

REPUBLIC OF LEBANON

NATIONAL COUNCIL FOR  
SCIENTIFIC RESEARCH

الجمهورية اللبنانية  
مكتب وزير الدولة لشؤون التنمية الإدارية  
مركز مشاريع ودراسات القطاع العام

Republic of Lebanon  
Office of the Minister of State for Administrative Reform  
Center for Public Sector Projects and Studies  
(C.P.S.P.S.)

FIVE-YEAR PLAN  
FOR THE  
ORGANIZATION AND DEVELOPMENT  
OF  
SCIENTIFIC RESEARCH  
IN  
LEBANON

INTRODUCTION

In conformity with the provisions of the bill dated September 14, 1962, (Appendix I), the National Council for Scientific Research hereby submits to the Government this first five-year Plan for scientific research in Lebanon, Article IV of said bill stipulates:

"As an advisory body to the Government, the "Council" shall prepare the general outlines of the national science policy for the development of scientific research and the optimum utilization of the country's scientific resources for the public good.

"Upon adoption by the Government of this general outline of the national science policy, the Council shall draw up and submit for the Government's approval work programmes the first of which shall be for a five-year period, embodying said policy and taking into account the economic and social objectives proposed by the Ministry of Planning and approved by the Council of Ministers. This programme shall be drawn up in consultation with the Ministries concerned".

On March 8, 1967, the Government signified their approval of the document submitted by the Council delineating the general outline for a national science policy. The provisions of the first paragraph of Article IV thus satisfied (Appendix II), it remained for the Council to satisfy the requirements of the second paragraph of the article in question. The present document thus constitutes the work programme referred to above in the bill of September 14, 1962. It aims at a concretisation of the principles of the national science policy as adopted by the Government, and this through a national programme that takes into account such human, scientific, social, economic and financial characteristics as are peculiar to Lebanon.

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It is indeed hardly necessary to justify official action in planning in the field of science; we shall therefore content ourselves to briefly expose a few particularities that render such planning especially significant in Lebanon.

Lebanon is a small country with limited human and material resources. Its aspirations, whether for a higher standard of living or an enhanced cultural standing, can therefore only be conceived and implemented through utilization of its resources, human and material, at the maximum possible efficiency.

With this in view, the necessity becomes apparent for integrating science planning into the framework of the overall national Plan. Being neither a pastime nor exclusively a domain for the sublime meandering of the spirit, scientific research can and should contribute to the material and intellectual enrichment of society and, as such, is called upon to play a leading role in the economic and social development of nations, which development cannot be conceived in our modern world without scientific progress.

In the light of the overall objectives of economic planning it would be possible to arrive at a judicious choice of subjects in the field of research - a field ever expanding and diversified through the explosive evolution of knowledge in our times.

Thus guided by social and economic objectives, and taking into consideration Lebanon's research potentials and the limited material resources at present available, the proposed plan for scientific research should aim at a coordination of effort in the various sectors of research such that the maximum benefit would accrue therefrom both in pure and applied science and thus contribute to increased productivity and a higher national income.

With this background, the proposed plan would have to go beyond the general delineations of the national science policy as laid out in the relevant document already approved by the Government. The need is now manifested for well-defined action in this purport, a need which the National Council for Scientific Research has met in the present document. It falls into two chapters, the first of which is entitled "Basic Data and Proposed Action", and the second, "The Five-Year Plan".

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CHAPTER I

BASIC DATA AND PROPOSED ACTION

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1. OBJECTIVES OF THE NATIONAL PLAN

On May 11, 1967, and in conformity with the provisions of Article IV, bill of September 14, 1962, the National Council for Scientific Research wrote the Ministry of Planning requesting statement of the overall objectives of the national Plan, which would then guide the Council in drawing up a plan for scientific research in harmony with said objectives.

In their reply dated 16 June 1967 (Annexe III), the Ministry of Planning defined these objectives, which may be summarized as follows:

- Maximum regular increase of the national income;
- Equitable distribution of the national income among citizens;
- Full employment ;
- Establishment of an equilibrium among the various economic sectors;
- Rational distribution of the population over the territory of Lebanon.

To attain these objectives within a framework of proper planning, it would be necessary to make the fullest possible use of the following:

- natural resources
- human potential
- modern science and technology

The research plan detailed hereinafter has been drawn up with these objectives in mind, and in full consideration both of the economic five-year Plan approved by the Government on April 21, 1965 and of the already available data of the next five-year Plan which the Ministry of Planning is in the process of drawing up.

## 2. THE ECONOMIC AND SOCIAL MILIEU OF LEBANON AND ITS DEVELOPMENT REQUISITES

The conditions relevant to the development of Lebanon may be gleaned from a brief review of its physical and demographic characteristics, and its economic and social situation; it is from these considerations that the general objectives of science planning emerge.

### 2.1 Physical characteristics

Lebanon is a small country (10.000 km<sup>2</sup>) with an accentuated relief and two mountain chains that run parallel to the shore line and attain a height of some 3000 meters above sea level.

Its maximum length is about 200 km in a North-East direction, while its maximum width, in an East-West direction, is about 50 km. To the West, it borders the sea with a shoreline 200 kms. long.

Its terrain is 50% rocky and appears to be lacking in economically exploitable mineral resources.

Its climate is varied, running from the marine to the continental, and is characterized by a rainy season of five months (November to March) and a dry season of seven months (April to October).

The soil is karstic and permeable (almost entirely secondary); this condition, together with heavy but badly distributed rainfall, makes the soil lose the larger part of surface waters; there exist, however, important underground reserves that should be tapped.

The flora is as varied as the climate and the topography; forests have been depleted through short-sighted exploitation. As to fauna, the country is relatively poor therein and presents no characteristics worthy of note.

### 2.2 Demography

The resident population in Lebanon is estimated at 2 700 000, of which nearly 500 000 are foreigners.

The emigrant Lebanese population, which is to be encountered in almost all countries of the World, numbers no less than the resident population; about one-third of the emigrants have kept the Lebanese nationality.

Population density is 250 persons per square kilometer, and the population is equally distributed between town and country,

The annual rate of population growth varies from 2.3% to 2.5%. On the whole the population is young, 50% of it falling between the ages of 18 and 65.

There is a noteworthy tendency to migrate into the cities, and also to emigrate abroad. As elsewhere in the world, the Lebanese citizen seems to seek lucrative posts requiring little physical effort.

The foregoing characteristics of demography and social evolution give rise to the problem of creating work for the new generations. In this respect it appears necessary to orient Lebanese youth and to create jobs for them in those sectors that seem best adapted to their propensities: research and technical innovation, engineering, mechanization of industry and agriculture.

### 2.3 The economic situation

The principal economic activities and the respective importance of each are set out in the following summary table drawn up from relevant documents published by the Ministry of Finance.

.../...

(see over)



DISTRIBUTION AND EVOLUTION OF THE G.N.P.

(in million of L.P.)

Activity	1964	1965	Variation % 65/64	1966	Variation % 66/65	1967	Variation % 67/66
Agriculture, breeding, fishing	381,0 <i>11,9%</i>	409,2 <i>11,6%</i>	7,4	441,7 <i>11,4%</i>	7,9	426,1 <i>11,1%</i>	-3,5
Water and Energy	69,4 <i>2,2%</i>	77,8 <i>2,2%</i>	12,1	87,5 <i>2,3%</i>	12,4	93,3 <i>2,4%</i>	6,6
Industry and handicrafts	410,6 <i>12,8%</i>	462,4 <i>13,1%</i>	12,6	511,9 <i>13,2%</i>	10,7	492,6 <i>12,9%</i>	-3,8
Construction	178,3 <i>5,6%</i>	200,4 <i>5,7%</i>	12,4	231,2 <i>5,9%</i>	15,3	195,5 <i>5,1%</i>	-10,6
Transport and communications	258,2 <i>8,1%</i>	290,8 <i>8,3%</i>	12,6	309,5 <i>8,0%</i>	6,4	329,4 <i>8,6%</i>	6,4
Housing	250,0 <i>7,8%</i>	269,1 <i>7,6%</i>	7,6	284,0 <i>7,4%</i>	5,5	300,0 <i>7,9%</i>	5,6
Finance	108,0 <i>3,4%</i>	124,5 <i>3,5%</i>	15,3	141,0 <i>3,8%</i>	13,2	149,2 <i>3,9%</i>	6,5
Other services	271,5 <i>8,5%</i>	320,2 <i>9,1%</i>	17,9	357,3 <i>9,2%</i>	11,6	336,7 <i>8,9%</i>	5,8
Commerce	1028,2 <i>32,1%</i>	1085,2 <i>30,8%</i>	5,5	1183,4 <i>30,6%</i>	9,0	1160,5 <i>30,4%</i>	-2,0
Administration	244,8 <i>7,6%</i>	283,8 <i>8,1%</i>	15,9	319,2 <i>8,2%</i>	12,5	336,8 <i>8,8%</i>	5,5
Total	3200,0	3523,4	10,1	3866,7	9,7	3820,1	-1,1

Figures in italics refer to the share of the sector in the G.N.P.

It will be noted that while the growth rate is satisfactory, yet there is a preponderance of tertiary activities (Commerce and Services), while Agriculture and Industry occupy a modest position. This explains why planners are striving to strengthen these two sectors in order to arrive at a more satisfactory equilibrium among the varied resources of Lebanese conomy.

### 2.3.1 The primary sector

Agriculture is a basic activity in Lebanon; it is currently engaged on fruit production, on wheat in dry farming areas, and on vegetables and beet-root in the Beka'a. Nearly half the population is engaged, part-time, in Agriculture, as well as a major part of the available non-Lebanese manpower (mostly Syrian).

Agricultural development must be envisaged through rational irrigation, increased yields, the adoption of new and better cash crops, and, finally, through mechanisation. One major element of stability can be brought to agricultural development through proper marketing and the establishment of agricultural industries.

Breeding is also an important source of revenue; aviculture is already very prosperous, and enlarged herds will help diminish the country's deficit in animal proteins when research has helped combat epizootic diseases. In the same line of thought fishing, which to-day is still very artisanal, can be expected to greatly develop on the strength of oceanographic research on Lebanese territorial waters as well as on the high seas.

In this primary sector, we find a restricted use made of local raw materials (rock, marble, clay, sand, salt). It is therefore important to establish methodical inventories that will make known the potential resources of Lebanon in this domain and thus contribute to their planified development.

### 2.3.2 Secondary sector

Industry is still in its adolescence in Lebanon. Heavy and medium industries (cement, fuel, fertilizers) feed construction, transport, and agriculture. The other industries are light and varied - textile, clothing, food-stuffs, packaging, some construction materials, chemicals etc...)

Lebanese industry suffers from an exiguous home market, an insufficient proficiency on the level of labour and management, and a lack of local raw materials.

The industry sector, however, has so far indicated a satisfactory growth rate (11% annually since 1960) which must be maintained.

All this requires the methodical prospection of our natural resources, followed by development research thereon, the adoption of perfected or new techniques adapted to the social and physical milieu, and the seeking and eventual entry into foreign markets.

### 2.3.3 Tertiary sector

#### 2.3.3.1 The private sector

Commerce in Lebanon is characterized by a great vitality that spreads beyond the national borders. In addition, it plays in many countries the role of middleman in commercial transactions.

Banking occupies a privileged position. After a period characterized by imprudent action in many an establishment, the banking sector is now in the process of a thorough and rational re-appraisal and reorganisation. But it is noteworthy that there is a lack of banking establishments for long and intermediate term loans.

Tourism is a very important resource the development of which requires adequate facilities in tourist accommodation, as well as the conservation of natural sites and the embellishment of our urban agglomerations in accordance with modern planning.

Other services and resources complete a sum-total of activities that bring into Lebanon invisible assets that permit it to square off its balance of payments, and this in spite of the considerable deficit encountered in its commercial exchanges.

The following is a table showing this deficit for the years 1966-1969:

	IMPORTS 1000 L.L.	EXPORTS 1000 L.L.	DEFICIT 1000 L.L.
1966	1 913 707	369 465	1 544 242
1967	1 769 992	453 347	1 316 645
1968	1 865 087	510 261	1 354 826
1969	2 006 431	554 301	1 452 130

2.3.3.2 The public sector

In so far as services are concerned, the public sector plays an important role therein, since it represents an annual spending potential of nearly one billion Lebanese pounds; in addition, it keeps busy some 50 000 persons and thus contributes to the creation of the infrastructure necessary for economic and social development.

Its contribution , which should be based on research, embraces principally the following:

- establishment of an inventory of natural resources and determination of the best conditions for their utilization (soil, climate, water, minerals...)
- elements of infrastructure (roads, harbors, airports, energy, telecommunications, irrigation, urban development)
- maintenance of the infrastructural elements ,
- public health ,
- defense ,
- education ,
- social development.

3. OBJECTIVES OF SCIENTIFIC PLANNING

The economic and social development of a modern society can no more be envisaged without a parallel development of scientific research. We are, however, called upon to choose from the vast domain of subjects open to the research worker, such thereof as would be in conformity with the objectives set out by the Ministry of Planning.

The summary analysis presented above of Lebanon's economic and social situation permits us to delineate the objectives of scientific planning, which may be more explicitly stated as follows:

- objectives relating to social and economic development;
- objectives relating to cultural and scientific development;
- objectives relating to Lebanon's cultural position in the World.

3.1 Objectives relating to social and economic development

- 3.1.1 Establishment of an inventory wherein shall be defined the possibilities of natural resources and human potential.
- 3.1.2 Development of applied research in the fields of agriculture, industry, building, health, human sciences relating to social and economic development; special consideration should be given to projects expected to yield quick and positive results.
- 3.1.3 Creating, through research, new jobs adapted to social and demographic tendencies.

3.2 Objectives relating to scientific and cultural development

Encouragement and development of fundamental research with a view to:

- valorise higher education;
- progressively reinforce scientific potential;
- conduct applied research.

3.3 Objectives relating to the Lebanon's cultural position in the world

- 3.3.1 Participation in international science conferences.
- 3.3.2 Development of fundamental and applied research projects of international value, and, eventually, of an international cooperative nature.

4. THE CRITERIA OF PRIORITY

In drawing up the present five-year Plan, the National Council for Scientific Research established, for its own purposes, criteria of priority according to which it would be possible to classify research themes and projects and to choose such that are in conformity with the general objectives of economic and social development as well as with those of scientific planning.

These criteria of priority helped guide the consulting committees in the propositions they submitted to the Council .

For each research theme or project, priorities have been assigned in accordance with the following criteria:

- The economic or social benefit of the theme or project to Lebanon or the surrounding region;
- the scientific interest;
- probability of success;
- possibilities for conducting the proposed research in Lebanon;
- duration;
- cost.

5. LEBANON'S SCIENTIFIC POTENTIAL AND MATERIAL RESOURCES

The elaboration of a realistic plan of action requires an exact assessment of the actual scientific potential in Lebanon, including such scientists as are presently pursuing their higher studies abroad. To this must be added a proper evaluation of such material means as can be utilized for research during the coming five years.

A first step in this direction was taken in 1964 when UNESCO sent Mr. W.R. Klappacher to effect such assessment; his report has been up-dated by the Council Secretariat in 1968.

The document relating to said report is appended to this Plan (Appendix IV)

The actual scientific potential may be summarily stated as follows:

<u>INSTITUTION</u>	<u>NO. OF RESEARCH UNITS</u>	<u>PERCENTAGE OF TOTAL</u>
American University of Beirut	30	54.5
St. Joseph University	6	11.0
Centre d'Etudes Mathématiques et Physiques	2	4.0
Ksara Observatory	1	1.5
Agricultural Research Institute	13	22.0
Industry Institute	1	1.5
Ministry of Public Works	2	4.0
Ministry of Public Health	<u>1</u>	<u>1.5</u>
Total	56	100

Other institutions that could be equipped to undertake research include:

- The Lebanese University
- Hospitals
- Green Plan
- Litani Office
- Electricity Authority

It is noteworthy to mention that nine research contracts have so far been awarded to researchers at the Lebanese University.

CLASSIFICATION OF RESEARCH UNITS

a) <u>Relation with Universities:</u>		
-University institutions	38	69.50%
-Non-university institutions	18	30.50%
b) <u>Field of Activity</u>		
-Chemistry	1	1.75%
-Physics	2	3.50%
-Mathematics	2	3.50%
-Applied Science	10	17.85%
-Biology	3	5.40%
-Medicine and Pharmacy	21	37.50%
-Agriculture	17	30.50%

c) Administration

Lebanese	17	30.00%
Foreign	39	70.00%

BUDGETS AND RESOURCES

-Total budget 13 million L.L. (compared with only 4 million L.L. in 1964)

Distribution:

American University	59%
French Institutes	2%
Lebanese Institutes	39%

Resources:

State budget	33%
American University	49%
French Institutes	2%
International aid	16%

Allocation of international aid:

American University	61%
Lebanese research units	37%
French Institutions	2%

Expenditure:a) by type:

-Salaries and remuneration	63%
-Equipement	22%
-Miscellaneous	15%

b) by activity:

-Applied research	33%
-Teaching	24%
-Accessories	22%
-Fundamental research	21%

c) by field of activity

-Medicine	26%
-Agriculture	31%
-Natural Science	22%
-Applied Science	21%



RESEARCH WORKERS

At present there are in Lebanon 290 research workers, full-and part-time; this number represent 253 researchers at full-time.

Distribution of Research Workers:

a) In institutions

American University	205
French Institutions	19
Lebanese Institutions	66
	<u>290</u>

b) In field of research

Medicine	108
Agriculture	75
Natural Science	73
Technology and Applied Science	34
Mathematics, Physics, Chemistry	-
	<u>290</u>

c) In relation to degrees

Doctorate	136
"Licence" or M.S.	99
B. Sc.	55
	<u>290</u>

d) In relation to nationality

Lebanese	170	or 59%
Arabs	31	or 10%
Foreigners	89	or 31%

RESEARCH ASSISTANTS

Skilled	154
Non-skilled	215

The various tables above, relating to existing research potentials in Lebanon (1967-1968) lead to the following observations:

The American University possesses the largest number of research units and the most in financial and human resources. It alone receives 61% of all international financial aid to Lebanon. It is to be noted, however, that a considerable part of the University's potential is oriented to teaching; also, that the material equipment is extremely satisfactory.

French institutions harbor very good researchers, but are lacking in financial support and possess insufficient equipment. Their possibilities can be greatly enhanced through financial support and added research personnel.

Lebanese research units are lacking in means, in researchers, and in objectives.

The Agricultural Research Institute is well equipped; but though research assistants are sufficient in numbers, the number of principal scientific investigators is not in proportion to its financial standing.

The Lebanese University, the new site of which is now being built, will be given special attention by the Council in order to help develop research therein.

The respective laboratories of the Ministry of Health, the Ministry of Public Works, the Industry Institute, and such others that could be co-opted to research, are at present engaged only in routine matters; they lack trained researchers as well as pertinent research programmes and the funds necessary for doing research.

The remuneration of qualified research workers, in the Lebanese research sector, is insufficient.

The National Council for Scientific Research will therefore strive to draw up a research programme and coordinate around it the available scientific potential. Thus weaker units will be strengthened according to their needs and oriented in directions expected to yield positive results; also a system of remuneration for research workers will be instituted aiming at improving their pay and conditions of work.

In so far as increasing the present research potential, the Council undertook, since its inception, granting fellowships to qualified university graduates. Their number totals some 140 to-day.

The table in Annex V shows the distribution of Council fellowships by year and field of specialization.

In conclusion, it may be said that the research potential in Lebanon is at a level that would make possible carrying out the present five-year Plan.

6. CONTRIBUTION OF SCIENTIFIC CIRCLES IN THE PREPARATION OF THE PLAN

The eventual success of a plan for the development of scientific research cannot be envisaged without its acceptance by the scientific circles and the cooperation of research workers therein. That is why the Council decided to associate researchers in Lebanon in the elaboration of the present Plan.

Thus, Consulting Committees were constituted wherein men of experience exchanged views and recommended pertinent action (Appendix VI).

Thirty such committees, totaling a membership of 142, gave the Council the benefit of their deliberations.

In order to maintain a measure of homogeneity in their work, the Council issued a set of directives (Appendix VII) which were presented to said committees. The Scientific Advisers in the Council Secretariat convened these Committees and provided them with the necessary secretarial services.

The reports of the Committees embodied such research projects as were proposed by each, together with a brief appraisal of their scientific value, the probability of success, their duration and cost (Annex IX).

These reports constitute an important contribution for the elaboration of the present five-year Plan and for the orientation of scientific research in Lebanon.

The National Council for Scientific Research hereby pays tribute to all those who took part in this cooperative endeavour.

7. INTERNATIONAL COOPERATION

During the early phases of preparation of the present Plan, the Council benefited on several occasions from the support of UNESCO, which sent several experts to help and counsel.

The missions of Dr. BLOUNT and Mr. WACRENIER had already indicated the general orientation to be followed. They were followed by Professor PIGANIOL, who made three trips to Lebanon; his enlightened advice has been of great value to the Council in conceiving the present plan and its framework. (Appendix VIII).

The National Council for Scientific Research wish hereby to express their sincere thanks to UNESCO, to Mr. de HEMPTINNE, Director of the Science Policy Division at UNESCO, and to Professor PIGANIOL.

CHAPTER II

THE FIVE-YEAR PLAN

FOREWORD

*Having described in the preceding chapter the methodology adopted for the elaboration of the present Plan, we shall now proceed to present the Plan, itself the result of extensive analysis and selective synthesis.*

*This presentation starts with a general outline of the major poles around which the various proposed projects are to be grouped. This will be followed by a description of the means the Council intend to use for the implementation of the Plan; thus man and machine will each assume the complementary role that would permit the optimum benefit to accrue therefrom. Finally a brief exposé will conclude this chapter, wherein the economic and social impact of the plan is discussed and an analysis made of the financial means necessary to ensure the success of this great task.*

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1. MAJOR FACETS AND THEMES

1.1 Major Facets

We shall strive here to clarify the formal structure of the present Plan in its major facets and the various phases according to which shall be methodically arrayed the proposed research projects.

The general set-up of this exposé has already been incorporated in the document relating to the national science policy. This document carried the definition of fundamental and applied research on the one hand and, on the other, oriented and non-oriented research (see paragraph 5.4.3, Appendix II).

The distinction between oriented and non-oriented research should be taken up here once again, since planning can only apply to oriented research, both fundamental and applied. On the other hand, non-oriented research must remain free, obeying only such criteria as are limited by the Council's finances and such developments as reflect the major scientific trends.

We shall therefore start by setting forth, once for all, the position of the present Plan vis-à-vis non-oriented research. This will be followed by a fuller statement of the orientations envisaged in this first Five-Year-Plan.

1.1.1 Non-oriented research

This type of research is, by definition, not amenable to planning. The Council therefore intend to leave it free and appropriate it with 20% of the total sum earmarked for research. The justification for this has already been presented and will not therefore be dwelled further upon.

It should be noted that in this domain fundamental research is largely predominant over applied research.

The Council believe that maintaining and encouragement of free research, especially fundamental research, acts as a dynamic support to higher education and a substratum for applied research. The scientific position of Lebanon on the international scene requires the freedom of action that makes for success in this domain.

In response to the objectives of planning as detailed in Chapter I, especially paragraphs 3.2 and 3.3 thereof, and in conformity with the need to favor cultural and scientific development and enhance Lebanon's position on the international scene, the National Council for Scientific Research will support non-oriented research within the limits prescribed.

There exist, in addition, other justifications for this attitude, chief among which is the difficulty which the Council find in predicting the reaction of the scientific milieu to a scientific five-year plan, and the fact that Lebanon still lacks research units well structured and already specialized, that would thus ensure the successful undertaking of oriented research.

As already explained in the document on national science policy, this Council plan to adopt a pragmatic and experimental policy excluding all rigidity; this, it is felt, will allow scientific research in Lebanon to fully develop before it can become directed into avenues that would appear too rigid at present.

However, one limitation to this liberal attitude is imposed by the modest financial means at the disposal of scientific research in Lebanon; thus any non-oriented and costly research cannot be financed; that is why the Council have limited the appropriations of non-oriented research to a maximum of 20% of the overall sums allocated to all research.

At the same time the Council will take it upon themselves to advise researchers to avoid such orientations as appear hopeless or too costly. To this effect, competent experts have been consulted and have suggested, for the time being, the following domains:

Mathematics: analysis, algebra, geometry, topology

Physics: acoustics, thermodynamics, very high and very low temperatures, optics, high voltage, solid-state, electronics, theoretical physics.

Chemistry: catalysis, corrosion, micro-analysis.

The Council plan to maintain permanent contact with international experts in order to keep its information on the above subjects up -to-date.

### 1.1.2 Oriented research

#### 1.1.2.1 Fundamental and applied research

The major part of the Council's efforts in drawing up the present plan was consecrated to oriented research, both fundamental and applied, with special emphasis on the latter. This was because research should contribute to Lebanon's economic and social development, thus to attain objective 3.1 of the preceding chapter.

Consequently such research projects as shall be undertaken must be chosen with a view to a practical application of the expected results, and this after a reasonable period of time and at costs within Lebanon's possibilities. That is why applied research had to be given greater consideration than fundamental research within the context of the present Plan.

#### 1.1.2.2 Stages of research development

In consideration of the stages of execution of a science research plan the various projects retained may be classified as follows:

- inventorial research, corresponding to the exploratory phase;
- innovative research, corresponding to the inventive phase;
- exploitative research, corresponding to the development phase.

Inventorial research is necessary in order to define problems and take all available data into account; a considerable effort has already been made in this direction in Lebanon, but a lot remains to be done on a strictly scientific basis.

Innovative research is really the core of it all; the Council have assigned it an important role which, however, is often conditioned by the necessity of carrying out, first, the corresponding inventorial research.

Finally, exploitative research is essentially applied research, and is undertaken when innovative research has attained its objectives. This phase is the most costly, requiring considerable material means that can be expended only when the results are certain.

#### 1.1.2.3 Beneficiary domains

The principal domains that stand to benefit from oriented research within the framework of this plan are the following:

- the natural milieu and resources
- the human milieu
- the technical infrastructure
- the elements of productivity

## 1.2 The Themes

Two main ideas directed the eventual choice of the research projects incorporated in this Plan :

- oriented research should lead to concrete results that would effectively contribute to the country's economic and social development;
- Lebanese scientific potential, present and future, must be fully utilized, and this by concentrating on subjects that would require contribution from several sources - subjects that lend themselves to what may be called "concerted action".

In its very essence, this Plan aims to *"develop a more profound scientific knowledge of the Lebanese milieu in all its aspects, and to solve the problems of this milieu where this would lead to a continuous and rapid betterment of human conditions"*: this is indeed its general theme.

In this general context, the projects incorporated are grouped around more specific themes in fields of "concerted actions", i.e., where a number of projects derive from varied disciplines but have all a common aim. This engenders among the various research teams, each working in its specialized field, a feeling of solidarity and a desire for cooperation that are both enriching and fruitful.

The themes for "concerted actions" which have been assigned top priority in this Plan are the following:

- Lebanese climate: bioclimatology and technoclimatology ;
- the conservation of the natural milieu ;
- health and disease in Lebanon: heredity, parasitoses, epidemiology, nutrition, hygiene;
- housing: urban and rural development ;
- the elements of production: Lebanese raw materials, soil and water, marine resources.

## 2. THE PROJECTS

Before embarking on a more detailed description of the projects incorporated in this Plan it should be emphasized that their number and estimated costs are in no way binding to the Council; the only things that count are the major facets and themes. This is so because a five-year plan, especially in scientific research, cannot foretell future developments and must therefore remain flexible in order not to tie research within a rigid framework and for a long period. Flexibility becomes therefore of the essence, since it permits the adaptation of effort to the current exigencies of development.

The description of the projects should not therefore be considered either exhaustive or limitative, since the Council deem it necessary that future action be tailored according to the developments that come to light, but always within the framework of the major themes referred to above.

### 2.1 General Outline

#### 2.1.1 Natural resources

Lebanon's economic and social development is conditional on the rational utilization of its natural resources: sub-soil, soil, atmosphere, sea, climate, flora and fauna.

##### 2.1.1.1 Inventorial research

It is necessary in this connection to identify and localise these resources and to know their extent and characteristics. Research in this domain would include:

- geophysics (sismology, magnetism , gravity)
- climatology (rainfall, evaporation, humidity, sunshine, nebulosity, wind, temperature, atmospheric pressure, atmospheric electricity)
- hydrology: surface and underground (hydrogeological maps, underground currents and reservoirs)
- geology, minerology and prospection
- pedology
- the marine milieu (oceanographic inventories)
- the flora and fauna of Lebanon.

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### 2.1.1.2 Innovative research

The general themes under this heading are:

- evolutive tendencies of the natural milieu;
- statistical correlations in climatology and their interpretation;
- identification and industrial utilization of Lebanese raw materials (clays, basalts, plant extracts);
- localization and recharging of underground water reservoirs;
- conservation of nature.

### 2.1.1.3 Exploitative research

Research in this connection would follow innovative research projects the results of which show promise.

## 2.1.2 The human milieu

The main interest here lies in research into the biological and pathological characteristics peculiar to the Lebanese population or to certain ethnic or social groups thereof, and the means of combating such diseases as are prevalent among them.

### 2.1.2.1 Inventorial research

Research projects may be divided among the following main topics:

- genetic and biological characteristics of groups;
- mortality its rate, tendencies and causes;
- the effect of environment.

### 2.1.2.2 Innovative research

Based on statistical and clinical data, innovative research will aim at a more profound knowledge of the mechanisms of causality, and attempt to deduce therefrom the basis for preventive or curative therapies.

### 2.1.2.3 Exploitative research

Exploitative research here would attempt to utilize the advantages of environment in perfecting preventive or curative therapies.

2.1.3 The technical infrastructure

In this vast domain it was necessary to limit ourselves to such subjects where the returns would not be too long coming. Our choice led to the following:

- local building materials;
- soil mechanics and foundations as apply in Lebanon;
- the influence of climate and materials on the choice of types of road foundations and surfaces;
- rational urban developement in a Lebanese context;
- solution of local problems in applied hydraulics;
- the generation and transport of electric energy in Lebanon.

These subjects will each constitute, according to its nature and the specific problem envisaged, the point of departure for research of an inventorial, innovative or exploitative nature.

2.1.4 Production activities

Under this heading we shall single the fundamental activities in which research plays a major role, i.e., agriculture and industry. Scientific research can provide both agriculture and industry with the dynamic qualities indispensable for their development; this it can do through increased production at lower costs. It is with this aim in mind that we now offer the following general directives.

2.1.4.1 Agriculture and livestock farming

As already mentioned in Chapter I, agriculture occupies an important place in Lebanon's economy due to its impact on nearly half the population. Agricultural research should therefore be foremost in the general development effort.

2.1.4.1.1 Inventorial research

- identification of local varieties and breeds and assessment of their productivity, resistance to pathological agents, adaptation to soil and climatic conditions;
- identification of local parasitoses and viral diseases and the study of their symptoms and characteristics;



- increased knowledge of soils and micro-climates;
- marine species and their characteristics.

2.1.4.1.2 Innovative research

-increasing productivity through:

- the selection or development of varieties or species with high yield;
- the selection or development of varieties or species resistant to parasites;
- the perfection of products and techniques for combating disease and parasites;
- the elaboration of means for increasing productivity in marine species.

-reduction of production costs through optimisation of:

- cultivated varieties;
- irrigation conditions;
- fertilizer utilization;
- methods of combating disease and parasitoses;
- mechanization;
- better nutrition for cattle;
- better conditions for fishing.

2.1.4.1.3 Exploitative research

Here again research will be undertaken where innovative research produces encouraging results.

### 2.1.4.2 Industry

Mention should be made, at the start, of the difficulties raised by a scientific research policy aiming at industrial objectives. Scientific industrial research is normally the concern of the private industrial sector and should be financed by it, since it is the one that stands to benefit directly from such research. Some even think that any incursion of the public sector in this domain would be unjust and inopportune. In fact a survey undertaken by the Council revealed that industrialists were quite in agreement with this opinion, for the larger industries are generally connected with international concerns that provide them with the necessary know-how, while the production and restricted activities of small industries keep them away from the preoccupations of scientific research. Furthermore, it is a fact that in Lebanon the commercial aspect of industrial activity takes clear precedence over the technological and scientific aspect. Finally, it must be emphasized that this industrial research will be of an exploitative nature, and thus too costly for the limited financial means of the Council.

In spite of these difficulties the Council deemed it necessary to give industrial research the importance it deserves in this first Plan. The imperatives of this decision derive from the necessity of finding outlets for the ever-increasing agricultural production through the establishment of agricultural industries; also it is necessary to furnish Lebanese industrialists with proof as to the positive contribution scientific research can make to industry. A major concern of the Council will therefore be to interest Lebanese industrialists in this policy and secure their association thereto.

The proposed action in this domain resolves itself as follows:

#### 2.1.4.2.1 Inventorial research

- an analytical study of the technological and scientific needs of existing Lebanese industries;
- a research infrastructure that would support prospective industrial development ;
- an inventory of local raw materials, as described in 2.1.1. above.

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and Studies

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Center for Public Sector Projects and Studies  
(C.P.S.P.S.)

2.1.4.2.2 Innovative research

Research here would aim at the best possible utilization of local raw materials identified through inventorial research; this will be done by methods of production adapted to these raw materials and to conditions relating to local labour and markets.

2.1.4.2.3 Exploitative research

- Perfection or improvement of current manufacturing procedures and processes.
- Improvement in building materials better adapted to local climates and utilizing indigenous raw materials.
- Adapting manufacturing procedures to the utilization of agricultural products in industry.

### 3. WAYS AND MEANS OF IMPLEMENTATION

Success in carrying out the programme presented above requires adequate organization both in equipment and human potential.

It is obvious that to undertake the proposed programme it is necessary to rally qualified full-time researchers and provide them with proper equipment and such other means as may be required by the nature of the particular research project under examination.

We therefore wish to present the measures which the Council would adopt, within the context of this Plan, in order to ensure success to the proposed programme of action.

#### 3.1 The Researcher Status Code

The co-opting of qualified researchers requires that they be provided with the material and moral assurance that would put them in the optimum situation for satisfactory output.

In this connection it is necessary to allude principally to the attractions offered by foreign countries already advanced in scientific research - attractions both material and environmental.

To help circumvent this situation it is proposed to adopt a status code for researchers and research auxiliaries that would make it possible for them to attain satisfactory conditions of work. The principle of such a status code has already been approved in the document relating to national science policy.

##### 3.1.1 Principal features and field of application

The code was conceived to be flexible and of general relevance; this was due to the legislation governing the modality of the Council's involvement in research and to the diversity of such institutions as will be called on to cooperate within the framework of scientific research.

Thus the code establishes the minimum standards of remuneration and work conditions for researchers. It applies to all those doing research work contracted for with this Council, but should also serve as criteria for Universities and Public Institutions, and this either by modifying their current status code or through a complementary contribution from the Council.

It is obvious that the adoption of a more advantageous status code is not objectionable although it might give rise to some competition within the profession.

### 3.1.2 Content

The status code consists of the following:

- a definition of "researcher" as designated by the code, and a classification of researchers in accordance with their academic degrees, length of service, and achievement;
- a definition of the modalities of work for various researchers and the obligations attendant on each;
- a scale of remuneration, allowances and other indemnities relating to the classification and modalities of work;
- similar provisions to the above, but applying to research auxiliaries.

### 3.1.3 Main provisions

#### 3.1.3.1 Definition of "researcher"

The term "researcher" refers to any person possessing the required qualifications and consecrating his time wholly or partly to research.

#### 3.1.3.2 Qualifications of researchers.

##### Level A

- Lebanese "Licence"
- French "Maîtrise"
- M.A.
- Other diplomas recognized by the Council as equivalent to the above

##### Level B

- French doctorate "troisième cycle"
- Ph.D.
- Diplomas or achievements recognized by the Council as equivalent to the above.

##### Level C

- French "Doctorat d'Etat" followed by the years of research
- Ph.D. followed by two years of research
- Diplomas recognized by the Council as equivalent to the above, followed by two years of research
- Original contributions equivalent to those expected from the holder of a "Doctorat d'Etat" after ten years of research.

These qualifications shall be admitted by the Council upon proposals submitted to them by special committees constituted by :

The Secretary General of the Council as President  
The relevant Scientific Adviser as Rapporteur  
Three Lebanese or foreign scientists designated by the Council for each field of science

Their task will be to submit to the Council pertinent proposals in the following matters:

- a list of diplomas relating to each level of qualification
- an appraisal of original scientific research undertaken
- an appraisal of trainees' aptitude for research
- proposals for compensation or advancement to researchers whose results attest exceptional merit.

3.1.3.3 Work conditions and duties

Research workers shall be classified into three categories with respect to the time devoted by each to research :

- 1- Full time researchers, exercising no other remunerative occupation;
- 2- Researchers who also teach at higher institutions and have no remunerative occupation other than research and teaching. In this case teaching shall be limited to not more than six hours per week;
- 3- Part-time researchers who devote to research at least a third of their time and whose other remunerative activities are compatible with the research project they propose to undertake.

3.1.3.4 Scale of remuneration for full-time researchers

In order to free full-time researchers from preoccupations that limit their efficiency, the Council adopted a scale of remuneration practically analogous to that applicable to full-time professors at the Lebanese University.

Full time researchers will be classified into three categories, each comprising eight steps. Advancement from one step to the next higher requires two years.

The following is the proposed classification and monthly salary for each of the three categories:

Research Assistant	825 - 1500 L.L.
Research Associate	1300 - 2200 L.L.
Principal Investigator	2000 - 3400 L.L.

Research assistants will be recruited among researchers from levels "A" and "B", and research associates, from level "C" (see 3.1.3.2 above) Principal investigators will be promoted to this rank from among research associates who have demonstrated their professional merit.

#### 3.1.3.5 Remuneration for part-time researchers

It is believed by the Council that part-time researchers should be on equal footing with full-timers in so far as total earnings are concerned, provided that not less than 75% of their time be devoted to research and not more than 25% to higher teaching.

Part-time researchers shall be remunerated on a pro-rata basis of the time allotted to research in accordance with the scale in 3.1.3.4 but after deducting therefrom an amount equivalent to 10% thereof.

#### 3.1.3.6 Research auxiliaries

These will be recruited from among technicians at various levels; they will be required to provide all scientific and technical services that would allow researchers to work at maximum efficiency.

They will be classified into three categories of two grades each:

##### Category "A"

Recruits to this category must be engineers or holders of equivalent university diplomas; their salary scale extends from 825 L.L. to 2200 L.L. per month.

##### Category "B"

Recruits here must be holders of the "baccalauréat technique" or equivalent diplomas; their salary scale extends from 450 L.L. to 1200 per month.

##### Category "C"

Recruits must be holders of a "brevet technique" or be qualified and experienced operatives; the salary scale extends from 250 LL to 850 LL per month.

### 3.1.3.7 Indemnities and other advantages

Researchers will be entitled to all social security benefits applicable to Government personnel.

## 3.2 Formation of researchers

Immediately after it was established, the national Council for Scientific Research adopted a long-term policy in order to continuously provide Lebanon with qualified researchers; this is a fundamental and essential measure on which depends the success of any plan for the development of research in Lebanon.

As early as 1963 the Council started awarding an average of 20 scholarships every year to qualified university graduates wishing to continue their higher education towards a doctorate degree.

Candidates must already be holders of the "licence", or M.A., M.S., B.Sc., or a diploma in engineering. They must agree to pursue their studies until obtention of the "Doctorat ès Sciences" or the Ph.D. in a field of specialization acceptable to the Council. Upon termination of their studies they must agree to return to Lebanon and to work under the directives of the Council for a period equal to twice the duration of their scholarships.

A list of Council fellowships is appended to this Plan, from which list it may be seen that some 75 new researchers have been added, through Council fellowships, to the scientific research potential of Lebanon for the present Five-Year Plan.

During the next five years the Council intends to pursue this policy but will direct it, more specifically, to serve the needs defined in this Plan.

With enhanced possibilities of research in Lebanon, it will become possible to help develop researchers locally. A start in this direction has already been given for holders of the "Doctorat 3ème cycle" of France whose supervisors have consented that they pursue their research in Lebanese institutions.

Finally, and with a view to encourage the scientific spirit in primary and secondary schools and develop the propensity for specialization later in science, the Council envisage the establishment of a Science Museum and the inclusion of scientific programmes in radio and television broadcasts.

## 3.3 Research units

Modern research methods give a particular importance to team research, since then each worker can go deep into his own particular interest; the team thus arrives at a more fertile cooperation resulting from several workers concerting their efforts from various angles towards a common objective.



The National Council for Scientific Research will seek all means by which to favor the formation of such teams in Lebanon, starting with those fields of research that best lend themselves to such measures in Lebanon: oceanography, geophysics, hydrology, geology, climatology, biology. The Council intend , when the need arises, to establish specialized institutes that would provide the necessary administrative and technical framework for these research teams.

### 3.4 The Logistic Support to Research

Scientific research to-day requires extensive and important material means if it is to bear fruit. In big and rich countries, such means are not lacking at the level of large research units.

But in Lebanon, financial means are so limited that it is imperative to concentrate their utilization in order to extract therefrom the maximum possible efficiency. Thus the Council decided to centralize under its aegis a few such research facilities and place them at the service of researchers in Lebanon; this, it is hoped, will avoid a duality of efforts as useless as it is costly.

The fields selected by the Council for such logistic support to research are:

- Documentation;
- Computer center ;
- Heavy scientific equipment ;
- Original scientific equipment,  
their development and maintenance

#### 3.4.1 Documentation

Knowledge of what has been, or is being done, in a particular field of research is of primary importance to all those engaged in the same line and constitutes a necessary step to ensure efficiency in further envisaged development of the subject.

The Council have therefore included in the present Plan the priority establishment of a Documentation Centre adapted to the present needs of Lebanon but capable also of further rational development concomittant with the increasing needs of Lebanese researchers.

### 3.4.1.1 Services of the proposed centre

- Make available to Lebanese researchers, rapidly and free of cost, a complete and up-to-date bibliography relating to a specific subject.
- Acquaint scientific circles abroad with Lebanese researchers, especially those working in Lebanon.
- Assist Lebanese researchers in the publication of their research findings.

### 3.4.1.2 Methods of operation

As already mentioned, these methods would evolve in order to remain well adapted to the needs of research in Lebanon, while avoiding all unnecessary expenses at the present stage. It is therefore possible to institute close cooperation with foreign documentation centres in order to obtain therefrom all necessary material at little cost. In fact, preliminary and encouraging contacts have already been made in this direction.

Under these conditions it is envisaged to take the following measures:

- 1- Inventoriate all scientific documents existing in Lebanon and index them in a way permitting easy reference thereto;
- 2- Set up, within the Centre, the following facilities:
  - reference books and scientific magazines that are not generally available in Lebanon ;
  - a list of research work currently undertaken in Lebanon ;
  - a list of foreign documentation sources, with all data relating to procedures attendant on obtention of their services ;
  - a special bureau for translation of scientific documents from languages not currently used in Lebanon, or into languages widely used in scientific circles.
  - a technical section for audio-visual aids and electromechanographic equipment for documentation and copying.

Full use will be made, towards these ends, of the facilities for storage and treatment of information that are available at the Computer Center referred to further on in this Plan.

#### 3.4.1.3 Personnel for the starting phase

- one librarian - documentalist
- two translators
- one secretary - typist
- one assistant

#### 3.4.1.4 Estimated budget for the first year of operation

-Personnel	45 000 LL
-Equipment	30 000
-Acquisition of documents	50 000
-Miscellaneous	5 000
	<hr/>
	130 000 LL

#### 3.4.2 The Computer Centre

No serious research to-day can be efficiently undertaken without the time-saving use of electronic computers. That is why the National Council for Scientific Research owed it to itself to put such a computer at the service of researchers in Lebanon.

##### 3.4.2.1 Fields of application

- scientific computations needed for researchers in mathematics, physics, technology;
- statistical research on human or natural phenomena;
- programming;
- control of the execution of a specific project;
- simulation research
- storage and documentation

This Centre has already been established by the Council with an IBM Computer Model 1130; it is perhaps a modest start but one which can progressively develop. Anyway the Centre has already rendered its services to a few public administrations.

3.4.3 Common scientific equipment

In view of the high cost of certain indispensable scientific equipment useful to many and varied research projects, it appeared necessary to house such equipment in a central organization where their use will be open to Lebanese researchers in need thereof.

3.4.3.1 Proposed equipment

The following is a list of proposed common equipment it is planned to acquire during the next five years. It was drawn up after consulting with some international experts; however, it is not necessarily exhaustive but gives a general idea of the type required.

Analytical centrifuge	150 000 L.L.
Electron microscope	200 000
"Sonde de Castaing" (1)	200 000
Neutron generator	100 000
Electron accelerator	400 000
Nuclear magnetic resonator	200 000
Mass spectrometer	150 000
Very high pressures	300 000
Very low temperatures	<u>300 000</u>
Total	<u>2 000 000</u>

3.4.3.2 Operating costs

This equipment requires for its operation a technical and scientific personnel costing some 200 000 L.L. per annum for the five years of the Plan.

It is obvious that purchases will be made in accordance with felt needs; hence, for example, the recent acquisition by the American University of Beirut of an electron microscope makes a similar acquisition by the Council less priority.

When the Centre is fully operating, after five years, the annual costs of operation may well attain some 300 000 L.L.

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(1) for metallographic analysis by use of X-ray excitation

### 3.4.4 Centre for Development and Maintenance of Scientific Equipment

Experience in other countries has demonstrated that such a centre will quickly become indispensable when the volume of research attains satisfactory proportions, probably (for Lebanon) after five years. Thus the need is foreseen for the establishment of this centre towards the end of the five-year period of this Plan.

#### 3.4.4.1 Organization

The proposed centre will include:

- a glass-blowing workshop overseen by a master glass-blower;
- a precision machine workshop;
- an electric and electronic workshop;
- workshop for plastic materials.

The personnel will consist of a director, two specialized engineers, and of the required technicians in each branch.

#### 3.4.4.2 Estimated costs

On the whole this Centre will annually cost some 90 000 L.L. for personnel. Its equipment will cost about 500 000 L.L. when fully operational, its annual running cost (personnel and consumables) will attain 150 000.

### 3.4.5 Overall cost of the logistic support to research

The following is a table deduced from data given above and from an evolution of the progressive development and requirements of scientific research:

	EQUIPMENT	PERSONNEL	OTHER	TOTAL
first year	500 000	120 000	175 000	795 000
second year	550 000	150 000	190 000	890 000
third year	500 000	180 000	200 000	880 000
fourth year	500 000	220 000	230 000	950 000
fifth year	500 000	310 000	265 000	075 000
five-year total	2 550 000	980 000	1 060 000	4,590 000

#### 4. THE ECONOMIC IMPACT OF ADOPTED RESEARCH PROJECTS

It must be emphasized from the start that it is extremely difficult, if not impossible, to arrive at a precise evaluation of the economic effect of a research programme. The impossibility becomes absolute in matters of fundamental research, but in applied research it may be possible to make a rough estimate of the economic advantages that may accrue therefrom.

We shall therefore limit ourselves to a prudent approximation of the overall impact of each sector in the Plan, and this by adopting coefficients taking into consideration the degree of advancement of research in that particular sector towards the practical application of its findings.

##### 4.1 Relative importance of the sectors

Reference to the national audit data issued by the Ministry of Finance allow a relative evaluation of the importance of the various domains touched by this Plan. Thus it is possible to tabulate them according to their contribution to the national income.

Services	43%	of the national income
Industry and handicraft	13%	" "
Energy, water, transport, communications	11%	" "
Agriculture	11%	" "
Building	5%	" "
Others	17%	" "

From the above table one clearly discerns the importance of the human element at the command of all sectors, but especially that of tertiary activities, where it accounts for more than half the national income. Public health, education, professional training, and research would appear thus to be domains in which research must be undertaken. They are followed by agriculture, industry, transport, and building. Production sectors also need great attention, since their weakness requires vigorous supporting action through research that aims at increasing productivity and raising its standard.

##### 4.2 Evaluation Method

We propose to evaluate the feasibility of research in a given sector by estimating its probable contribution, when terminated, to the national income. We shall presume next that this contribution represents the interest, at 9% annually, of a capital sum calculated according to the following accepted formula:

$$R = \frac{S (1 + i)}{i}$$

where R = capital  
 S = annual increase in the national income  
 i = annual rate of interest

Application of this formula to this case results in:

$$R = \frac{S ( 1 + 0.09 )}{0.09} = S \times 12$$

This means that the capital represented by the annual contribution to the national income is twelve times said contribution. This, however, is not realistic, since the benefits accruing from research depend on two important factors:

- probability of success
- possibility of application

In so far as the probability of success is concerned, we shall assume it to be 25% (probability factor : 0.25). As to the possibility of application it would depend on the type of research and may be assigned an "application factor" as follows:

-fundamental research	0.1
-applied research	0.2
-development and exploitative research	0.8

On the basis of the foregoing it is possible to deduce the following formulas for calculating the hypothetical capital involved in a given domain of research:

-for fundamental research:	
$R = S \times 12 \times 0.25 \times 0.1$	= 0.3 S
-for applied research:	
$R = S \times 12 \times 0.25 \times 0.2$	= 0.6 S
-for development and exploitative research:	
$R = S \times 12 \times 0.25 \times 0.8$	= 2.4 S

The coefficient of feasibility "F" is then obtained by dividing the capital "R" by the estimated cost of research projects "C" in the domain under consideration; thus;

-for fundamental research	$F = \frac{0.3 S}{C}$
-for applied research	$F = \frac{0.6 S}{C}$
-for development and exploitative research	$F = \frac{2.4 S}{C}$

#### 4.3 Evaluation by Sector

##### 4.3.1 Agriculture

The national income from agriculture is estimated at around 500 million L.L., of which some 300 million from agriculture proper and 200 from cattle and animal products.

4.3.1.1 Botany, Agriculture, Forestry

Projects adopted under this heading aim at improving the efficiency of combating plant diseases and pests that considerably reduce production, and also at improving the quality of this production.

The global cost amounts to 1.54 million L.L.

The impact of these projects, if carried out successfully, would be at a minimum of 10% of the agricultural national income, evaluated, as already stated, at some 300 million L.L. Therefore the research projects adopted may mean an increase of about 30 million L.L. annually in the national income, equivalent to the interest of a capital investment of 360 million L.L. at 9% annually. By application of the formula relevant to applied research we find:

$$R = 0.6 S = 0.6 \times 30 = 18 \text{ million L.L.}$$

the coefficient of feasibility would then be:

$$\frac{18}{1.54} = 11.75$$

4.3.1.2 Pedology, Irrigation, Fertilizers

The aim here is to arrive at a rational utilization of water and fertilizers according to soil type; also the improvement of soil fertility especially in soils hitherto considered unproductive. The global cost of research projects under this heading amounts to 2 million L.L.; and the corresponding increase in the national income is estimated at 20 million L.L. annually.

Here

$$R = 0.6 S = 0.6 \times 20 = 12 \text{ million L.L.}$$

and the coefficient of feasibility would then be:

$$\frac{12}{2} = 6$$



4.3.1.3 Animal Biology and Livestock

The global cost amounts to 2 420 000 L.L. and the projects envisaged aim at the development of production through:

- better nutrition
- study of major diseases and methods of cure
- improvement of species

Livestock contributes an estimated 200 million L.L. to the national income ; this can easily be more than doubled within the next ten years. The projects themselves may contribute some 30 million L.L. per year to the national income; this represents the interest on a capital of 360 million L.L. As these research projects are of an applied nature, we find:

$$R = 0.6 S = 0.6 \times 30 = 18 \text{ million L.L.}$$

and the coefficient of feasibility:

$$\frac{18}{2.42} = 7.4$$

4.3.1.4 Oceanography and Marine Biology

With increasing World population, marine resources are becoming progressively more and more important.

Lebanon consumes about 12 000 tons of fish annually, of which only 2 000 tons are of local origin, fished by primitive means and methods.

The national organization of sea-fishing in Lebanon requires research on the marine milieu and its development in order for Lebanon to become at least self-sufficient in this respect. Thus the research projects adopted in this Plan aim at finding the necessary data that would help the adoption of the proper technique for exploiting Lebanon's marine resources.

The global cost here is estimated at 1.15 million L.L. the increase in fish tonnage varies between six and ten thousand tons, resulting in a contribution to the national income varying between 12 and 20 million L.L.. If we take 15 million L.L. as an average, then

$$R = 0.6 S = 0.6 \times 15 = 9 \text{ million L.L.}$$

and the coefficient of feasibility will become:

$$\frac{9}{1.15} = 7.9$$

#### 4.3.2 Human Biology and Medical Sciences

Research projects here aim at a statistical study of the most common diseases in Lebanon, find their causes, and develop appropriate prophylactic and therapeutic methods of dealing therewith, and this in an attempt to raise the standard of health, leading to a higher productivity and a lower overall cost of medical care.

The Lebanese population of 2 700 000 provides a manpower of about 720.000 persons, which averages 1.5 persons for each family of five.

A statistical study conducted on employees of the Electricity Office showed that the cost of medical care for 2 500 active persons to be as follows:

medical care of workers	300 000 L.L.
medical care of families	160 000 L.L.
paid sick-leave	240 000 L.L.
Total	<u>700 000</u>

This brings the average cost of medical care per person to 280 L.L. per year, which means some 200 million L.L. per year for the total working population. If to this we add the loss in productivity due to health deficiencies, estimated at 400 million L.L. per year, we arrive at an annual loss of 600 million L.L., which represents 9% of the national income.

The research projects envisaged can be expected to reduce the annual loss by some 15% or 90 million L.L. As the global cost of the projects is estimated at 4.4. million L.L. the capital represented would be

$$R = 0.6 S = 0.6 \times 90 = 54 \text{ million L.L.}$$

and the coefficient of feasibility becomes

$$\frac{54}{4.4} = 12.3$$

#### 4.3.3 Applied Science

Research in this domain aims at improving techniques in hydrology, roads, building, agricultural industries, etc...

Building represents an annual expenditure of 225 million L.L.

Energy, water, transport and communications represent 275 million L.L.

It is plausible to expect the contribution of research in this domain to be 10%, or 50 million L.L.

As the projects will cost an estimated 5.08 million L.L. the capital represented by the contribution of research will be

$$R = 0.6 S = 0.6 \times 50 = 30 \text{ million L.L.}$$

and the coefficient of feasibility,

$$\frac{30}{5.08} = 5.9$$

#### 4.3.4 Fundamental Research in Physics, Chemistry, Mathematics

Research in these fields is preponderantly fundamental and theoretical, with the exception of chemical research that might lead to practical results.

The total cost of research projects adopted in this Plan is estimated at 4 million L.L. It is, however, difficult to evaluate the economic impact of this group, but a feasibility coefficient of 2 - 3 appears admissible.

#### 4.4 Conclusion

In spite of the approximation and arbitrariness inherent in our estimates, we believe they give a fairly accurate idea, on the whole, of the direct economic impact of projected research in this Plan. But in addition to this direct impact attention must be called to the following considerations which, we believe, contribute further to enhance the feasibility of the Plan:

- some material equipment may not be entirely used up at the termination of the Plan and can therefore be further utilized;
- expenses incurred in forming researchers, which constitute an inestimable investment contributory to the social and economic impact of the Plan. If no mention has been hitherto made of this, it is because we wanted to limit our estimates to the very minimum;
- indirect impacts have not been considered because difficult to evaluate;
- patents which may be marketable abroad constitute an important financial resource which was not counted on.

In general it can be estimated that the capital representing an expenditure of 38 million L.L. in five years will not be less than 300 million L.L., representing, in its turn, an annual increase of at least 0.5% in the national income. Analytical economic data are appended to this Plan, and furnish more detailed information about the various domains affected by its execution (Appendix X).

5. FINANCIAL ASPECTS OF THE PLAN

- 5.1 The cost of the present Five-Year-Plan has been maintained within the limits stipulated in the bill of 14 September 1962, by virtue of which the National Council for Scientific Research was established.

Article 15 of said bill stipulates that the annual contribution of the State to the Council's budget shall not be less than 1% of the ordinary State budget.

As already explained this Plan is not rigid and should gradually widen its scope with the development of Lebanese human potential in scientific research. In fact, the document relating to scientific policy, which was adopted by the Lebanese Government, anticipated an increase in expenditure on research which will gradually attain, and eventually surpass, 1% of the gross national income.

In what follows, however, we shall take into consideration only such projects as have been adopted and described in the present document.

-Oriented research

When grouped into sectors, the total cost of each may be estimated as follows:

Agriculture	7 118 000
Biology and Medicine	4 408 000
Technology	5 280 000
<u>Total</u>	16 606 000

These overall costs may also be expressed in terms of personnel and equipment, as follows:

Personnel	9 757 000
Equipment	6 849 000
<u>Total</u>	16 606 000

These costs have been distributed over the five-year period of the present Plan in priority order (Appendix XI) .

To the above costs must be added the following:

-non-oriented research, at 25% of the cost of oriented research	4 151 500
-logistic support to research, as defined in 3.4	4 590 000
-formation of researchers over the five years of the Plan	5 000 000
-running cost of the Council's administrative and scientific set-up for the five-year period	4 000 000
-miscellaneous and unforeseen expenses, at about 10% of the total	3 654 000
<u>Total</u>	21 394 000

The overall total cost of 38 million L.L. will be distributed as follows over the five-years of the Plan :

first year	5.5 million L.L.	
second year	6.5	"
third year	7.5	"
fourth year	8.5	"
fifth year	10.0	"
	<hr/>	
<u>Total</u>	38.0	"

## 5.2 Sources of Financing

A review of the total costs for each of the five-years of the Plan would reveal that they are within the limits prescribed by bill of establishment of the Council. But the Council may seek assistance from other sources, such as the United Nations Special Fund or national and international organizations interested in scientific research in Lebanon. In fact, several contracts have been made in this respect, and all augur well for the execution of certain well defined projects.

Such supplementary resources presuppose equivalent counterpart support from the State budget. Thus the Council hope to widen the scope of research projects beyond what has been described herein above, or be able to lighten the financial burden of the final years of the Plan. This will be dependant on such results as shall be obtained during the initial period and in accordance with the needs of the country.

Finally, we would like to conclude by stressing, once again, the importance of flexibility to this Plan, whether in financing or projected research, in order to ensure its full success.

# الجمهورية اللبنانية

مكتب وزير الدولة لشؤون التنمية الإدارية  
مركز مشاريع ودراسات القطاع العام

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Republic of Lebanon

Office of the Minister of State for Administrative Reform

Center for Public Sector Projects and Studies

(C.P.S.P.S.)