve observes that in China, "the First Five-Year Plan fostered technical changes that would produce plants and equipment equivalent to those.../

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16. Norman Vig, Science and Technology in British Politics, (1968), Pergamon Press Limited, London, P.9.

17. C.H.G. Oldham, "Science and Technology Policy in Developed and Developing Countries" in King Gordon, Canada's Role in Science and Technology for Development, (1977), International Development Research Centre, Ottawa, P. 39.

being manufactured in industrially advanced countries. The ultimate goal was the supply of modern machines, equipment, intermediate goods and raw materials."<sup>18</sup>

Thus the Chinese science and technology policy for the years (1955 - 1960) aimed at developing a local capacity in the technical field through the building of the necessary physical infrastructure. This parameter is one of the major areas of particular concern in this study.

Another developing country where science and technology policy studies are gaining currency is Argentina. Reduction of dependence by developing nations on developed states has been underlined by many development scholars in Latin American countries. One such writer is Cardon who studied science and technology policy making in Latin America, but with special focus on Argentina. He argues that a viable national science and technology policy "attempts to create or improve an operational network of infrastructure for scientific and technological work".<sup>19</sup> For any developing country to do the reverse, he notes, would mean to operate in a vacuum.

Cardon's advice about the need for developing countries to put up a national scientific and technological infrastructure is not restricted only to Latin American countries. Zambia, as one of the developing countries in Africa can probably also benefit from that advice. Cardon's views are relatively similar to those of Frances Steward, another advocate of the achievement of scientific and technological parity between the rich Northern and poor Southern hemisphere states. Where such parity is not achieved, results which are inimical to international relations occur. Steward writes thus:- "a capital goods sector is an essential condition for local technological development and that without such development LDCs are forced to accept the technical change of the advanced countries with deleterious consequences for the rate and pattern of development".<sup>20</sup>

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18. Genevieve Dean, Technology Policy and Industrialization in the People's Republic of China, (1979), International Development Research Centre Ottawa, P. 10.
  19. R.L. Cardon, "Science Policy Making in Latin America, with Special Reference to Argentina", Decision Making in National Science Policy, (1969), J & A Churchill Limited, London, P. 223.
  20. Frances Steward, Technology and Development, (1978), MacMillan Press Ltd., London, P. 154.

Building an infrastructure for the generation of local technology is especially important during the formative stage of science and technology capabilities. As observed by several other writers, this involves the building of institutions for science and technology. Alexander King, like other scholars already referred to, holds the notion that a science and technology policy for infrastructure building should be based on the centralised model. This model, King says, has been adopted by many European countries - Belgium and France being among them. The adoption of such a model is not only with regard to budget practice but also relates to planning or organisation of research and development. In this system "all the resources of the government research are provided through a central authority, often a ministerial committee presided over by the Prime Minister".<sup>21</sup> King, writing in his book 'Science and Policy' (1974), cautions us however that the preceding model can have a disadvantage if not planned carefully. This occurs when a large number of science and technology institutional **infrastructure** expands without a corresponding increase in the demand for its .../

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21. Alexander King, Science and Policy, (1974), Oxford University Press Ltd., Oxford, P. 48.

service. At that point, institutions become self-centred, paying little or no attention to the requirements of industrialisation. Ultimately institutions begin to isolate themselves. This warning is, in some respects, similar to the observation made in the previous paragraphs by Lamontagne who asserts that a pluralist science and technology policy makes agencies egocentric.

On the other hand the model's merits appear to outweigh the disadvantages. The approach attempts to centralize not only resource allocation but also decision-making in a broad sense, while leaving the detailed planning and conduct of research decentralized. Science and technology policy based on this approach sets out for all agencies national objectives, desired outcomes, and even establishes specific targets and further provides criteria for generating and choosing among alternatives in the performance of functions and activities. These criteria, once made specific to affect directly the decisions having to do with the growth of local scientific and technological capability, make explicit a country's science and technology policy.

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The reviewed literature so far shows how important it is for developing states, and Zambia in particular, to develop a strong scientific and technological base through pursuance of an explicit science and technology policy. It is argued that the financial, legal and other aspects of material backing for such a policy is outside the scope of individual private or separate agencies in Developing Countries. Only the state in these countries has substantial resources to back up such a policy. The local private sector is said to be still weak. Even in advanced countries, as we have seen in the previous pages, the significance of a centrally co-ordinated science and technology policy was stressed, though the private sector there is adequately strong.

#### HYPOTHESES

In view of the afore reviewed literature, it is hypothesised that:

- (i) The Zambian Government, in reference to the listed parameters on page 6 has not for the past 25 years formulated and implemented a significantly explicit science and technology policy to develop Zambia's scientific and technological infrastructure.
- (ii) The measures adopted by the government for the development of scientific and technological infrastructure tend to have less significant impact in the context of Zambia's economic crisis.

#### METHODOLOGY

In order to test the hypotheses, data were collected from a sample of 50 respondents. Oral interviews, as a primary source, were used for this purpose (see oral questions at appendix VIII). Most of the recorded questions were used as leading or main questions. Additional or subsidiary questions which were not recorded in the report were also asked orally in order to clarify responses to the main questions.

Hypothesis (i) was tested on the basis of subjects' responses to the questions for each of the listed parameters on an explicit science and technology policy (see page 6). For purposes of systematising the sequence of reporting, **parameters** were dealt with one after another in the order in which they come at page 6. Hypothesis (ii) was not treated with a chronology similar to that of hypothesis (i). This is because hypothesis (ii) was not assigned specific parameters.

To test both hypotheses (i) and (ii) more information was further collected from secondary sources such as annual reports, magazines, journals, pamphlets and books relevant to the topic under investigation.

The sample subjects for this study were drawn from two categories of institutions - the political and technical institutions. Subjects from the political institutions are considered to be policy makers since they are the ones who make policy-decisions on funding scientific activities. Through parliament they are responsible for enacting legislation which can either facilitate or slow down the process towards achieving national endogenous capability in science and technology. International technical agreements are negotiated and signed by political actors. This category of subjects was hence necessary to be included in the sample to provide data to **test** the formulated hypotheses.

**Respondents** from technical institutions are looked at as implementers of the policy. Scientists and technologists in scientific centres know the equipment, machinery and other facilities which are already in the centres and are in a better position to know what else is needed to make further **improvements**. It is additionally assumed that the scientific community are familiar with some reasons that have prompted the exodus of some of their colleagues to other countries or to join multinationals within the country. In other words, to know what should be done to develop or improve the physical scientific and technological infrastructure, useful ideas can be obtained from those who work in those infrastructures - the scientists, technologists, technicians and artisans. On the basis of this rationale it was justifiable to include the scientific community in the sample.

On choosing the above two categories of subjects judgemental sampling procedure was therefore applied.

In order to ascertain the validity of responses from the subjects in one institution, the other subjects' responses in the second institution served as a counter-check. The two are therefore treated separately in the report.

The sample of 50 respondents was drawn from the research universe covering Freedom House (Sub-Committee on Science and Technology) and the Ministry of Higher Education, Science and Technology policy makers). The others were the National Council for Scientific Research, Department of Technology (UNZA) and Northern Technical College (NORTEC), Ndola) - policy implementers. In the process of systematic random selection, the following were eliminated: Mount Makulu Research Centre (Lusaka), Zambia Railways Technical Workshop (Kabwe), ZCCM Technical Data Bank (Kalulushi, Kitwe) and Zambia Institute of Technology, now Copperbelt University (Kitwe).

Since the study was more of a survey rather than an experimental one, data collected were organised, summarised, described, analysed and interpreted by using simple statistical techniques, for instance percentages and averages. In some cases where data could not be quantified, intuition as a qualitative approach was used for analysis.

Tentative recommendations are provided as part of the chapter on conclusion. These recommendations are made on the basis of information collected.

#### LIMITATIONS

Inadequate financing of research undertakings is often experienced as a major limitation and in this study that problem was no exception. Affected therefore was the size of the sample of subjects from whom data were collected. Future researchers interested to have more views on Zambia's science and technology policy should, given more funds, enlarge the spectrum of the sample and include more respondents from both political and scientific institutions.

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CHAPTER II

THE TYPE OF ZAMBIA'S SCIENCE AND TECHNOLOGY POLICY:

POLITICAL INSTITUTIONS  
DATA ANALYSIS AND DISCUSSION

The first hypothesis of this study states that the Zambian Government, in reference to the parameters listed on page 6 has not for the past 25 years formulated and implemented a significantly explicit science and technology policy to develop Zambia's scientific and technological infrastructure. To test this hypothesis a question was posed on the basis of the first parameter which requires that for the science and technology policy to be explicit, there should be:-

A CENTRAL, POLITICAL CO-ORDINATING BODY TO TAKE DELIBERATE DECISIONS AS REGARDS SPECIFIC AND FLEXIBLE NATIONAL SCIENCE AND TECHNOLOGY POLICY OBJECTIVES.

From the political institutions - the Sub-Committee of the Central Committee and the Ministry of Higher Education, Science and Technology - fifteen (15) subjects were asked which agencies formulated Zambia's science and technology policy objectives after the advent of our political independence in 1964. They responded as follows:-

<u>Response</u>	<u>Number of Subjects</u>
(i) Policy objectives were formulated - by the government	3
(ii) Policy objectives were formulated by separate departments, Ministries, research centres, technological institutions etc.	9
(iii) Policy existed but was enshrined - within the school curriculum.	1
iv) Policy objectives were jointly made - between the government and individual scientific and technological institutions.	2
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N= 15	
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From the above figures it shows that 9 subjects (60% of the total of 15 subjects) held the view that Zambia's science and technology policy objectives were formulated by individual agencies. By individual agencies they referred to government established departments, ministries and to scientific and technological institutions. 3 subjects (20% felt that science and technology policy objectives were made by the government. Reference was made to the cabinet to denote the government to distinguish it from separate departments, ministries and research centres having many top bureaucrats who are not members of the cabinet and hence cannot attend cabinet meetings to influence decision making. 2 subjects (13% said policy objectives for Zambia's science and technology were jointly formulated by the government and individual scientific and technological institutions. The assumption here is that since the National Council for Scientific Research was given the assignment of advising the government on Zambia's science and technology issues, ultimately the government views and those of the National Scientific Research Centre were congruent and therefore policy objectives were formulated jointly. Finally, 1 subject (7%) looked at the school curriculum as the bearer of Zambia's science and technology policy objectives. This last response assumes that the Ministry of Education, through its curriculum development centre made Zambia's science and technology policy objectives.

Documented literature on this issue appears to support the subjects who felt that Zambia's science and technology policy objectives were formulated by separate or individual government ministries, departments, research centres etc. Lameck Goma, attending a science and technology symposium in Yaonde, Cameroun, in 1967 said that in Zambia "there is no single body responsible for the science policy for the country as a whole".<sup>22</sup>

In the same paper which he presented, Lameck Goma noted that a "surprisingly large amount of scientific research has been and is being done in Zambia, but much of this is unco-ordinated. Currently, scientific work is mainly carried out by:-

1. Government departments controlled by Ministries; namely, the Department of Agriculture, Forestry, Game and Fisheries, Health, Water Affairs, Geological Survey and Meteorology;

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22. Lameck Goma, "Structure and Organisation of Science Policy", The Promotion of Science Activity in Africa, No. 11 July, 1967, P. 103.

2. International Organisation, e.g. the Agricultural Research Council of Central Africa, the International Red Locust Control, and Special teams and Consultants from the Food and Agricultural Organisation, Co-operation with the Department of Agriculture, Game and Fisheries and Water Affairs;
3. The Private Sector, e.g. the Anglo-American Corporation and the RST Group of Mining Companies, and;
4. The University of Zambia".<sup>23</sup>

As Goma hinted, scientific and technological activities occurring and based on objectives conceived by individual scientific and technological agencies were disjointed. In such a case, co-ordination, meaning "harmonious combination of agents or functions towards the production of a result", <sup>24</sup> or the process of integrating the scientific research and technological efforts of all scientific and technological institutions in the country in order to achieve national science and technology objectives could not be achieved.

During the years 1974 - 1984, the United National Independence Party (UNIP) wrote that it had assigned the co-ordination of scientific activities to the National Council for Scientific Research. In part the envisaged science and technology policy options ran as follows: "The Party will therefore:-

1. Strengthen and expand the scope of the National Council for Scientific Research.
2. Actively support the research departments at the University of Zambia.
3. Co-ordinate and rationalise all the activities of research institutions through the National Council for Scientific Research to avoid unnecessary duplication of efforts and ensure full utilization of results".<sup>25</sup>

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23. Ibid Lameck Goma, P. 103.

24. C.T. Onions, Shorter Oxford English Dictionary 3rd Edition, (1944), Clarendon Press, London P. 390.

25. UNIP, National Policies for the Decade 1974 - 1994, Freedom House, Lusaka, P. 60.

Although on paper UNIP assigned the co-ordination of scientific activities to the National Council for Scientific Research, in practice there was little or no co-ordination at all in a number of major areas. For instance the NCSR never co-ordinated or harmonised the movement of the scientific and technological community from one scientific institution to another. The Council never came up with a common policy to transfer, for example scientists, engineers or technologists from one government owned scientific institution to another without resigning first.

The NCSR has its own Parliamentary Act under which it was established. The institution has its own administrative hierarchy and conditions of service for its scientists, engineers and technologists - indeed for the rest of its workers - quite different from those conditions of service obtaining at the University of Zambia, Lusaka Campus or Copperbelt University, Ndola Campus. An engineer from the NCSR skilled in a particular field of learning cannot transfer to the University of Zambia to join the relevant school and department until he first resigns his post. This often causes frustration due to loss of service benefits as one starts almost afresh where he goes. Frustration can have adverse effects to the actual scientific performance of the officer.

Empirical data collected during visits at the NCSR revealed that the Council has its own separate personnel recruitment criteria and procedures.

.../

It has also independent staff development programmes unrelated to what is happening at other scientific and technological institutions in the country. In fact, the NCSR does not know how many scientists engineers, technologists etc are being trained at scientific and technological institutions both at home and abroad in order to plan properly the co-ordination of current and future scientific activities on the basis of the available or envisaged manpower. Neither does the NCSR make an inventory of the qualified scientific community already working in various scientific institutions in the country.

Co-ordination of national scientific activities would also entail the NCSR authorities to go round the scientific and technological institutions to assess the adequacy and viability of the scientific facilities and equipment in the scientific and technical workshops, technical data banks and laboratories in order to verify the needs of the nation in the area of scientific and technical infrastructure. But the NCSR does not carry out this co-ordinating function and so can not know clearly what research problems for example are being faced by scientists at other scientific institutions.

Duplication of efforts and under utilization of the scientific personnel or the results of their scientific discoveries can not be avoided where the NCSR does not conduct the actual co-ordination. Various scientific institutions in the country plan and embark upon their own research projects, without knowing whether or not a **similar** identified problem is being **probed** at another scientific centre.

.../

Documentation of research results is not co-ordinated either. The NCSR has its own journal of science publication known as the "Zambia Journal of Science and Technology". School teachers of science subjects established their own bulletin referred to as the 'Zambia Association for Science Education Bulletin'. When one reads through those publications, one sees no co-ordinated documentation of scientific and technological activities taking place at various scientific centres in the country.

Thus by pronouncement the UNIP Government delegated co-ordination of scientific and technological activities in Zambia to the NCSR. But in practice the NCSR never conducted that co-ordination and the government set up no machinery to monitor or check that the NCSR was carrying out the functions of co-ordination. Instead, the NCSR concentrated on its own activities, just as did the rest of the other scientific and technological institutions in the country. Under literature review, Maurice Lamontagne warned us that individual research centres just like the NCSR, the Northern Technical College (NORTEC), the Technology Development and Advisory Unit (TDAU) at the University of Zambia and other scientific institutions tend to move towards autonomy and seek to accomplish their own individual goals and self preservation rather than a movement towards co-operation and co-ordination. This observation is testified by studies conducted by Goma (pages 16 and 17) where it is noted that a greater part of scientific research in Zambia has been and is still being done in unco-ordinated fashion.

The preceding discussion sums up to the following:

that the UNIP delegation of the scientific co-ordination function to the NCSR was implicit to the extent that the government did not spell out exactly in which specific areas the Council would carry out its function of co-ordination; government political functionaries conversant with the rules, regulations and administration of scientific and technological co-ordination were not identified to check whether or not the NCSR was conducting its delegated function; areas of common cause between and among scientific institutions such as free horizontal and vertical mobility of labour among scientists as regards transfers with carry-over service benefits were not cited as guidelines for co-ordination. The final outcome of the government policy was an implicit lipservice commitment already referred to by Isaias Flit in the preceding citations.

#### FUNDING OF SCIENTIFIC AND TECHNOLOGICAL INSTITUTIONS

Another parameter which forms part of an explicit science and technology policy is non patronage funding. This type of funding requires that the central government should unflinchingly fund scientific and technology activities because the top political decision makers themselves should fully understand and realize the important role which science and technology play in various dimensions of national development. Funding or allocation of money and political support should not depend on whether or not the scientific and technological institutions are able to please those who constitute the patronage or top government political actors. Rather, financial allocation should be guided by conviction and unfettered political will to ensure that within the confines of available financial resources science and technology activities receive a fair and reasonable share.

The fifteen subjects from political institutions were asked about the criteria upon which the government bases its decisions to allocate sums of money and how often this is done. They responded as follows:-

<u>RESPONSES</u>	<u>NUMBER OF SUBJECTS</u>
i) Financial Allocations depend on estimates made by various scientific and technological institutions through their departments and ministries.	N= 15
ii) Financial allocations are done annually for all scientific and technological institutions.	N= 15
	<hr/> N= 15 <hr/>

When estimates are handed in to the relevant authorities, the receipts often are far less than what the institutions expect. The following figures for Northern Technical College provide a stark testimony.

AUTHORISED EXPENDITURE	REVISED	ACTUAL
1974 - K50,000	-	K15081
1975 - K772,00	K532,000	K467,282
1976 - 632,000	-	K336,382
1977 - K1095,000	K1015,000	K865,087
1978 - -	-	-
1979 - K60,000	-	K47,215
1980 - K150,000	-	K112,388

The above figures were summarised from various annual reports prepared by the Department of Technical Education of the Ministry of Education and Culture at that time. It is, however, normally expected to see institutions making estimates which are far above the expected provisions in order to receive a figure which is fairly reasonable. This, of course, does not exonerate the government from patronage funding, as Goma observes: "hitherto, the funding of higher educational institutions, particularly Universities, has been done on

.../

a more or less ad-hoc basis and has largely depended on how well an institution argues its case for increased support".<sup>26</sup> If the institution can not argue its case well, then the patron withdraws or reduces the amount for allocation.

Silwangwa expressed similar displeasure about patronage funding by attacking the Civil Service administration as a conduit for financial distribution: "the Civil Service administration has not fully understood the function of the NCSR as one of the basic instruments of development and therefore instead of regarding it as an integral part of the national development strategies, the Civil Service administration has been regarding the NCSR as an appendage to the national expenditure bill. Because of this lack of appreciation and understanding of the role of the NCSR by the Civil Service administration, the NCSR has been inadequately funded even during the past years of economic sunshine".<sup>27</sup> Additionally, patronage funding creates fear of expenditure, either on improving the existing scientific and technological infrastructure by replacing old equipment with new ones, or on making extensions. The fear ordinarily is that those who constitute the patronage may be displeased to see advances of very high estimates made to them.

Conversely, when funding is finally made, some heads of scientific and technological institutions may feel constrained to use all the money allocated to them in case the patron may enquire why some of it was not reserved. Credence was lent to this assertion by the Third National Development Plan (TNDP) where it was noted that "the research activities that were implemented during the Second National Development Plan, therefore, were under constant financial uncertainty, and some had to be prematurely terminated".<sup>28</sup>

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26. Lameck Goma, "New Policy Measures for the Financing of Higher Education", Ministry of Higher Education, Science and Technology, April, 1989, P.3.

27. S.M. Silwangwa, "Building up and expansional Systems for Science and Technology", Science and Technology for Development, (1979), NCSR, Lusaka, P. 93.

28. Third National Development Plan (1979 - 1983), Office of the President, National Commission for Development Planning, Lusaka, P. 392.

Patronage funding which depended on how well individual scientific and technological agencies argued their cases for financial allocation brought in another problem of non co-ordination of scientific and technological endeavours. The TNDF additionally observed that "the present research funding and administrative arrangements through individual ministries of Government or managements of individual parastatal organisations, with reference to overall national research requirements, had led to unco-ordinated national research activity".<sup>29</sup> Overall national research requirements where a pluralist science and technology policy is in place are often remotely conceived.

To the subsidiary question of why financial allocations were made yearly, the response was that annual funding is considered to be more rational since the money purchasing power is taken account of in the face of the depreciating value of the local currency. Some science and technology policy scholars have criticised this arrangement, as we shall see later in this report.

#### CONDUCTIVE TAX DECISIONS TO EXPORT OR IMPORT TECHNOLOGY

Tax decisions relating to the buying and sale of technology can either strengthen or stifle the acceleration of scientific and technological infrastructural development in the country. If heavy tariff duties are imposed on imports of machinery, equipment, spare parts (hardware technology), as well as on scientific designs, specifications, production techniques and production processes (software or information technology), institutions making those imports are likely to reduce them and make do with the available machinery, equipment etc. The outcome of such a situation is likely to be one where existing research laboratories, technical workshops, technical data banks and technical museums become derelict and out of touch with contemporary scientific and technological needs. In dealing with this parameter, the 15 subjects were asked whether or not research centres, technical workshops, technical data banks etc, pay any tariff duties on either of the two types of technology imported from outside the country.

The following were their responses:-

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29. Ibid - T.N.D.P. - P. 392.

<u>RESPONSE</u>	<u>NUMBER OF SUBJECTS</u>
i) No tariff duties imposed on machinery, spare parts, scientific designs, specifications etc. imported by government scientific and technological institutions.	N= 15
ii) Machinery, equipment, spareparts scientific designs, specifications etc. imported by local but foreign organizations have tariff duties levied on them.	N= 15
iii) Individual Zambian entrepreneurs face tariff duties when they import both hardware and software technology.	N= 15
iv) Small scale industrialists who are registered with small scale industries Development Organisation (SIDO) do not pay tariff duties on their scientific and technological imports.	N= 15

The subjects' responses on this parameter appear to indicate that the Zambian Government has demonstrated support for the growth of scientific and technological centres, especially those which are under government jurisdiction. This seems to have been accomplished by waiving off customs duties on imported machinery, equipment and other spare parts that are crucial for either modernization, extension or development of new scientific and technological centres. Cuts in import costs for the required tools and equipment serve as an incentive to order more. The subjects, however, further indicated that although tariff duties are not imposed on both hardware and software technology imported by government scientific and technological institutions, insurance and warehouse charges have to be shouldered by those agencies.

On the other hand a question was asked about whether or not government scientific and technological institutions charge anything on technology which they develop themselves. The response from all the 15 subjects was in affirmative, with further clarification that charges are in the form of trade licences. In some instances research centres sell patents for the technology which they develop. Also sold out are consultancy services (see appendix 1). The University of Zambia, through the Department of Technology is prominent in technical consultancy services.

THE LEGAL DEVICE FOR SCIENCE AND TECHNOLOGY POLICY

The legal backing of any policy is vital for both the formulators and implementers to feel free and safe to carry out their activities within the confines of the prescribed law. When the 15 respondents from the political institutions were asked to identify the law which permits the scientific and technological institutions to carry out their activities, a suggestion was made to consult files on the Zambian Republican Laws. That suggestion led to the discovery that CAP. 236 No. 55 of 1967 was the first Act to establish the Zambian National Council for Scientific Research. The above Act specifies membership, functions, powers, and funds of the Council. Though the Act was amended in 1970, its functions remained the same.

Membership of the Council

After the Act was passed in Parliament in 1967 to establish the National Council for Scientific Research Centre, membership was as follows:-

- (a) the Permanent Secretary responsible for the National Commission for Development Planning,

.../

- b) two representatives from the University of Zambia,
- c) two representatives from the Ministry of Commerce and Industry,
- d) two persons experienced in civil engineering and construction industry,
- e) five persons experienced respectively in agriculture, education, health, natural resources and social sciences,
- f) not more than two other persons.

The above N.C.S.R. composition was credible in the sense that it drew its membership from some relevant institutions with bias on science and technology. The head of the Council was given the title of Secretary General.

The Act, however, does not state whether or not the Council's Secretary General could sit on the Cabinet of the government of the day to influence decision making on science and technology related issues. This usually is the case in many developed nations where heads of scientific and technological centres are given a place in political institutions such as the cabinet in order to effectively co-ordinate scientific issues through taking part in debates on varied issues of development.

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Another alternative way in which the deliberations of the Council's meetings would receive an immediate attention of the political leadership was for the Act to empower the inclusion in the Council's membership of a cabinet minister versed in science and technology policy issues. He, the minister, would brief the full cabinet about the discussions conducted during the Council's meetings and report back to the Council the views of the cabinet. This close liason between scientific and political institutions was realised later, as we shall notice in the coming paragraphs, the actions taken by the U N I P Government to popularise the efforts of science and technology policy. Interviews with the scientific community at the N.C.S.R. revealed that the activities of the research centre began to show poor performance in the mid seventies when the economy started to slide down. Had the law, according to one scientist, empowered the research centre to commercialise production of many of its discoveries, financial hardships -- discussed under funding in the previous paragraphs would have been alleviated. The other scientists, however, advanced a contrary view that if the Act had empowered the N.C.S.R. to commercialise the production of its discoveries, scientists would concentrate their energies on those concrete products and services already fetching high profits.

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Basic research aimed at discoveries to contribute to the reservoir of knowledge about our physical and social environment would suffer reduced attention. Even after its revision in 1970, the Act still never permitted N.C.S.R. to commercialise its products except patents.

An important aspect of patents as a legal transaction under the Act relates to the secrecy to be observed by all scientists, technologists and technicians of the scientific discoveries of the centre. Arising from that legal requirement, no scientist employed by the Council is permitted to provide private consultancy to other individuals, firms or any other organisation, even during free time of the officer. My own observation hinges on the problem of the Council to enforce such a legal requirement at a time when some scientists would wish to cushion the economic hardships by privately selling part of their knowledge for a financial return from certain wealthy individuals and organisations.

#### FUNCTIONS OF THE COUNCIL

Among the functions of the Council, Section 13 of its Act stresses the following:

- a) to advise the government on national scientific research activities within Zambia;
- b) to co-ordinate scientific research activities within Zambia;
- c) to determine priorities in the national research programme, particularly in relation to development plans;

.../

- d) to advise the government on the provision and use of finance for scientific research purposes, and to advise on the recruitment and use of research staff;
- e) to encourage voluntary scientific associations;
- f) to advise upon and encourage the training of research personnel by provision of bursaries, fellowships and other material assistance.

It is true that the N.C.S.R. has been advising the government on a number of issues relating to scientific research in the country, and on the basis of their research findings the government has been making certain policy decisions. For example in 1977 the Council scientists conducted a research project in the Kafue River to determine the amount of pollution allegedly caused by a conglomeration of related industries within the vicinity of Kafue Textile industrial area. The results of the water tests proved the amount of pollution to have been negligible and the recommendation to the government not to close the tannery, boat-making, net-manufacturing, including nitrogen chemicals industries was made. A further recommendation was made for the industrial entrepreneurs to make lagoons into which to deposit industrial effluents, so that these are never carried by rain water into the adjacent rivers.

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A comment on the Council's role to co-ordinate scientific activities in the nation has been abundantly made clear already in the preceding pages. Here one would say that one of the major constraints for the Council to co-ordinate scientific activities in the country during the early years after its establishment could have been the paucity of its staffing in relation to the vast size of the country and the scattered nature of other smaller research centres, particularly those dealing in agricultural sciences.

The National Commission for Development Planning has been, and continues to conduct a lot of research independently of the National Council for Scientific Research. The Council therefore does not have overriding jurisdiction of determining priorities in many of the research programmes having relevance to development plans.

Similarly, an observation has already been made in the preceding pages that many scientific centres devise their own recruitment and training programmes which appear to be devoid of advice from the Council.

#### THE POWERS OF THE COUNCIL

Section 14 of the Act delegated most of the powers to the head of the Council, the Secretary General, who chaired Council meetings. Under the Secretary General's chairmanship the Council was empowered to:

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regulate the custody and use of the common seal; acquire, hold, manage and dispose off property; authorise any person or persons to enter into or execute any agreement or contract on behalf of the Council to enable it to carry out its functions; provide support for research projects by way of grants or loans and by arranging the common use of equipment.

It is not clear what it means by common use of equipment. In one sense it may refer to the common use of scientific equipment by the Council's scientists in various departmental laboratories at the centre. In another sense it can refer to the common use of scientific equipment by government scientists, engineers, technologists and artisans at different scientific institutions spread out in the country. Additionally, it is not clear to who the Council can provide grants or loans. As we have already noticed in this report, discussions on funding of scientific activities at the Council's centre showed that the Council itself has been under financed even during the period of Zambia's economic honey-moon. It therefore gives rise to question the ability of the Council to fund itself and have extra resources to dispense out as loans or grants.

As observed in the above discussions, the Council's sources of funds appear to have been very limited. According to Section 15 of the Council's Act, credible funds sources of the Council consisted of parliamentary grants and other moneys or assets which accrue to the Council in the course of its business or otherwise. The Council was also empowered to raise funds by levying fees on services rendered to individual persons or organisations.

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Funds raised through levying of fees on Council's services rendered to other people, especially through the sale of patents and consultancy might not have been substantial enough to enable the Council to finance its activities and at the same time provide loans to other centres. As observed in the preceding pages, the Act never allowed the Council to commercialise on a large scale the production of goods based on its scientific discoveries to enable the raising of large sums of money.

The above inadequacies in the legal functions and powers of the Council to operate effectively were gradually being identified by the UNIP Government which began to realise the significance of close political involvement and interest in science and technology issues. In the 1985 - 1995 policy booklet for instance, UNIP stated that "the Party shall therefore enhance the role and place of the National Council for Scientific Research, whose added responsibilities will cover not only national science and technology research policy but also science policy approved by the Party"<sup>30</sup> What was not clear in that statement was who in the Party would knowledgeably approve some policy options conceived by the Council. This aspect of policy planning is important because in many developing countries political figure-heads who do not understand the scientific language of research have had the vanity of perusing through highly technical literature outside their educational background, and finally ended up making wrong choices among policy alternatives presented to them by advisers.

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30. U N I P, National Policies for the Decade 1985 - 1995, Freedom House, Lusaka, P. 39.

This is what the Organisation for Economic Co-operation and Development observed on the same issue: "If governments are indeed to become the enlightened patrons of science, which the needs of the 21st century as well as their own long-term self-interest dictate, the primary requirement is that they should fully understand the circumstances, methods and environment which fundamental research must have if it has to be highly creative".<sup>31</sup>.

The Technology Development and **Advisory** Unit (TDAU) has its functions legally permitted by the University of Zambia Act No. 66 of 1966, Cap.233 of the Laws of Zambia. The Act, under No. 10, was amended in 1970.

*Northern Technical College (NORTEC)* falls under Technical Education Department which in turn has been a branch of the Ministry of Education and Culture until late in 1982 when it became a department under the new Ministry of Higher Education, Science and Technology. The legal status of technical education dates back to 1972 when Act CAP.239 No. 37 was passed.

The preceding Acts, as they pertain to each of the Scientific and Technology institutions under discussion, suggest the legal mandate given to these agencies to operate singly or individually. Separate development has led to individual aims being linked to national felt needs not in an explicit manner but in an implied fashion. It is, however, important to mention that individual scientific centres have to formulate individual or narrow objectives only to meet the needs of specific research projects. But these have to be linked to overall national science and technology objectives, a domain for the central political authority.

#### TRAINING, EMPLOYMENT AND RETENTION OF THE SCIENTIFIC AND TECHNOLOGICAL COMMUNITY

Training, employment and retention of the scientific community in research centres, technical data banks and technical institutions constitute an important parameter in the quest of any nation to develop or improve its scientific and technological infrastructure. The respondents were asked whether or not the Zambian Government has been able to absorb.../

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31. OECD, Fundamental Research and the Policies of Government, (1966), Paris. P. 47.

in active employment many scientists, engineers and technologists that have been trained over the past period of 25 years and what incentive it has created to retain that community. Recorded were their responses:

<u>Response</u>	<u>Number of Subjects</u>
i) The government has employed many scientists, engineers and technologists but incentives have been responsive to economic fluctuations.	6
ii) The government has not employed many scientists, engineers and technologists from those trained. Those employed received adequate pay, electricity, water and car allowances.	3
iii) Some scientists, engineers and technologists get jobs in the private sector, but those working for the government are adequately housed and have generous loan facilities.	1
iv) Government scientists, engineers and technologists often attend national and international symposia, seminars and workshops on science and technology. While away from home, they receive allowances in foreign exchange.	5

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N= 15

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According to the United Nations Statistical Year Book, 1981, 32nd edition, to 1981, Zambian Scientists, Engineers and Technicians can be put into two categories (see appendix) (ii). These are, (a) 'potential scientists, engineers and technicians and (b) 'actual' scientists, engineers and technicians engaged in research and experimental work. Roughly between 1971 and 1978, there were 11,000 potential scientists, engineers and technicians in Zambia. The statistical year book for 1985/86 recorded the same figures but gave further details, stating that of the 11,000 'potential' scientists, engineers and

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technicians, only 400 were engaged in real scientific research. 250 were scientists 150 were technicians. Of the 250 scientists, 222 were foreigners.

If we deduct 400 from 11,000, we remain with 10,600 potential scientists, engineers and technicians who, during the period between 1980 and 1989, must have become fully qualified. So far there is no empirical data to indicate whether these and other scientists, engineers and technicians trained in the later period were employed by the Zambian Government.

In reference to the subjects' responses there is evidence to show that some highly educated and trained Zambia Scientists, Engineers and Technologists have at least been able to find a job, either within the government sector or in the private organisations. For those employed in the government establishments, the main problem has been their retention, particularly in the face of general economic recession. Industrialised countries with stronger economies have, through offering more attractive salaries and conditions of service, lured a sizeable number of the Zambian Scientific and Technical personnel. But this reverse transfer of technology should be understood not only from the view-point of human resource migration from one country to another, but also from the point of view of geographical relocation. Thus it is possible for a nation to lose some of its highly skilled scientific and technical personnel within the confines of its geographical frontiers, for instance scientists, engineers and technicians leaving government sectors and joining rich multinational corporations operating in the country. Adigun Ade, a scholar on reverse transfer of technology, observed that the prevailing situation is not only in Zambia but in many other developing countries where he wrote that in the past few years much attention has been focused on the subject of brain drain. The most serious aspect of brain drain, however, is the multitude of qualified and capable individuals who are now idle in their own countries. In several instances their talents remain unrecognized and therefore unutilized, unchallenged and hence under-utilized or misdirected and therefore misapplied. 'Potential' Zambian Scientists, Engineers and Technicians are likely to fall within the cohort of those unutilized.

A more heart-breaking instance of the Zambian Government's failure to retain its scientific community appeared in the pro-government news paper "Daily Mail" of 18th May, 1990. The paper gives a general estimate of 127 specialist lecturers with Phd. and M.A. degrees who have left the University of Zambia since 1984. Of the 127 specialist lecturers, 50 belong to medical science and engineering fields which are areas of principal concern in this study. The paper further reports that "according to UNZA records some of the recipient countries of Zambian Specialists are the United States (6), Zimbabwe (7), Botswana (13), Swaziland (8), Britain, Canada and Gabon (3) each, Kenya, Ethiopia (2) each with Congo, Malawi, Sweden, Tanzania attracting one (1) each. Of the experts in Canada one is (a highly qualified nuclear physicist".<sup>32</sup>

As regards re-location or reverse transfer of scientific and technological personnel, the paper reports that 41 specialist Zambian UNZA lecturers are rendering service in private and parastatal organisations

One parastatal sector where the government has recently lost highly qualified scientific and technical personnel is Zambia Airways. Under the subheading 'Engineers desert Zambia Airways' the 'Zambian Sunday Times' Paper reported that "Zambia Airways Corporation has been hit by an exodus of engineers and the tally of those who have resigned reached 25 last week".<sup>33</sup> Zimbabwe Airways received 17 while Botswana Airways got six. The rest joined other organisations within Zambia. Lack of adequate incentives relating to housing, salaries and worker-employer relations were identified as major causes of departures. Advocates of South-South technical co-operation would view the above phenomenon as one which is not very much a threat to Zambia. This is so because Zambia Airways engineers left for countries within the 'Front-line States' which are in SADCC region. However, under normal circumstances, certain conventions or rules apply to the signing of technical agreements between and among developing states found within the same region. Thus regional brain drain precipitated by the absence of adequate incentives to retain the community of scientists and engineers in particular countries within the same region should not be confused with South-South Technical Co-operation. If the trend of brain drain .../

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32. Daily Mail, (Zambia), 18th May, 1990, P.1

33. Sunday Times of Zambia, 3rd June, 1990, P.1.

continues at the present rate, some scientific and technological centres may have laboratories and other equipment without qualified personnel. The preceding figures showing the size of the Zambian community of scientists as it has been growing over the years provide an empirical insight into the challenge of absorbing the trained scientific personnel into jobs while at the same time being able to retain them. The problem posed by this situation is explained by some aspects of implicit science policy which the UNIP Government has been implementing over the previous 25 years. While it is easier to measure retention and loss of trained scientists, engineers and technologists by examining figures of those present and the others who have either left the country or gone to join foreign-owned scientific and technological institutions operating within the country, it is more difficult to evaluate the quality of output from the scientists, engineers and technologists themselves.

Hiroko Morita-Lou who specialised in evaluating science and technology policy implementation found out in his input - output approach that it is easier to measure input than output. For example "one can measure the amount of funds invested in research. But it is more difficult to measure the quality of output of scientific man-power".<sup>34</sup>

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34. Hiroko Morita-Lou, Science and Technology Indicators for Development, (1984), West View Press, Boulder and London, P. 11.

Check appendix III where it is easier to see 5 million U.S. dollars spent by Zambia on research and experimental development in the seventies.

Also check appendix II for the strength of the Zambian scientific community during the same period.

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CHAPTER III

THE TYPE OF ZAMBIA'S SCIENCE AND TECHNOLOGY POLICY:  
SCIENTIFIC AND TECHNOLOGICAL INSTITUTIONS  
DATA ANALYSIS AND DISCUSSION

As explained under methodology, the validity of responses from subjects in the political institutions had to be counterchecked by those from subjects in the scientific institutions. Both categories of respondents answered similar questions to test the first hypothesis as stated below:

that the Zambian Government, in reference to the parameters listed on page 6 has not for the past 25 years formulated and implemented a significantly explicit science and technology policy to develop Zambia's scientific and technological infrastructure.

The sequence of treating each parameter after another, as is evident in Chapter II, was also followed in this chapter. But analysis and discussion were brief in those cases where subjects' responses from both groups were alike. The first parameter for an explicit science and technology policy is thus here re-stated:

A CENTRAL, POLITICAL CO-ORDINATING BODY TO TAKE DELIBERATE DECISIONS AS REGARDS SPECIFIC AND FLEXIBLE NATIONAL SCIENCE AND TECHNOLOGY POLICY OBJECTIVES.

From scientific and technological institutions 35 subjects were interviewed to tell which agencies since the attainment of independence have been formulating Zambia's science and technology policy objectives. The following were their responses:-

.../

<u>Responses</u>	<u>Number of subject</u>
i) Scientific and technological centres have been formulating their own objectives to suit research, experimental or technological projects' requirements.	14
ii) There has been no central agency to formulate science and technology policy objectives until when the Science and Technology Sub-Committee of the Central Committee was formed.	16
iii) Scientific and technological centres have been suggesting policy objectives subject to the approval of the central government.	05
<hr/>	
N= 35	
<hr/>	

These responses are similar to those given by subjects in the political institutions. A general consensus is indicated that Zambia has had no centrally formulated science and technology policy objectives for a long time because such a central policy making agency has been non existent. Response number two (ii) provides new information about recent political interest in Zambia's science and technology policy. Surprisingly, this response could not be given by any of the subjects from the political institutions at the time of interviews. The Science and Technology Sub-Committee, as an idea began to gestate in the minds of intellectuals in the early part of 1987. Towards the end of 1987 the idea grew stronger as it was repeatedly mentioned at several political education seminars organized by the Party (UNIP). By August, 1988, the Science and Technology Sub-Committee was enshrined in the Party Constitution after the National Council unanimously adopted the amendments to the Constitution. The Chairman was appointed in 1988 and the other members of the Sub-Committee were appointed in 1989 and their appointment was published in 1990. (See Science and Technology Sub-Committee membership at appendix) (iv).

#### FUNDING OF SCIENTIFIC AND TECHNOLOGICAL INSTITUTIONS

Patronage funding of scientific and technological activities has already been referred to in chapter II. Scientists and technologists included in the sample gave their own responses to the question: What criteria does the government consider to arrive at figures of funds to

be allocated for scientific and technological activities in the country? And how often are allocations made?

	<u>Responses</u>	<u>Number of subjects</u>
i)	Allocations are considered on the basis of estimates made by each scientific and technological centre.	N = 35
ii)	Research project proposals must be convincing enough before their estimates can be accepted by the government.	N = 35
ii)	All allocations are made once in a year.	N = 35

Both subjects from political institutions and those from scientific and technological centres are congruent on estimates as the basis for funding scientific and technological activities in the country. They also agree that funds are allocated annually. Annual funding for the National Council for Scientific Research is here shown as follows:-

	1972	1973	1974	1975	1976	1972/1976
CAPITAL EXPENDITURE	0.9	0.9	0.9	0.9	0.9	4.5
(KM) RECURRENT EXPENDITURE	0.8	1.0	1.1	1.1	1.3	5.4
TOTAL EXPENDITURE	1.7	1.9	2.0	2.1	2.2	9.9

Source: SNDF Jan, 1972 - Dec. 1976, P. 154.

When interviewees were further asked to provide annual figures for the funding of the National Council for Scientific Research, their responses were summarised as shown on the next page:-

YEAR	CAPITAL	RECURRENT
1990	K11 Million	K46 Million
1989	K4.25 Million	K21.71 Million
1988	K3.5 Million	K19.74 Million
1987	K1.5 Million	K11.15 Million
1986	K500.000	K6.2 Million
1985	K200.000	K4 Million
1984	K200.000	K4.2 Million
1983	K1 Million	K3.79 Million
1966-1967	£250,000	£73,000
1967-1968	£170,000	£73,000
1968-1969	£45,000	£73,000
1969-1970	£45,000	£73,000

When the respondents at the above institution were asked whether the figures allocated were adequate for their functions to be carried out satisfactorily, the answer was that between 1967 and around 1976 funds allocated could buy more. Thereafter, when the economy began doing badly, allocated funds were far from being satisfactory. When asked about the rationale of annual funding, they repeated the argument of providing yearly financial allocation in order to take account of fluctuations in the value of the local currency.

Annual funding has been criticised by some scholars who favour long-term funding arrangements. Researchers and other Scientific Personnel ardently interested in science and technology policy issues had met in Paris in 1966. In the paper which they prepared jointly, they observed that "government programmes and financing must take into account the need for continuity in scientific work. Experiments, staffing and equipment of laboratories can not be fitted into short periods determined by annual budgets. Consideration should be given to useful experience in some countries on long-term programming based on

.../

the carry-over budgets or moving plans, plans of 4 or 5 years duration."35

Further, it is argued that where frequent, unpredictable changes occur in terms of political regimes in power (governments which may have differing views about funding scientific and technological activities in the country) long-term financial allocation may circumvent unnecessary budget cuts which are likely to be instituted under annual funding time frame. Simon Ramo, writing about the foreign dimension of national technological policy, also favoured longer span policy programmes. He thus noted that "planning for the realisation of the gains of technology demands long-term strategy."36

#### CONDUCTIVE TAX DECISIONS TO IMPORT AND EXPORT TECHNOLOGY

To the question on whether or not scientific and technological centres pay tariff duties on machinery, equipment and spare parts imported from abroad the 35 subjects responded as follows:-

<u>Response</u>	<u>Number of subjects</u>
1) No tariff duties imposed on machinery, equipment and spares imported by government research centres, technical institutions etc.	29
ii) Government Scientific and Technological centres pay rates for insurance and warehouse.	06
<hr/>	
N = 35	
<hr/>	

From both subjects in the political and scientific institutions, empirical data show that tariff duties are not paid by these agencies when machinery, equipment and spareparts are bought from other countries to develop or improve laboratories, data banks etc. Tariff duties are always regarded as a disincentive.../

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35. OP. Cit. OECD, P. 47.

36. Simon Ramo, "The Foreign Dimension of National Technological Policy", Technological Frontiers and Foreign Relations, (1985), National Academy Press, Washington D.C. P. 16.

by those who pay them since they dwindle their financial resources.

#### A LEGAL DEVICE FOR SCIENCE AND TECHNOLOGY POLICY

As regards the above parameter, subjects in the scientific and technological centres, like their counterparts in the political institutions referred me to consult various pieces of legislation found among Zambian laws. It is therefore assumed that data in Chapter II about the above parameter suffice in both cases.

#### TRAINING, EMPLOYMENT AND RETENTION OF THE SCIENTIFIC AND TECHNOLOGICAL COMMUNITY

Available figures (see appendix II) about Zambia's scientists, engineers and technicians indicate that the country has been pursuing a vigorous training programme over the years to produce those experts. The 35 scientists, engineers and technicians included in the sample were asked about whether or not the government has been able to absorb into employment the increasing number of the Zambian scientific and technological community and what incentives have been created to retain them. Their responses in some respects diverged from those of their counterparts in the political institutions but in other respects both views were in agreement as reported below.

	<u>Response</u>	<u>Number of subjects</u>
i)	The government has not employed some trained scientists, engineers and technologists, but those employed in scientific and technological centres enjoy salaries which are generally higher than in the civil service.	17
ii)	Many trained scientists, engineers and technologists who had their courses done in Eastern Europe are shunned by private and parastatal organisations. Those employed by the state are granted substantial electricity, water and house allowances.	10

.../

<u>Response</u>	<u>Number of subjects</u>
iii) Some scientists, engineers and technologists who go into private sectors do not get adequate government financial support, while their opposite numbers in government get merit salary increments and promotions considered yearly, also their house rent is heavily subsidised.	8
<hr/> N = 35 <hr/>	

The preceding responses, when compared with those from subjects in the political institutions, generally show that conditions of service in government scientific and technological institutions are better than elsewhere in the country. Particular attention seems to have been given to job incentives, reflecting seriously government policy to keep within the country and in government scientific research centres, technical workshops and technical data banks the experts that the government has trained.

Some scientists, engineers and technologists (subjects), however, gave further explanation that although salaries, loans and allowances were encouraging enough in government scientific and technological agencies, the inflation spiral in the country is such that many skilled experts leave the country to fetch for jobs elsewhere to take advantage of strong local currencies there to enable them to buy houses, cars refrigerators and television sets upon return to Zambia. For those scientists, engineers and technologists who decide to remain home, some have to engage in private, extra activities such as providing consultancy service, delivering lectures or carrying out research ventures for other organisations without express permission from the employers. In research centres, the law on the secrecy of the activities of the organisation prohibits scientists or any of the centres' skilled workers to offer any services to other organisations even during the free hours of the workers. But what is legally prohibited occurs in order for those workers to make ends meet.

The disadvantage of scientists, engineers, technologists and other skilled workers engaging in private assignments is that they never concentrate on official activities designed to promote the functions and achieve the goals of their centres and finally those of the country as a whole.

Another reason given for the frustration of some members of our scientific and technological community and the failure to retain them is lack of legally authorised mobility of these personnel from one centre to another without losing service benefits. Thus a qualified researcher in nuclear physics at the National Council for Scientific Research has to resign first before he can take up a similar job at the University of Zambia, or a technical consultancy expert at the Northern Technical College (NORTEC) in Ndola cannot take up a similar job at the Department of Technology Development and Advisory Unit (TDAU) (UNZA) without resigning first. Why not allow a smooth transfer of service benefits within the same country for workers whose employing institutions, though corporate entities, belong to and are funded by the same government? One subject asked.

Disparity in salaries and other conditions of service between Zambian Scientists and their expatriate counterparts holding similar qualifications and rank was cited as another reason for displeasure. One subject said expatriate scientists' houses were fully furnished by the government while Zambian experts have to buy their own furniture, probably through a loan scheme. In addition, climate allowances are given to foreign experts, including the ones whose home countries have climatical conditions which are akin to those of Zambia.

Another factor accounting for expatriate scientific and technological personnel being retained while their Zambian counterparts become mobile in search of brighter work opportunities elsewhere is the receipt of two salaries. Five technologists I interviewed said they were receiving salaries from the Zambian Government, and there was a further supplementary salary from their home governments. Additionally, their home governments pay airfares for travel to and from their home countries. Salaries from home governments are paid in foreign exchange which buys more from the local Zambian market (duty - free shops).

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## CHAPTER IV

### THE IMPACT OF THE ECONOMY ON ZAMBIA'S SCIENCE AND TECHNOLOGY POLICY

#### POLITICAL INSTITUTIONS

The performance of the Zambian Economy began to show signs of the down-ward trend in the early nineteen seventies and has, until today, continued to do badly. The chronological sequence of the economic depression is shown in Appendix VII. Arising from this situation, it was hypothesised that the measures adopted by the government for the development of scientific and technological infrastructure tend to have less significant impact in the context of Zambia's economic crisis.

One of the measures adopted by the Zambian government to develop the country's technological capability was the introduction into the economy of the import substitution strategy. It was hoped that through this strategy rapid transfer of technology would be achieved, and by installing on the Zambian soil technical plants such as the Livingstone Motor Assembly and the Land-Rover assembly in Ndola the required technical intersectoral linkages would be established to enable Zambia become self-sustaining technologically. In addition it was expected that in order to maintain these plants, technical workshops and research laboratories would be required.

The creation of the Small Industries Development Organisation (SIDO) was another government measure which aimed at stimulating technical initiative among Zambians in order to provide jobs in the informal sector. The establishment of SIDO was expected to give rise to the development of small and medium size laboratories, as well as technical workshops to be owned by individuals. These activities were envisaged to contribute towards the process of constructing the technological infrastructure.

The third government measure taken to develop the indigenous scientific community in institutions of learning was the introduction of educational fees. With a gradual deterioration in the quality of education as a direct response to the weakening

economy educational fees were aimed at reversing that unwanted trend.

In reference to import substitution strategy, documented data support the affirmative assertion of the hypothesis. Ann Seidman conducted studies on the performance of import substitution measure in Zambia and she noted that "The technologies of such industries will be relatively capital intensive, and reliant on imports of parts and materials."<sup>37</sup> For a weakening economy, the purchase of imported spare parts and raw materials erodes the little foreign exchange available. In due course it becomes difficult to maintain industrial plants based on import substitution model.

The intersectoral technical linkages expected to be established by the import substitution strategy also appear to be in problems. The capital goods sectors which make components of cars, refrigerators, air conditioners, radios television sets etc are set-up in Europe, North America and Japan. In Zambia, like in many other developing countries, import substitution industrialisation strategy provides only the forward linkages which "consist primarily of last-stage assembly and processing of imported parts and materials. This inevitably reduces the potential spread effect."<sup>38</sup>

By the term 'reduction of the potential spread effect' several meanings can be deduced. Firstly, the technology transferred through the provision of forward linkages is static. Thus it does not lend itself easily to innovation and further creativity since the technical operations involved are repetitive and routine. An assembler of a particular component has to carryout that function throughout each day's hours of work. Where workers do not alternate or rotate through the whole system of assembling parts, each worker is likely to acquire the technical skill of fitting one, specific part to the car until he retires or resigns.

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37 Ann Seidman, "The Distorted Growth of Import Substitution: The Zambian Case" in Ben Turok, Development in Zambia, (1979), Zed Press, London, P.103.

38 Ibid. Ann Seidman, p. 104

Secondly, there is no multiplication of technical sectors. This is because the backward and intermediate linkages, the actual manufacturing sectors, remain in the home countries of the companies that make the components. Such a technological infrastructure whose forward linkages have no reciprocal backward linkages becomes incoherent and disarticulated and can therefore never make a country achieve a self-sustaining technological capability.

Thirdly, there is no 'spread effect' regarding creating more jobs. Only a few people get employed in the forward assembling sectors. Jobs found in the backward and intermediate sectors are reserved for nationals in the metropolitan countries from which the transnational companies originate. This argument was observed by Jonathan Chileshe (page 2) under introduction.

Import substitution industries such as the Fiat Livingstone Motor Assembly and the Land Rover assembly plant in Ndola require big land space. This is often out of reach of small scale entrepreneurs. In order to foster technical drive based on local materials and to a modest extent, on local capital inputs, the Small Industries Development Organisation (SIDO) was created by an Act of Parliament in 1981. That attempt to develop Zambia's technological infrastructure has suffered reversals primarily resulting from the country's economic hardships as Chiselebwe Ng'andwe, SIDO Director explains: "Studies of the existing small - scale industries have indicated the following major constraints:

Workshop Space: Inadequate space for productive activities and storage.

Finance: Inadequate access to credit facilities and/or insufficient own financial capital.

Transport; Inadequate public or private transport for the procurement of inputs and distribution.

Energy: Inadequate access to electricity hampers possible use of certain machinery."<sup>39</sup>

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39 Chiselebwe Ng'andwe, "The Small Industries Development Organisation in Zambia," African Social Research, Vol. 13, PP. 143 - 144.

The major reason why workshop space is inadequate, especially in urban areas is that land in town tends to be more expensive as a result of higher demand than the situation is in rural areas. Government authorities also often charge high rental rates which can not be afforded by the small scale entrepreneurs.

Since the majority of small scale entrepreneurs are considered to be 'high risks' for the award of credit, their financial status is mostly weak and therefore can not meet the higher land rental rates, including those of electricity and the purchase of necessary equipment for their technical workshops.

With the depletion in the available public transport, rural small-size entrepreneurs can not move quickly between their homes and urban places to look for inputs for their productive work. Some of their machines become dysfunctional because spare parts can not be obtained in time.

The introduction of fees is another reflection of the problems the Zambian economy has been experiencing since the beginning of the seventies. Lameck Goma, at that time Minister of Higher Education, Science and Technology, said: "It is conceded that the severe economic crisis Zambia is going through has had and continues to have profound negative impact on the provision, development and progress of higher education, science and technology in our country."<sup>40</sup> Fees paid in technical and scientific institutions are shown on the next pages.

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40 Opcit Goma, p. 1.

FEESTECHNICAL AND VOCATIONAL INSTITUTIONS

1)	<u>GRZ Bursary Holders (Zambians)</u>	
	Tuition fees	K525
	Boarding and lodging	K900
	Total expenses	K1,425
	Less studentship	K360
	Student's contribution	K1,065
ii)	<u>Self or Family sponsored (Zambians, Residents)</u>	
	Tuition fees	K1,050
	Boarding and lodging	K1,800
	Total expenses	K2,850
iii)	<u>Company Sponsored (Zambians, Residents)</u>	
	Tuition fees	K2,100
	Boarding and lodging	K1,800
	Total expenses	K3,950

(Source) - New Policy Measures for the Financing of Higher Education

(1989), Ministry of Higher Education, Science and Technology, Lusaka, P. 14.

Northern Technical College (NORTEC) prospectus shows higher fees for its institutions as follows:

1)	<u>Sponsored Zambians (Craft level)</u>	
	Tuition fees	K1,350
	Boarding fees	K1,500
ii)	<u>Sponsored Zambians (Technology / Technician level)</u>	
	Tuition fees	K2,000
	Boarding fees	K1,500

Source) - NORTEC, 1989 / 90 Prospectus.

a) UNIVERSITY STUDENTS (Kwacha per annum)

i) GRZ bursary holders (Zambians)

	Humanities	Science Engineering	Medicine, Vet. Medicine
	K	K	K
Tuition fees	2,000	2,500	3,000
Lodging (on campus)	690	690	690
Meals	<u>5,520</u>	<u>5,520</u>	<u>5,520</u>
Total expenses:	8,210	8,710	9,210
Less: Studentship	<u>7,000</u>	<u>7,200</u>	<u>8,200</u>
Student's contribution	1,210	1,510	1,010

ii) Self or Family-sponsored (Zambians and Residents)

	K	K	K
Tuition fees	4,000	5,000	6,000
Lodging (on campus)	690	690	690
Meals	<u>5,520</u>	<u>5,520</u>	<u>5,520</u>
Total expenses:	10,210	11,210	12,210

iii) Company sponsored (Zambians and Residents)

Tuition fees	8,000	10,000	12,000
Lodging (on campus)	690	690	690
Meals	<u>5,520</u>	<u>5,520</u>	<u>5,520</u>
Total expenses	14,210	16,210	18,210

iv) Non-Resident Non-Zambians

Tuition fees	24,000	30,000	36,000
Lodging (on campus)	690	690	690
	<u>5,520</u>	<u>5,520</u>	<u>5,520</u>
Total expenses:	30,210	36,210	42,210

(Source) - New Policy Measures for the Financing of Higher Education, (1989), Ministry of Higher Education, Science and Technology, P. 12

As is shown on the tables referring to fees to be paid by students of different categories and under different schools in the University for example, technical courses demand slightly higher fees than other courses. The reason for this difference was attributed to expensive equipment found in laboratories used by students who pursue technical courses, as distinguished from their counterparts in humanities and social sciences who may not need a laboratory in the process of their learning.

The only cause for alarm is that as fees continue to rise each year due to continued economic depression, more and more intellectually capable but financially poor students may not afford even the sum of money referred to as 'student's contribution'. Gradually, the nation can expect to experience reduction in the total number of young people training in science and technology based subjects.

The counter argument is that it does not really help the nation to increase student enrolment for science and technology based curriculum if the learning environment is not stimulating enough because inadequate funding can not develop or improve the required facilities. The scientific community turned out from such institutions may not be thoroughly groomed for the challenges lying ahead of them.

The assertion goes further that a smaller number of carefully selected students taught and inspired in a highly stimulating science and technology environment can be great assets to the nation as regards possible scientific and technological discoveries to come from them later in life. From this point of view fees are justified, even though they may keep many students out of school, but as long as their payment enables the state to improve the learning environment for the few whose manifold contribution later can benefit the majority of the people in the nation. Looking at it from the perspective of quality of education in a depressed economy, fees as an alternative source of funds appear to be justifiable.

The preceding documentary data which support the thesis that the measures taken by the government between 1964 and 1989 to try to develop Zambia's scientific and technological infrastructure has had less impact were contrasted with views of 15 respondents representing political institutions. The subjects were asked how and where the government would raise funds for the purchase of expensive but necessary equipment, machinery, spare parts, including books, pamphlets and other facilities required in our scientific and technological research laboratories, workshops, technical data banks, technical museums, scientific and technical training institutions. Below were their responses:

	<u>Responses</u>	<u>Number of subjects</u>
i)	The national budget will continue to be the source of funding the construction or renovation of scientific and technological infrastructure.	2
ii)	Outside donor agencies and friendly organisations will have to be contacted for financial aid.	10
iii)	There is no need to extend the existing scientific and technological infrastructure in the face of the current declining economy.	01
iv)	Parastatal organisations and other private enterprises dealing in scientific and technological activities should assist the government to contribute towards a common fund to build a viable based for science and technology.	02

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N = 15  
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Response one refers to the national budget which has been affected adversely by the poor performance of the economy since the mid-seventies when the copper price began to plummet at the international metal market. It is doubtful whether the government can safely rely on adequate financial allocations from the ever weakening national budget at the time when other capital projects, for instance the building of teachers' houses, road construction and road mending are perennially unresolved issues.

Foreign aid, which response two suggests, sounds plausible. But endogenous scientific and technological capacity becomes unsafe when its development largely depends upon external funding, particularly funding from the developed North. The Zambian Government, for example, has in the past been "assisted by various International Agencies such as Canadian International Development Agency (CIDA), UNDO/ILO, Swedish International Development Authority (SIDA) in the supply of personnel and equipment,"<sup>41</sup> and yet we seem not to move faster towards bridging the technical gap between us and the richer nations. This may be attributed to the fact that external aid fluctuates with changes in international relations. The already existing asymmetry in economic strength between the developed North and the developing South makes it difficult for the weak South to pursue independent trade or economic policies. The UNCTAD secretariat supported this view when it noted that Third World technological dependence on the developed countries, in so far as this relates to funding, is dangerous. Financial asymmetry arises with respect to both direct private investment as well as loans and aid from developed countries to developing ones. The financial dependence of developing countries has been much discussed and since finance is an important part of the control of business making, financial asymmetry also implies asymmetry of decision making.

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41 Lubasi, R, Development and Planning of Technical Education in Zambia, (1976), Department of Technical Education, Lusaka, P.3

Since Zambia intends to develop local capacity in science and technology through the construction of a viable infrastructure, the government should not be oblivious of the fact that foreign funding entails financial asymmetry which means its continuity will make it difficult for Zambia to reduce or come out of its dependence syndrome.

Modern scientific research is such that increasingly complicated but highly telling scientific equipment and other modern facilities are required to make the research environment creatively stimulating for the scientists, engineers and technologists. Improvisation, if this refers to use of outmoded equipment, often leads to killing of researchers' investigative curiosity. Elsewhere, scholars have argued that one of the reasons for the reverse transfer of technology is that scientists, engineers and technologists from the Third World leave for developed countries because in their countries of origin the research or experimental environment has been made intellectually unstimulating by antiquated facilities. At a certain point, therefore, improvisation of equipment for scientific enquiry does not constitute a remedy.

The last response about a common science and technology fund to be made up by contributions from both government and other private or parastatal organs in the country sounds to be a veritable solution out of the current government economic malaise. But if parastatal enterprises comprise some of the salient and central economic pillars of the Zambian economy, then one wonders how these commanding heights of the economy can escape the general economic recession in the country in order to be able to contribute substantially towards the science and technology common fund. Private companies which are foreign based are likely to have extra sources of funds from their mother bodies abroad and can be in position to adequately contribute towards the intended fund. But the problem of financial asymmetry will re-emerge. The situation therefore looks to be intractably desperate, with no immediate solution insight.

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CHAPTER V

THE IMPACT OF THE ECONOMY ON ZAMBIA'S SCIENCE AND TECHNOLOGY

POLICY: SCIENTIFIC AND TECHNOLOGICAL INSTITUTIONS

To further compare the views of political leaders (chapter 4) to those who constitute the scientific community (chapter 5) as regards the second hypothesis, the study collected the following responses:

<u>RESPONSE</u>	<u>Number of subjects</u>
i) Money is there but government priorities are shifted away from the concerns of science and technology.	5
ii) The government should, in a country-wide campaign, mobilize the people to generously contribute towards the science and technology fund, just as what happened when the new party headquarters construction campaign was launched.	1
iii) Scientific research centres such as the NCSR should be legally allowed to commercialise their production (which is not the case now) in order to raise funds for their activities and lessen dependence on the government.	6
iv) Foreign donor organisations such as KRUPPS of West Germany, JICA of Japan, NUFFIC of the Netherlands should continue to provide aid.	23
	<hr/>
	N= 35
	=====

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Response one about government priorities has some message worth considering. One may argue that even under conditions of economic buoyancy of the country, certain sectors of the economy may suffer stagnated development if government attention does not look at such sectors as priority areas. Sarah White studied the historical process of scientific and technological development in the Soviet Union from which Zambia can learn useful experiences. She observed that in the Soviet Union, "government belief in the importance of science for the development of a modern technologically - based industry meant that from the very beginning (despite the economic difficulties) a greater proportion of the national wealth was allocated to science than in any other country at that time".<sup>42</sup>

Critics of the Soviet Union's path to scientific and technological advancement contend that force, rather than persuasion or influence, was used by the government to divert resources from some sectors, such as agriculture, to scientific areas. However, the Soviet Union, using that unpopular path, managed to achieve parity with the United States in various dimensions of science and technology.

Response two refers to mobilisation of the people by the government in the campaign to raise money for scientific and technological centres. Such a campaign may have effect if conducted for a year only. Anymore similar campaigns to be carried out thereafter are likely to receive negative response from the people. For a Third World country, the development of a sound scientific and technological base requires many years of both human and material investment. Such expensive programmes can not depend on funds raised in a countrywide public campaign to be conducted only once in several years.

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42 . Sarah White, Guide to Science and Technology in the USSR, (1971), Francis Hodgson Ltd., Quensey, British Isles, P.10.

Commercialisation of products produced in a scientific and technological centre can, to some extent, enable the centre to raise a substantial sum of money to improve its facilities and retain its highly qualified personnel. The Technology Development Unit at the University of Zambia receives quite good income from its consultancy services (see TDAU Consultancy Projects at appendix 1).

Critics of wholesale commercialisation of the activities of scientific and technological centre point at the temptation for these centres to concentrate on production of those goods and services that bring direct and immediate material benefits to its personnel. Basic research to provide knowledge to the state for purposes of policy making for instance would suffer a negative impact.

The fourth response focusses attention on aid from donor agencies, an alternative which was discussed abundantly under views of subjects from political institutions. Here we can only say that for Third World countries' financial, technical and other forms of aid from developed nations are inescapable. This is because Third World countries want to achieve development faster.

But there is now recognition "that technology and related management culture have become crucial assets in market competition."<sup>43</sup> It, therefore, becomes doubtful to expect advanced countries to provide genuine financial and technical aid to less developed countries which are their potential competitors in world trade.

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43 Calestous Juma, "Market Restructuring and Technology Acquisition: Power Alcohol in Kenya and Zimbabwe", Development and Change, Vol. 16, No.1, January, 1985, P. 47.

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## CHAPTER VI

### CONCLUSION AND RECOMMENDATIONS

The skills in science and technology mark the greatest difference between the developed and developing states. Today's nations with more advanced scientific and technological acumen are able to exert greater economic and political influence over those still making efforts to acquire similar capability. To achieve that goal requires deliberate planning guided by a determined government policy.

This study investigated whether or not such a serious science and technology policy has existed in Zambia during the past 25 years.

#### Restatement of the problem

As here restated, the study was guided by the following problem: Has the Zambian Government, between 1964 and 1989 formulated a significantly explicit science and technology policy regarding the development of Zambia's scientific and technological infrastructure?

Literature on science policy in both developing and developed countries was examined for purposes of comparison and also to see what lessons developing states can learn from advanced countries.

In reference to the parameters listed on page 6 the study hypothesised that the Zambian Government, for the past 25 years, has not formulated and implemented a significantly explicit science and technology policy.

Further, the study conjectured that the measures adopted by the Government for the development of scientific and technological infrastructure tend to have less significant impact in the context of Zambia's economic crisis.

#### MAJOR FINDINGS

On the basis of the first hypothesis, empirical data gathered from both respondents and documentary sources show that science and technology objectives were being formulated by individual scientific establishments without clear central government co-ordination. Such objectives therefore suited more the needs of individual scientific institutions and were not specifically conceived to meet the broad spectrum of national requirements. Where national and institutional

objectives fulfilled similar needs, it was more by coincidence rather than by deliberate and specific design. Part of the explanation for this situation is that the National Council for scientific Research which had been given powers to oversee National scientific and technological activities concentrated on its own affairs.

It is on planning of manpower training where subjects felt that there is little foresight made between enrolment of future scientists, and the employment absorptive capacity of the economy. This resulted in some scientists, particularly those trained in former socialist countries, being ignored for employment. Socialist education has been viewed negatively in some parastatal organisations.

An additional finding was that all scientific and technological centres operate under a specific law, outlining functions and powers of the centres. Some provisions in some acts may require revision or strengthening to permit the centres to carry out more activities, commercialisation of their products for example. Thus for parameters (c), (d) and (e) on page 6, the first hypothesis was rejected.

In the case of hypothesis two, collected data indicate that the government never gave science and technology a determined attention even when it had more money before the mid-seventies, but when the economy began to perform badly stress was put on foreign financial assistance for the development of the nation's scientific and technological infrastructure. The study has also shown that import substitution strategy has not led to the development of technical intersectoral linkages to establish a viable and self-sustaining scientific and technology base in the country. Rather, the strategy has perpetuated technological dependence. The small Industries Organisation (SIDO) technical activities have been impeded by heavy costs in providing energy, finance, land-space, raw materials and transport. These problems have been worsened by the weakening economy. The introduction of fees in scientific and technical institutions, as well as

in other educational institutions became a clear testimony of the government looking for alternative sources of funds for scientific and technological activities in the face of a depressed economy.

Documentary data have also proved that government ardent interest in science and technology issues began to show signs through the establishment of the Ministry of Higher education, science and technology in 1983. Real political commitment however, was demonstrated after the formation of the science and technology sub committee of the United National Independence Party during the 1988/89 period. Parameters (a) and (b) of the hypothesis were therefore, confirmed.

To improve Zambia's future policy for science and technology, the recommendations on the next pages may prove useful to all those concerned:-

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RECOMMENDATIONS

1. Membership of the Science and Technology Sub-Committee, aside from the chairman who is appointed by the Head of State, should be dynamic, that is it should rotate and include as many people as possible for a certain duration in order to furnish the chairman with diverse ideas from which a selection can be made for decision making purposes.
2. Arising from the premise that science and technology determine the rate of industrialisation process of any country, and that industrialisation in turn determines the strength of the national economy by improving production, stabilising balance of payments, cutting down foreign debt and ultimately lessening dependence, the government should, from now on, unflinchingly allocate substantial funds for the national science and technology concerns. This will mean priority making in the face of scarce resources, as we are not oblivious of our economic depression.
3. To overcome the financial obstacles which plague us most, Zambia can-within the SADCC region-propose the creation of a clearing union, an agreement into which SADCC members can enter so that convertible foreign exchange is not required for the member countries' mutual scientific and technological transactions.

.../

4. Regional Science and Technology concerns should require member countries to adopt a consortia approach which may assist Zambia and her SADCC fellow members to undertake scientific and technological activities which Zambia alone might not be capable of taking up. The proposed joint chamber may facilitate the contracts between firms and provide information on their capabilities.
5. The above approach favours the South-South dialogue which suggests that Zambia should recognise the subtle advantage of importing technology from some developing countries as against that from advanced transnational corporations.
6. A piece of legislation should be enacted to allow the scientific and technological community to transfer from one centre to another without loss of service benefits. This will reduce frustration, retain the scientists, engineers and technologists and check the reverse transfer of technology.
7. The Science and Technology Sub-Committee should provide advice on the science and Technology curriculum for institutions of higher learning; suggest felt needs as regards scientists, engineers and technologists which the nation requires in various fields and co-ordinate the training and employment of the scientific personnel from training institutions both at home and abroad. This can be done in conjunction with the Ministry of Higher Education, Science and Technology.
8. If the National Council for Scientific Research (NCSR) is considered to be the most leading scientific and technological centre in the country, its head should have a ministerial status to be able to sit on the cabinet and influence decision making there. The same thing applies to the University of Zambia.

.../

9. Tropical countries in Asia, Africa and Latin America have a similar climatical environment. Zambia can initiate a joint programme where energy infrastructure based on renewable resources with stress on biomass energy, bio-chemistry and solar energy can be researched into as a possibility. This can be part of the South-South technical co-operation.
10. The government has to develop confidence in the capability of its own scientific and technological personnel and utilize it to the full, rather than often turning to foreign experts because of the reputation of coming from developed countries.
11. When an academy of sciences is established, its scientists and technologists will need to adequately prepare themselves into an effective national scientific community, determined to set their own standards of relevance and excellence and gain global reputation therefrom.
12. The academy of sciences will need to stress the intellectual challenge often confronted in applying existing knowledge to neglected areas of development and underline to the government the requirement of recognizing outstanding work of this nature when considering appointments, career advancements and awards. This will constitute an incentive to lessen the current problem of brain drain.
13. The Science and Technology Sub-Committee should convince the government to permit scientists, engineers and technologists, as members of the national academy of sciences, to participate in public debate and development matters generally, and underline the significant place of science and technology as a vehicle for various dimensions of national development.
14. As commercialisation of production of goods and services has proved to be useful in supplementing government budgetary allocations at the UNZA Department of Technology (TDAU), it might equally be useful to extend similar legal permission to other scientific and technological centres during this period of economic crisis in the country.

15. The national academy of sciences should, once formed, launch a full scale search for traditional technologists who should be harnessed together since their generations of experience can, under proper guidance, enable them to make the transition and adapt in an innovative way to meet the needs of the modern society. To harness the skills of traditional technologists, the national academy of sciences would be required to decentralise their activities down to the provincial level. This can give rise to local village industries whose success can be ensured only if the central government:
- i) Assured traditional technologists with a regular supply of cheap raw materials and offered protection against large scale industries which are devouring raw materials from the village forest areas.
  - ii) The academy of sciences in conjunction with SIDO will have to start an intensive scheme of education and training for traditional technologists.
  - iii) Further policy decisions will have to be made to protect traditional technologists whose workshops do not operate on cheap electricity, easier transport, foreign exchange and skill obtained in high institutions of learning. Traditional technologists have no tariff protection from foreign competition. They need more attention.
16. The government should try to introduce carry-over budgetary allocations for long-term plans of up to six years to avoid unnecessary budget cuts which may be instituted by a new government under political pluralism.

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APPENDIX (1)TDAU - UNZACONSULTANCY PROJECTSON GOING

Project	Partner(s)	Sponsor	Fund	Status
Oil seeds	Royal Tropical Institute	Dutch aid	(Kwacha) 40,000	Completion
Testing of ram press	Africare	U.S. aid	71,932	Completion
Adaptation and production of ram press.	Africare	U.S. aid	379,308	Completion of 10 ram presses

## In preparation:

Project	Partner(s)	Sponsor	Fund	Status
Ox powered Maize mill Fruit press	VIS	German Aid UNIDO	(Kwacha) 200,000 76,450	Awaiting approval Awaiting approval
Feasibility study small scale metal upgrading of ram press to ox-drawn and motorised equipment.		ILO	22,000	Awaiting approval
		Dutch aid	75,000	awaiting approval

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APPENDIX (11)SCIENTIFIC AND TECHNICAL MANPOWER EXISTING IN  
SOME AFRICAN COUNTRIES IN THE 1970s

YEAR	COUNTRY	POPULATION (In millions)	Potential scientists, engineers and technicians	Number of scienti- sts, engineers and technicians actual engaged in research and experimental development
1977	Nigeria	78.9	19885 (15241)	3545 b
1973	Egypt	37.8	593 254 (NA)	10665
1975	Ghana	9.9	6897 (15096)	9819
1978	Sudan	17.4	13792 (2689)	6537
1975	Kenya	14.1	5130 (5879)	544
1976	Cameroon	7.7	11785 (NA)	329 b
1977	Mauritius	0.906	6264 (NA)	301
1972	Algeria	15.1	(NA)	42 b
1971	Chad	3.7	(NA)	187
1977	Congo	1.4	3461	284 b
1970	Gabon	0.502	(NA)	28
1975	Ivory Coast	6.8	(NA)	502 b
1976	Togo	2.3	461 (211)	445
1976	Niger	4.7	(NA)	94
1976	Senegal	5.1	(NA)	400
1976	Zambia	5.1	11000	

Appendix (ii) cont'd

- NOTES: (a) : Figures in brackets represent the number of potential technicians. (NA) data are not available.
- (b) : Data for either actual technicians or for actual social scientists are not available for inclusion.

SOURCE: Statistical Year Book, 32nd edition, 1981, International Financial Statistics, 1982, Europe Year Book, A World Bank World Tables, 2nd edition, 1980, for population figures of some countries.

APPENDIX (iii)

EXPENDITURE FOR RESEARCH AND EXPERIMENTAL DEVELOPMENT  
IN SOME AFRICAN COUNTRIES IN THE 1970s

Country	Total Expenditure	Expenditure financed by government in millions of US Dollars	Expenditure financed by non-government in millions US Dollars	Amount spent per head	Percentage financed non-government
Nigeria	68.0	54.4	13.6	19182	20
Egypt	11.5	10.5	01.3	1095	11
Ghana	24.8	24.8	-	2530	0
Sudan	2.1	1.9	0.2	312	9.5
Kenya	12.5	10.2	2.3	22978	18.4
Cameroon	7.1	7.1	-	21588	.0
Mauritius	2.9	2.1	0.8	9835	27.5
Algeria	19.5	19.5	-	57060	.0
Chad	0.8	0.6	0.2	4239	25
Congo	2.7	2.7	-	9492	.0
Gabon	0.007	0.007	-	244	.0
Ivory Coast	6.2	3.7	2.5	12350	40

Togo	4.3	3.6	0.7	9683	16.2
Niger	0.6	0.6	0	6066	0
Senegal	18.1	15.9	2.2	27596	12.1
Zambia	5.0	2.9	2.1	2500	42

NOTES: (a): Column 5 (amount spent per head) is calculated by dividing Column 2 in this table by Column 5 in Table 2. Column 4 and 6 are calculated from Column 2 and 3.

SOURCES: Statistical Year Book, 32nd edition, 1981 for Column 2 and 3. See also Europe Year Book, "A World Survey" 1971 - 1978.

APPENDIX (iv)

LIST OF MEMBERS OF THE SCIENCE AND TECHNOLOGY

SUB-COMMITTEE

1. Hon. J.B. Simuyandi, MCC (Chairman)  
Chairman of the Science and Technology Sub-Committee.
2. Hon. Prof. L.K.H. Goma, MCC, MP  
Minister of Higher Education, Science and Technology  
and Vice Chairman of the Science and Technology  
Sub-Committee.
3. Hon. Dr. H.S. Meebelo, MCC  
Chairman of the Political, Ideological and Legal  
Sub-Committee.
4. Hon. P.W. Matoka, MCC  
Chairman of the Social and Cultural Sub-Committee.
5. Hon. B.C. Chilunga, MCC  
Chairman of the Youth and Sports Sub-Committee.
6. Hon. Gen. G.K. Chinkuli, DFS, MCC, MP  
Minister of Home Affairs.
7. Hon. J.M. Nyaywa, MCC  
Managing Director, ZAMCAPITOL.
8. Hon. Brig. Gen. Dr. J.K. Manuwele, MCC  
Director-General, Defence Forces Medical Services.
9. Hon. F.S. Hapunda, MCC, MP  
Minister of Defence.
10. Hon. J.J. Mukando, MDS, MCC, MP  
Minister of Agriculture.
11. Hon. Dr. E.H.B. Mwang'onze, MP  
Minister of General Education, Youth and Sport.
12. Hon. Dr. J.B. Chijikwa, MP  
Minister of State for Health.
13. Dr. M.M. Bull  
Provincial Political Secretary, Science and  
Technology Sub-Committee.
14. Hon. R.S. Kumalo, MP  
Member of Parliament for Kalomo.
15. Hon. A. Mkandawire, MP  
Member of Parliament for Matero.
16. Hon. B.H.W. Mwiinga, MP  
Member of Parliament for Mazabuka.
17. Hon. C.L. Ngalande, MP  
Member of Parliament for Kasempa.

APPENDIX (v)INTERVIEWED RESPONDENTS FROM POLITICAL INSTITUTIONS

<u>NO.</u>	<u>POST HELD</u>	<u>DATE OF INTERVIEW</u>
1.	Chairman - Science and Technology Sub-Committee	14/02/90
2.	MCC - Freedom House, Lusaka.	30/03/90
3.	MCC - Freedom House, Lusaka.	10/04/90
4.	MCC - Freedom House, Lusaka.	10/04/90
5.	P.P.S. Freedom House, Lusaka.	18/04/90
6.	P.P.S. Freedom House, Lusaka.	18/04/90
7.	Director - Higher Education, Science and Technology, Lusaka.	26/04/90
8.	D.G. National Guidance, Lusaka.	26/04/90
9.	D.G. National Guidance, Lusaka.	30/04/90
10.	Member of Parliament, Lusaka.	04/05/90
11.	Member of Parliament, Lusaka.	09/05/90
12.	Member of Parliament, Lusaka.	09/05/90
13.	Member of Parliament, Lusaka.	21/05/90
14.	Member of Parliament, Lusaka.	30/05/90
15.	Member of Parliament, Lusaka.	30/05/90

APPENDIX (vi)INTERVIEWED RESPONDENTS FROM SCIENTIFIC INSTITUTIONS

<u>Post Held</u>	<u>Institution</u>	<u>Date of Interview</u>
Senior Research Planning Officer	NCSR	16/02/90
Research Planning Co-ordinator	"	16/02/90
Scientific Officer 1	"	16/02/90
Scientific Officer 1	"	16/02/90
Scientific Officer II	"	16/02/90
Glass Blowing Technician	"	16/02/90
Glass Blowing Technician	"	16/02/90
Data Bank Officer	"	16/02/90
Data Bank Officer	"	16/02/90
Scientific Editor	"	16/02/90
Scientific Editor	"	16/02/90
Laboratory Assistant	"	16/02/90
Laboratory Assistant	"	16/02/90
Head Ceramics Production	"	16/02/90
Head - Botanical Sciences	"	19/02/90
Scientific Officer I	"	19/02/90
Assistant Research Planning Officer	"	19/02/90
Laboratory Assistant Technician	"	19/02/90
Laboratory Assistant Technician	"	19/02/90
Scientific Officer II	"	19/02/90
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<u>TDAU (UNZA)</u>		
Senior Research Fellow, Acting Manager	"	09/03/90
Senior Technician	"	12/03/90
Technician	"	12/03/90
Technician	"	12/03/90
Technician	"	12/03/90
Senior Technician	"	19/03/90
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<u>NORTEC</u>		
Head, Automotive Heavy Engineering Department	"	27/03/90
Head, Mechanical Engineering Department	"	27/03/90
Head, Section Mechanical	"	27/03/90
Head, Section Fabrication	"	27/03/90
Lecturer, Electrical	"	27/03/90
Lecturer, Mechanical	"	27/03/90
Lecturer, Fabrication	"	27/03/90
Technician-Automotive	"	27/03/90

APPENDIX (vii)CHRONOLOGY OF ZAMBIA'S ECONOMIC DECLINE IN THE YEARS FOR WHICH DATA ARE AVAILABLE-SUMMARIES MADE FROM BANK OF ZAMBIA ANNUAL REPORTS

- 1970 - The beginning of the recession in the economy.
- The price of Copper fell sharply during the second half of the year; the short rainy season cut the maize crop; the latter necessitated importation of maize. The curve-in at Mufulira Copper Mine in September - the most fatal accident - resulted in a loss of foreign exchange earnings. Foreign reserves which had risen from K266 million in December, 1967 to K430 million in August declined sharply to K381 million by December, 1970.
- 1973 - 9th January, 1973 Rhodesian Ian Smith Border closure; ZIMCO sets in redemption bonds and the oil crisis triggers off.
- Contingency measures - re-routing of exports and imports cost Zambia K26 million.
- 1974 - Sudden nosedive in the Copper price.
- General world economic recession.
- The balance of payments surplus which had built up during the first six months became almost completely eroded by the end of the year.
- 1975 - Continuous fall in the price of copper averaging from K1326 per tone in 1974 to an average of K793 per tonne in 1975.
- GDP decline from K918 million in 1974 to K890 million in 1975.
- 1977 - Copper price falls continued.
- Low copper production output registered.
- Balance of payments deficit widened from K136.2 in 1976 to K223.5 million in 1977.
- 1978 - Copper price depreciation continued.
- TAZARA almost grinds to a halt as a result of inadequate supply of locomotives.
- October, 1978 the crisis forces the government to re-open the Southern route.

- 1980 - Copper price recession persisted.
- Import bill grew from K97 Million in 1979 to K150 million in 1980.
- 1984 - GDP declined from K2,018 million in 1983 to K1,992.1 million in 1984.
- 1985 - Introduction of a floating exchange rate system; decontrol of interest rates and prices of most goods, as well as reduction of subsidies.
- Copper production declined from 321,000 tonnes in 1984 to 479,000 tonnes in 1985.
- 1986 - Economic recession continued.
- GDP slackened from 1.5 per cent in 1985 to 0.5 per cent in 1986. Balance of payments deficit increased from K718 Million in 1985 to K1.2 billion in 1986.
- 1990 - The Gulf crisis, meteoric rise in oil price resulting in a corresponding rise in Zambia's oil bill having a ripple effect on the rest of the economy.
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APPENDIX (viii)ZAMBIA'S SCIENCE AND TECHNOLOGY POLICY AND ITS IMPLEMENTATIONTENTATIVE ORAL INTERVIEW GUIDEQUESTIONS FOR POLITICAL INSTITUTIONS

1. Recently the Government has formed the Ministry of Higher Education, Science and Technology, and the Sub-Committee of the Central Committee for Science and Technology. Which agency or agencies has, or have been formulating Zambia's Science and Technology Policy before?
2. The formation by the Government of the above mentioned two institutions seems to suggest that somewhere, somehow certain particular policy decisions for science and technology have either not been made, or if made have not been implemented, what has gone wrong which has prompted the formation of the two Government institutions for Science and Technology?
3. A look through our three National Development Plans does not indicate specific decisions made for the funding of research centres, technical data banks, scientific and technical museums and other technical institutions. How has the Government been organizing the funding of these institutions - annually, after every two or three years?
4. If Government financial support for Science and Technology has been on short-term (annual budgets) or long-term, what advantages or disadvantages of each of these modes of funding have been identified? If more disadvantages than merits were identified, has the Government taken any measures to correct the situation?

5. Local capacity in science and technology requires that the country develops, expands or modernises its scientific research centres, technological institutions and technical documentation centres. Now that we have the Ministry of Higher Education, Science and Technology, where does the Party and its Government expect to get the money to buy expensive but necessary equipment, tools, spare-parts and other machinery for these institutions in a weakening economy?
6. Correspondingly, the improvement of physical scientific and technological centres requires to be followed by the upgrading or increase of the scientific community. Now that the economy is not doing very well, how does the Ministry of Higher Education, Science and Technology, or the Science and Technology Sub-Committee intend to make progress in this direction?
7. Recently, the Government expressed concern over the exodus of various Zambian educated and trained experts going to look for brighter opportunities outside the country. What measure does the Party and its Government intend to apply to control this brain-drain among Zambian scientists researchers, engineers, technologists, etc.?
8. During the past years, the Government has been training scientists, engineers and technologists both at home and abroad. What plans has the Government previously implemented to employ these experts?
9. If many of them have remained without jobs, what new plans does, for instance, the Science and Technology Sub-Committee have to correct the situation?
10. Which groups of people have been advising the Government on funding

QUESTIONS FOR SCIENTIFIC AND TECHNOLOGICAL INSTITUTIONS

1. When the institution buys expensive laboratory and other research equipment from outside the country, do you pay import taxes or tariff duties like any one else?
2. Has Government funding to this institution been based on annual, three-year, or five year budgets. Any documents to show figures for the past years?
3. When a scientist, engineer or technologist decides to move from this institution (NORTEC, Mount Makulu, etc) to another Government scientific institution (e.g. Department of Technology, UNZA) does the Government allow the smooth transfer of his benefits for instance pension and recognition of service period accumulated at the other institution?
4. How many qualified scientific or technical staff have resigned or have left this institution to join non governmental organizations either within the country or outside the country?
5. In order to strengthen our scientific community, do you think we should worry about numbers or about something else? What should we do as a country?
6. What other additional (private) work activities do our scientists, researchers, engineers and technologists engage themselves in apart from their daily official assignments?
7. In which ways has the Government demonstrated its recognition and encouragement of individual persons of scientific talent at this institution?
8. How much exchange of scientists, engineers, technologists and consultants does the Government encourage between and among institutions within and outside the country? How has this encouragement been shown?

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9. What restrictions are put by the Government on the publication of research results in the country, and why are such restrictions instituted if any?
  10. How close is the relationship between the scientific personnel in this institution and those in industries? Do Government scientists, engineers or technologists in industries come to deliver lectures at this institution and vice versa?
  11. How many of your qualified scientists, engineers, technologists or consultants stay in hotels or are without proper accommodation?
  12. How many expatriate scientific personnel are in this institution? How were they recruited? What conditions of service apply to them which do not apply to their Zambian counterparts?
  13. Have some authorities in this institution met the political authorities in the Ministry of Higher Education, Science and Technology or those in the Science and Technology Sub-Committee to discuss policy objectives? What new ideas for Zambia's science and technology policy have they come up with?
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