

**BASIC DESIGN STUDY REPORT  
ON  
THE NOGUCHI MEMORIAL INSTITUTE  
REHABILITATION AND EXTENSION PROJECT  
IN  
THE REPUBLIC OF GHANA**

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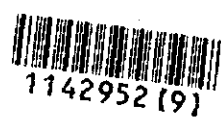


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## PREFACE

In response to a request from the Government of the Republic of Ghana, the Government of Japan decided to conduct a basic design study on The Noguchi Memorial Institute Rehabilitation and Extension Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ghana a study team from August 4 to August 31, 1997.

The team held discussions with the officials concerned of the Government of Ghana, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Ghana in order to discuss a draft basic design, and this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Ghana for their close cooperation extended to the teams.

February, 1998

A handwritten signature in black ink, reading "Kimio Fujita", written in a cursive style. The signature is positioned above a horizontal line.

Kimio Fujita  
President

Japan International Cooperation Agency





February, 1998


### Letter of Transmittal

We are pleased to submit to you the basic design study report on the Noguchi Memorial Institute Rehabilitation and Extension Project in the Republic of Ghana.

This study was conducted by Kume Sekkei Co., Ltd., under a contract to JICA, during the period from July 28, 1997 to February 5, 1998. In conducting the study, we have examined the feasibility and rational of the project with due consideration to the present situation of Ghana and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

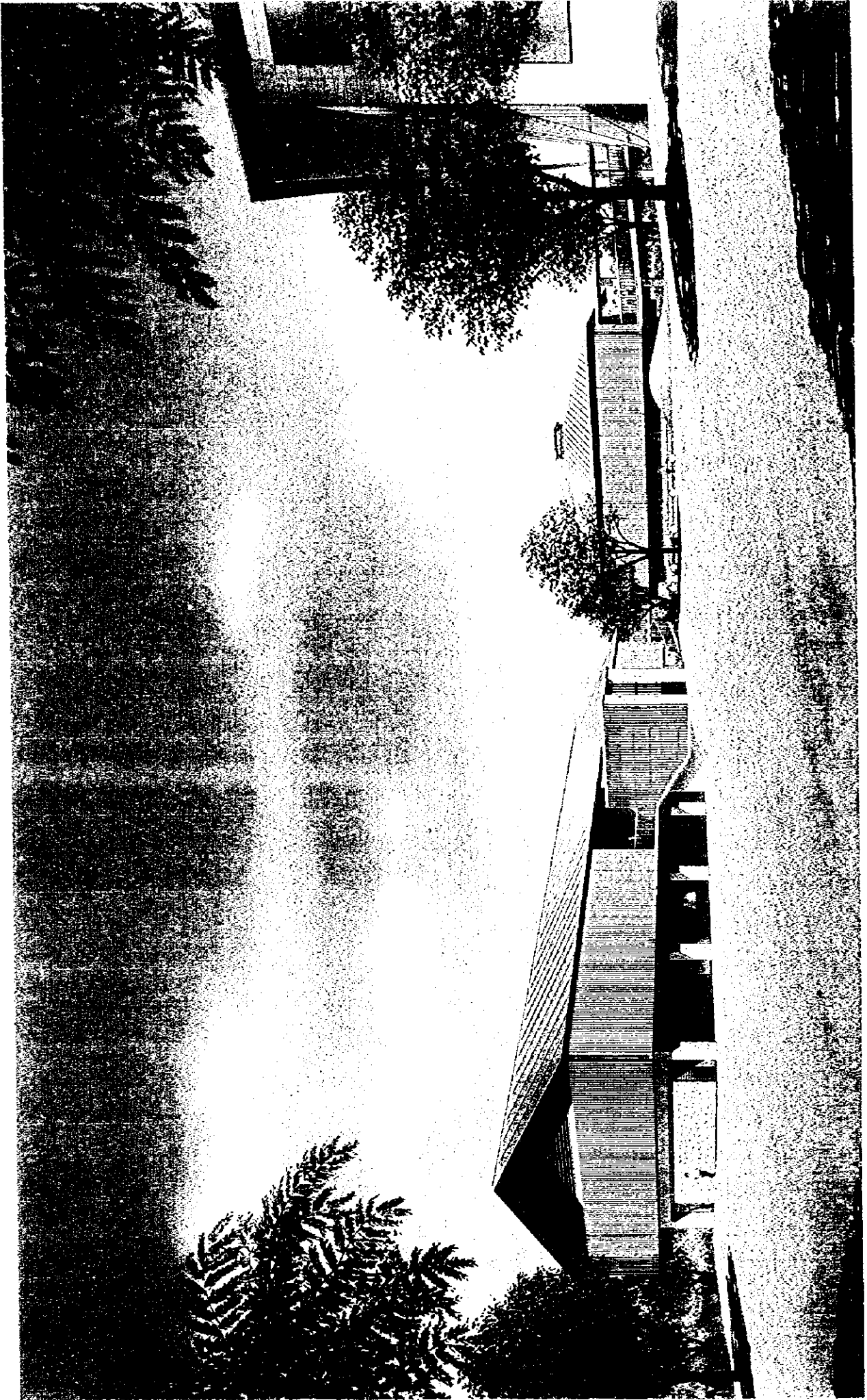


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Koji Kodama  
Project Manager,  
Basic Design Study Team on  
The Noguchi Memorial Institute  
Rehabilitation and Extension  
Project  
Kume Sekkei Co., Ltd.



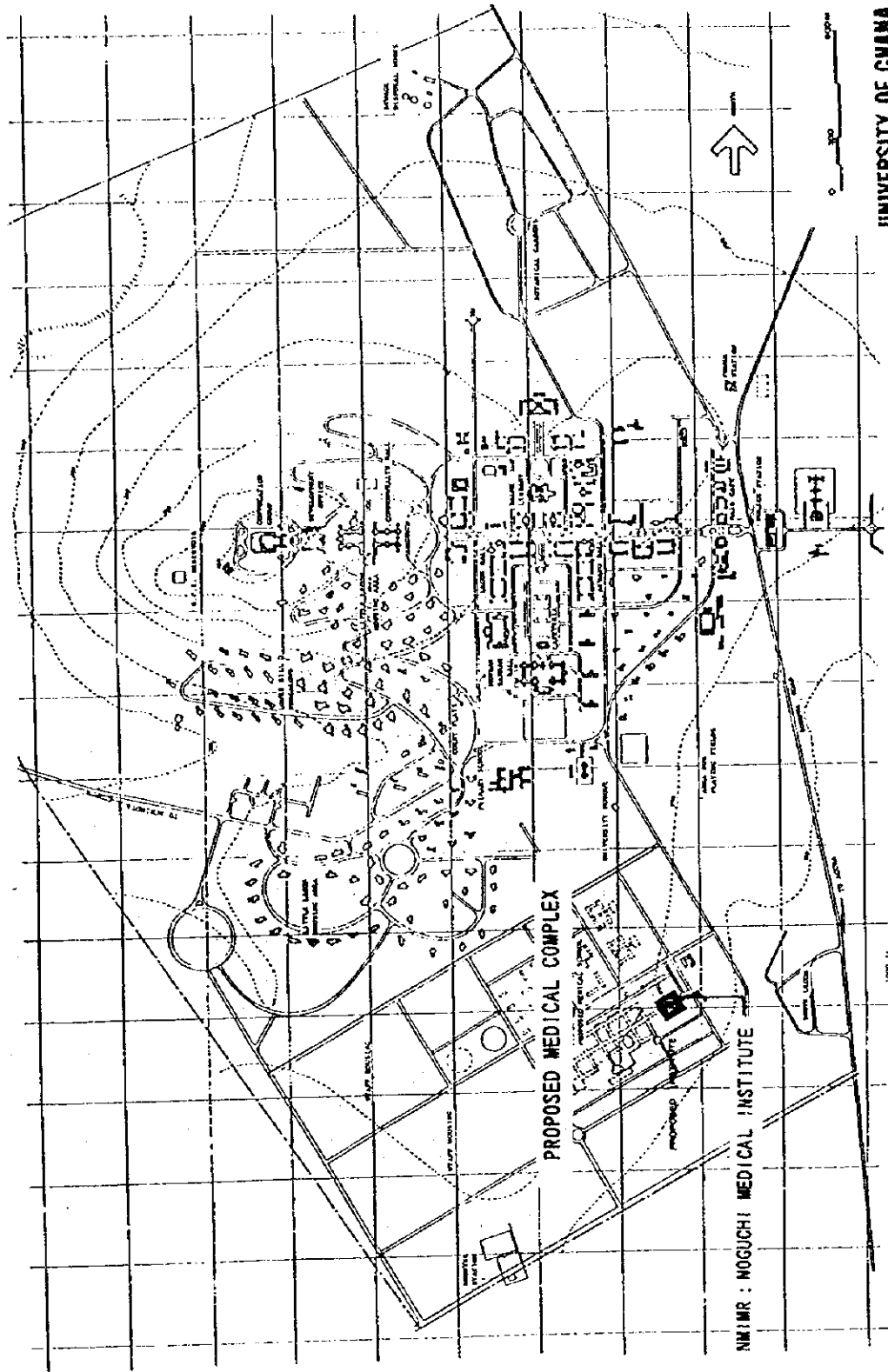
THE PROJECT FOR IMPROVEMENT OF NOCUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH  
KUWE SEKKI Co., Ltd. JAN 1998



THE NOGUCHI MEMORIAL INSTITUTE REHABILITATION AND EXTENSION PROJECT IN THE REPUBLIC OF GHANA  
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# SITE LOCATION MAP





UNIVERSITY OF GHANA  
MASTER PLAN



## LIST OF ABBREVIATIONS

<b>AIDS</b>	<b>Acquired Immunodeficiency Syndrome</b>
<b>BCG</b>	<b>Bacille de Calmette - Guerin</b>
<b>CDC</b>	<b>Communicable Disease Center /USA</b>
<b>CDD</b>	<b>Control of Diarrhea Diseases</b>
<b>DANIDA</b>	<b>Danish International Development Agency</b>
<b>DCP</b>	<b>Department of Chest Diseases</b>
<b>DCU</b>	<b>Diseases Control Unit /MOH</b>
<b>DPT</b>	<b>Diphtheria /Pertussis /Tetanus Vaccine</b>
<b>ECOWAS</b>	<b>Economic Community of West African States</b>
<b>ELISA</b>	<b>Enzyme-linked Immunosorbent Assay</b>
<b>EPI</b>	<b>Expanded Programme on Immunization</b>
<b>FP</b>	<b>Family Planning</b>
<b>GHANA 2020</b>	<b>GHANA - VISION 2020 / The First Step: 1996 - 2000</b>
<b>HEPA</b>	<b>High Efficiency Performance Filter</b>
<b>HIV</b>	<b>Human Immunodeficiency Virus</b>
<b>HRU</b>	<b>Health Research Unit /MOH</b>
<b>IERD</b>	<b>International Economic Relations Division /MOF</b>
<b>IFPRI</b>	<b>International Food Policy Research Institute /USA</b>
<b>IMR</b>	<b>Infant Mortality Rate</b>
<b>MCH</b>	<b>Maternal Child Health</b>
<b>MMR</b>	<b>Maternal Mortality Rate</b>
<b>MTHS</b>	<b>MEDIUM TERM HEALTH STRATEGY: TOWARDS VISION 2020</b>
<b>NACP</b>	<b>National AIDS/STD Control Programme</b>
<b>NCTE</b>	<b>National Council for Tertiary Education /MOE</b>
<b>NMIMR</b>	<b>Noguchi Memorial Institute of Medical Research</b>
<b>NPHRL</b>	<b>National Public Health and Reference Laboratory</b>
<b>NTBP/NTP</b>	<b>National Tuberculosis Programme (DANIDA)</b>

<b>OAU</b>	<b>Organisation of African Union</b>
<b>ORT/ORS</b>	<b>Oral Rehydration Therapy / Oral Rehydration Salts</b>
<b>P3</b>	<b>Physical Contaminant, Level 3</b>
<b>PBME</b>	<b>Planning, Budgeting, Monitoring and Evaluation /MOE</b>
<b>PCM</b>	<b>Project Cycle Management</b>
<b>PCR</b>	<b>Polymerase Chain Reaction</b>
<b>PHC/PHS</b>	<b>Primary Health Care /Primary Health Services</b>
<b>PHD</b>	<b>Public Health Division /MOH</b>
<b>PIP</b>	<b>Public Investment Programme</b>
<b>PPME</b>	<b>Policy, Planning, Monitoring and Evaluation /MOH</b>
<b>PPP</b>	<b>Purchasing Power Parity</b>
<b>SPF</b>	<b>Specific Pathogen Free</b>
<b>STD</b>	<b>Sexually Transmitted Diseases</b>
<b>TB</b>	<b>Tuberculosis</b>
<b>TFR</b>	<b>Total Fertility Rate</b>
<b>U5MR</b>	<b>Under 5 Mortality Rate</b>
<b>UGMS</b>	<b>University of Ghana Medical School</b>
<b>UNAIDS</b>	<b>Joint United Nations Programme on HIV/AIDS</b>
<b>UNDP</b>	<b>United Nations Development Programme</b>
<b>VPD</b>	<b>Vaccine Preventable Diseases</b>



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## CHAPTER 1 BACKGROUND OF THE PROJECT



## CHAPTER 1 BACKGROUND OF THE PROJECT

### 1-1 Health Conditions in Ghana

#### 1-1-1 Infectious Diseases vs. Population Increases

The Republic of Ghana (hereafter referred to as Ghana) is situated in West Africa, has an area of 239,000 square kilometers and an estimated population of 16.5 million (as of 1994). The population is comprised of about 90 different tribes; and, anthropologically, the patrilineal society is situated mainly in the south, while the matrilineal society is situated in the north. These two regions are roughly divided by the Volta River. In terms of diseases found in Ghana, the country may be further divided into the following geographical areas: The warm monsoon belt in the south, the northern Savanna region and the wet belt spanned by the Volta River.

The annual rate of population increase is roughly 3%, and almost half of the population (47%) is comprised of persons under 15 years of age. If this rate of increase continues unchanged, it is predicted that the population will be 19.5 million by the year 2000 (UNDP). It is feared this will place an ever increasing burden on the government, which will need to provide the required social services. For this reason, the government of Ghana has promoted population control measures designed to bring the problem under control from the outset. It has endeavored to bring the rate of population increase reduce to 2.75%, promote a family planning programme, and achieve a distribution that will bring the rate of increase into equilibrium.

The present state of public health is the fruit of a 40 year reform movement which began just after Ghana achieved its independence. According to government statistics, the infant mortality rate (IMR) decreased from 133 in 1957 to 66 in 1993; while the average life expectancy increased from 45 years of age in 1957 to 55 years of age in 1993.

However, there is a widening locality gap in the quality of reform measures from one region to the next. This is especially noticeable in the heavy incidence of the 10 major diseases, which have always included malaria, bronchial ailments, dysentery and parasitic infections among the vulnerable people.

Table 1-1-1 Major Diseases in Ghana

(per 10,000 population)

Name of Disease (year)	Changing of Major Diseases				Rate per 10,000 pop
	1991	1992	1993	1994	1994
Malaria	1	1	1	1	1464
URI	3	2	2	2	295
Skin Diseases	5	5	4	3	184
Diarrhoea	2	3	3	4	185
Accidents	4	4	5	5	170
Intestinal Worms	7	7	6	6	106
PRC	6	6	7	7	104
Acute Eye Infection	9	10	8	8	-
Gynaecological Disorders	8	8	9	9	-
Hypertension	10	9	10	10	-

Source: MOH Medium Term Health Strategy: Towards Vision 2020, 1995

The next Table 1-1-2 is from the UN Human Development Report (1996). It gives a comparative index of Ghana's public health situation. Ghana was rated 128 for the year given, a step behind Kenya (at 129). However, its Gross Domestic Product (GDP) was US\$430, about 1.5 times as high as Kenya's US\$270 (per person). Thus, when viewing these countries in terms of income, it may be said that Ghana has greater potential for improvement.

While Ghana's index of infant survival is lower than that of Kenya, it is felt this is due to the unavailability of disease prevention vaccines for 1 year olds. On the other hand, looking at population statistics, Ghana shows more favorable numbers, with the exception of those relating to the use of contraceptives, which is yet another reason to expect continued government support, especially in the areas of infectious disease prevention and public health measures for children.

Table 1-1-2 Comparative Health Profile in African Countries

		West Africa		East Africa		Mean LDC	
		Ghana	Ivory Coast	Kenya	Zambia	South of Sahara	LLDC
<< Health Profile >>	(year)						
Access: Health Services (%)	1985-95	60	30	77	75	57	50
Safe Water (%)	1985-95	56	72	53	50	45	52
Sanitation (%)	1990-95	42	54	77	37	37	31
Daily Calorie Supply (per day)	1992	2,206	2,491	2,075	1,931	2,096	2,027
Adult Literacy (%)	1993	62.0	38.0	75.7	76.2	56.0	47.3
HIV/AIDS (per 100,000 pop)	1994	13.7	44.6	24.8	17.3	12.4	8.3
Doctor (per 1,000 pop)	1988-91	25	11	20	11	19	19
Nurse (per 1,000 pop)	1988-91	4	3	9	5	7	14
Health Expenditure (per GDP)	1990	1.7	1.7	2.7	2.2	2.4	1.8
GDP per capita (PPP \$)	1993	2,000	1,620	1,400	1,110	1,385	894
GNP per capita (US \$)	1993	430	630	270	380	555	210
<<Child Survival>>							
IMR (per 1,000 live births)	1993	80	91	69	103	97	110
U5MR (per 1,000 live births)	1994	131	150	90	203	174	171
MMR (per 100,000 live births)	1993	740	810	650	940	929	1,015
Low birth-weight (%)	1990	17	14	16	13	16	23
1 year olds immunised: TB (%)	1990-94	61	49	92	100	64	71
: Measles (%)	1990-94	49	49	73	88	51	60
Oral Rehydration (ORT) (%)	1990-94	44	15	76	90	49	57
<<Demographic Profile>>							
Est. Population (mills.)	1993	16.4	13.3	26.4	8.9	520T	550T
	2000	20.2	16.8	32.6	10.8	640T	670T
Life Expectancy at Birth (year)	1993	56.2	50.9	55.5	48.6	51.4	51.5
Crude birth rate (%)	1993	41.5	50.0	44.4	44.3	44.8	42.9
Crude death rate (%)	1993	11.6	15.2	11.8	15.3	15.1	14.9
Total fertility rate (%)	1992	6.0	7.4	6.3	6.0	6.3	5.8
Human Development Index (HDI)	1996	129	147	128	136	-	-

Source: UNDP Human Development Report 1996

### 1-1-2 The Increasing Incidence of AIDS and Other Infectious Diseases

Despite an increase in the number of diseases which can now be prevented, infectious diseases and recurring outbreaks of infectious diseases have once again become prominent as part of "repeating cycles". Yellow Fever, having a 10 year cycle, ran rampant in the North in 1983 and again became prominent in the Northwestern states in 1994. Cholera has a 6 to 7 year dominance cycle, and Meningitis is reported to have a 5 year recurrence cycle. An outbreak of Measles occurs every 2 years and, following an increase in the rate of vaccination, will tend to subside, though the rate of contraction for infants under 1 year of age is generally on the rise.

The deterioration of public sanitation is particularly cited as an underlying cause of recurring outbreaks of contagious diseases. Tuberculosis was rampant in the early part of 1980 and, later on, went into a phase of "inactivity". In recent years, however, a drug-resistant strain has reappeared, suddenly becoming widespread in densely populated slum districts. There also seems to be a correlation between Tuberculosis and AIDS.

According to a government report, 12,600 people had been infected by the AIDS virus by 1993, the first patient having been reported in 1986. While examinations are not widespread, there are now an estimated 30,000 AIDS patients, and a warning has been issued that the number of HIV positive persons will reach 760,000 by the year 2000. According to a 1995 infection rate survey, 90% of the AIDS patients were between 20 and 49 years of age, women outnumbered men by about 50%, and 75% of the HIV positive patients had become HIV negative. In 1987, the National AIDS Council for Prevention (NACP) was formed and efforts are now being made in the area of prevention and in the issuance of warnings regarding sexually transmitted disease.

USAID formed a Public Health Reference Laboratory (PHRL) in 1995 and is now supporting the Department of Public Health in deterring the rate of HIV positives. The United Nations formed UNAIDS in 1996, and next year in Ghana 6 related agencies began to develop AIDS prevention measures.

The incidence of AIDS is greatest among the "vulnerable" peoples of the society, that is to say infants and expectant mothers. However, with recurring outbreaks and the rampant spread of infectious diseases, the "working force" is typically most affected, which has raised concerns about future social and economic development in the wake of this dreaded disease. The impact on society will not be limited to a reduction of the workforce. Like an infant infected with AIDS, it will have a far reaching impact on future



generations, on a global scale. With the progress of air and sea transportation, organisms causing infectious diseases will increasingly traverse national borders. Thus, the need for global countermeasures has once again come to the fore.

While Ghana's public health programs are more favorable than those the neighboring countries of West Africa, there is still much room for policy reforms, especially in such areas as developing appropriate prevention measures and furthering research to determine the causes of disease - the primary social duties.

### 1-1-3 GII: Global Issues Initiatives (Population / Aids)

At its present constant rate of increase, the world's population will reach 8.3 billion by the year 2025. It is predicted that this will greatly increase poverty and bring severe food shortages on a global scale. One outcome of this is that the AIDS virus will be spread at a rapid rate. According to a joint communique of the UNAIDS Commission, there were 3.1 million AIDS patients in 1996, and the AIDS virus was being spread at a rate of 8,500 persons per day. The rate at which the AIDS virus has spread (in various countries) has made it impossible to contain by government programs implemented since Ghana's independence. It is feared that in the short run, it will escalate the cost of medical treatment; and, in the long run, demobilize the labor force. As mentioned, moreover, the social burden will be passed on to future generations and, thus, a global attack on the spread of AIDS is indispensable.

Thus, through the US-Japan common agenda of 1994, both governments proposed the Global Issues Initiative (GII). Japanese government has pledged US\$300,000 in support of this initiative between 1993 and the year 2000, and US\$100,000 has already been committed for the years 1994 and 1995. The United States government appropriated \$90 billion for the same period, for the development and implementation of plans under the Common Agenda. Japanese government has selected Ghana as one of 12 major countries to which aid is to be extended, and dispatched a Project Formulation Mission to deal with the problems of population growth and AIDS in February of 1996.

The Japanese Government also made generous public health sector appropriations under the New Development Strategy by DAC launched in 1996. A results-oriented program, it has put plans in place for specific developmental goals, including, reduction of the

mortality rate for infants and children under 5 years of age to one third (1/3) of its former rate, reducing child birth-related mortality to quarter (1/4) of its current level, and the promotion of reproductive health programs.

Children's health is a major concern. Efforts are being made to deal with outbreaks of treatable disease and lighten the effects of preventable disease epidemics by use of vaccines. In this offensive, as well, Japan has targeted Ghana for projects, along with other countries including Cambodia, Ethiopia, Tanzania, Zimbabwe and Peru. In accordance with the WHO theme of "Polio Eradication by Year 2000", the Japanese government has been supplying vaccine throughout Asia and has expanded its outreach to Africa. Moreover, under the wing of WHO/UNICEF, the support offered the US-Japan alliance continues to grow.

In addition to efforts by the developing nations to implement reform measures, the support made possible by the cooperative effort of UN organizations in global prevention and observation programs is essential to the public health sector to overcome infectious disease. Programs such as environmental preservation programs to control infectious disease are only made possible through public support. It is therefore essential to minimize costs around the globe.

## 1-2 Economy and Structure of Ghana

Ghana became an independent country in 1957. It has an abundance of gold, diamonds, cacao and lumber. These are its primary natural resources which, collectively, account for its economic development. However, being dependent on foreign exports, Ghana faced hardship in the early 1980's when international price of primary goods plummeted, drastically reducing its export income. The economy was soon stagnated, inflation set in, and the national debt was ever mounting.

In 1983, however, Ghana received support from the IMF and World Bank, launched a plan for economic recovery (1983-1986), and devised a number of policy reforms aims at reviving the ailing economy. At the end of 1985, Ghana saw the fruits of its macro-economy situation. Since that time, the government has implemented three structure adjustment plans with the support of the IMF and World Bank. Beginning in 1987, Structure Adjustment Loans were made, followed by Sector Adjustment Loans; and, during this period, the Japanese government supported Ghana on four separate occasions with cooperative financing Yen loans. The results of such support have been no less than remarkable. After 1986, the economy began to sustain itself in a state of equilibrium; and, in 1994, it was once again "in the black". The rate of development, as measured by the Gross Domestic Product (GDP), rebounded to a level of around 5% on the average from 1988 to 1990; and, since that time, has been in a state of smooth transition.

Table 1-2-1 Macroeconomic Index

	1985	1990	1991	1992	1993	1994	1995	1996
Real GDP Growth (%)	5.1	3.3	5.3	3.9	5.0	3.8	4.5	5.2
Nominal GDP (billions cedi)	343.0	2,031.7	2,574.8	3,008.8	3,932.4	4,950.4	7,418.0	10,384.5
GDP in US\$ (millions)	6,317	5,462	6,454	5,561	4,823	4,631	4,883	5,877
Inflation Rate (%)	n.a.	37.2	18.0	10.1	25.0	24.9	70.8	32.7
Dollar Exchange Rate	54.3	326.3	399.0	541.0	816.5	1,068.9	1,519.2	1,767.0

Source: CEPA Macroeconomic Review and Outlook, 1997

In 1994, the government began to curtail new expenditures, extending this policy (EXTRACON) to 16 agencies, implementing pilot programs focusing on the Departments of Education, Public Health and Public Information. In March of 1995, it introduced a Value Added Tax (VAT), thereby doubling tax revenues. Though Ghana is still subject to Regulated Development policies, it is said to be out of troubled waters. The Structure Adjustment financing extended through IMF was discontinued in February of 1992, also World Bank has shifted its form of support to project financing.

Thus, receiving support from the IMF and the World Bank, Ghana quickly and boldly entered a stage of regulated development. Hastening its rate of economic growth, increasing its volume of exports and reducing its debt has made it a success story as a nation undergoing Regulated Development. Moreover, in 1995, "Ghana Vision 2020" was instituted. This plan will make Ghana one of the "middle-income" nations by the year 2020 and will hasten its progress toward an export-oriented model economy.

## CHAPTER 2    CONTENTS OF THE PROJECT



## CHAPTER 2 CONTENTS OF THE PROJECT

### 2-1 Objectives of the Project

#### (1) Main Objectives of the Project

The health indices in Ghana have shown a significant improvement since independence. Nevertheless, most of the major diseases today are infectious diseases which can be prevented and which cause a strain on the socially weak, such as infants and pregnant women. The spread of HIV/AIDS and the recurrence of contagious diseases among people of productive ages in recent years are causing concern in regard to adverse impacts on Ghana's socio-economic development, making the prevention of infectious diseases, investigation of the causes of diseases which can be prevented by vaccines and the early introduction of remedial measures an urgent necessity.

The national development plan of the Government of Ghana entitled "Ghana Vision 2020" calls for a healthy, productive life for all Ghanaian people while implementing measures to control infectious diseases to reduce the infant mortality rate(IMR) as well as the under 5 mortality rate(U5MR) and maternal motility rate (MMR). Meanwhile, the Ministry of Health identifies concrete improvement targets in its "Five Year Medium-Term Health Programme" and has called for a strengthening of cooperation between all related organizations, including the central government, private sectors and NGOs.

The NMIMR was established in 1978 with grant aid provided by the Government of Japan and has since functioned as the central research institute for medical science in Ghana. Since its establishment, JICA has continuously provided technical cooperation and the activities of the NMIMR have been highly evaluated throughout the world. Its research themes have diversified and advanced over the years and there is an increasing demand for research dealing with more hazardous pathogens. Unfortunately, however, the existing building has not the necessary facilities and equipment for the safe handling of such hazardous organisms and the NMIMR has been obliged to use the available laboratories to deal with these organisms with extra care.

For the project-type technical cooperation which is planned to commence in 1998 as a continuation of the previous cooperation, 15 research themes have been put forward in the HIV/AIDS, TB and other fields under the overall research target of developing measures to control infectious diseases. In particular, the introduction of P3 level laboratories and laboratory animal facilities is called for to ensure the safety of researchers and to prevent the spread of biological contamination to the surrounding environment. Moreover, the application to and dissemination of the research results in the clinical field through lectures and practical training is planned, necessitating the construction of a conference hall and training laboratories. This project-type technical cooperation is expected to contribute to improving public health, which is being eagerly attempted by the Government of Ghana, by means of assisting the activities of the NMIMR and applying the research achievements to the disease prevention and diagnosis activities of the Ministry of Health.

The main objective of the Project is to create a working environment in which research and training activities in the field of infectious diseases, planned for the next phase of the project-type technical cooperation, can be safely and efficiently conducted through the construction of P3 laboratories and laboratory animal facilities, etc. and the provision of relevant equipment. The Project also intends to strengthen the functions of the NMIMR in terms of the development of measures to control infectious diseases and investigation of the causes of diseases so that the achievements of the NMIMR's research activities widely benefit the people of Ghana.

## **(2) Target Activities of next Project-Type Technical Cooperation**

The planned next phase of the project-type technical cooperation to commence in fiscal 1997 identifies the following project objective under the project theme of controlling infectious diseases.

“The research capability of the NMIMR will be strengthened and improved, the capability of the medical staff engaged in the control of infectious diseases will be improved through training and linkage with other public health organizations will be promoted with a view to contributing to the control of infectious diseases.”



In short, the next phase of the project-type cooperation aims at contributing to the advancement of infectious disease in Ghana by means of ① strengthening the research capability, ② manpower development through training and ③ close linkage with other public health organizations.

<u>Objectives of the Project</u>	
Goal:	- improvement of public health in Ghana
Project Purpose:	- consolidation of basic research on such infectious diseases as AIDS and TB, etc. in Ghana
Expected Outputs:	<ul style="list-style-type: none"> <li>- to delineate of the causes of AIDS and STDs, etc.</li> <li>- to function as a reference laboratory for TB research</li> <li>- to delineate of the causes of vaccine preventable diseases</li> <li>- to contribute to manpower development in the research field of infectious diseases</li> </ul>
<u>Project Components</u>	
Facilities:	<ul style="list-style-type: none"> <li>- P3 level laboratories;</li> <li>- Laboratory animal facilities</li> <li>- Conference hall</li> <li>- Renovation of existing facilities</li> </ul>
Equipment:	<ul style="list-style-type: none"> <li>- P3 laboratory equipment</li> <li>- Experimental animal equipment</li> <li>- Electron Microscope</li> </ul>

A similar objective was agreed at the workshop held during the field survey period in regard to the activities of the NMIMR and the contents of this agreement were attached to the Minutes of Discussions. To be more precise, the agreed issues were;

- ① that improvement of the diagnosis, monitoring and prevention of infectious diseases is required to strengthen and improve health care in Ghana,
- ② that the NMIMR could make a social contribution in this field by means of elaborating the epidemiological and pathological causes of diseases, developing vaccines and facilitating manpower development in the field of infectious diseases through training and
- ③ that close linkage between the NMIMR and the Ministry of Education and Ministry of Health is required as a precondition for the above improvement and development.

## 2-2 Basic Concept of the Project

### 2-2-1 General Concept of NMIMR

#### (1) Functions and Activities

The NMIMR has nine research units which cooperate with each other to deal with specific research themes. There are three main functions, i.e. "research and surveillance", "education and training" and "diagnosis and monitoring". It is important that these functions are performed in unison to achieve the objective of the NMIMR, i.e. "the improvement of public health regarding the control of infectious diseases". In the area of each function, the following activities are expected to take place.

##### 1) Research and Surveillance

The research function focuses on the prevention of contagious and infectious diseases and on nutrition which are urgent issues regarding public health in Ghana and each unit prepares and implements research programmes. The actual activities include the pursuit of the causes (such as viruses, bacilli and parasites) of various diseases, the identification of pathogens and research on the micro-nutrients and micro-organisms contained in food. In reality, however, because of research funding and staff strength constraints, those research units which have obtained special funding for entrusted research or joint research are more active than other units.

As part of the research function, various surveillance activities are conducted regarding the distribution of diseases and pathogens, patient ratio and outbreak ratio and nutritional conditions, etc. Special research on vectors includes the study of means of infection concerning schistosomiasis, onchocerciasis, malaria and filaria and the collection and breeding of vectors to study their biological characteristics and immune mechanism.

## 2) Practical Training and Academic Training

The practical training function of the NMIMR includes the acceptance of medical students for post-graduate (master course) study from the Faculty of Medicine of domestic universities and guidance on doctoral theses. At present, medical students seeking a career in medical research are accepted and the number varies from year to year. In connection with the EPI, some 17 staff members per year of the Ministry of Health are trained on a regular basis.

With regard to academic training, two or three seminars are usually held every year, the most prominent of which is the annual seminar organised under the project-type technical cooperation. Academic training in a third country is also organized with infectious disease control projects in Kenya, Zambia and Malawi. In addition, two seminars with some 200 participants each have been held twice this year by the DANIDA for the purpose of establishing the Malaria Vaccine Network (with the NMIMR acting as the head office).

## 3) Diagnosis and Monitoring

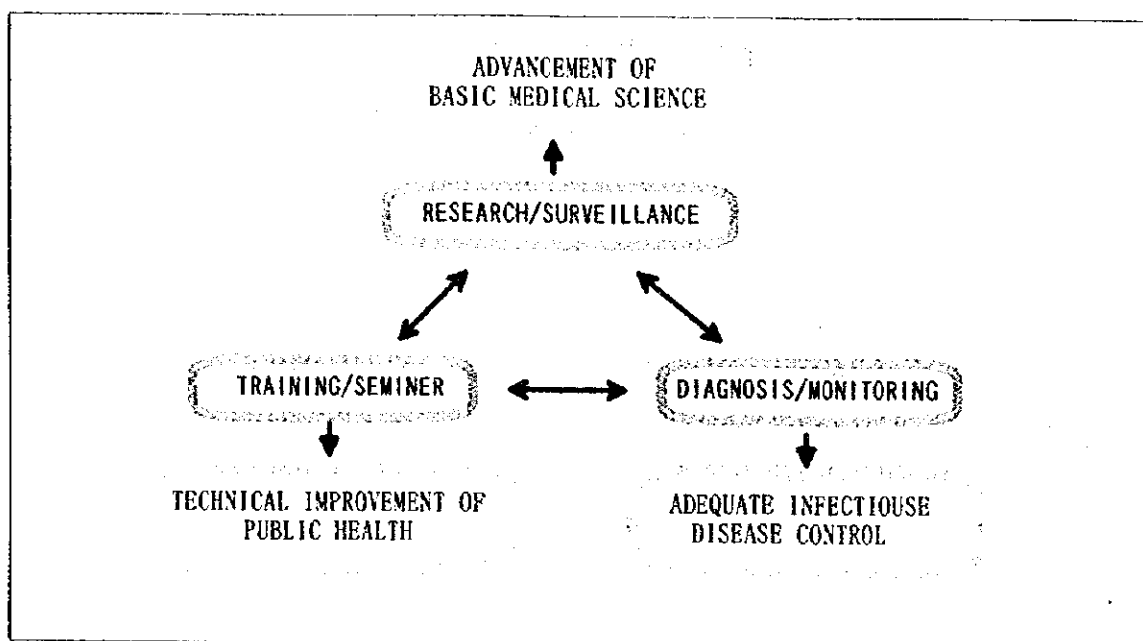
In the case of the diagnostic function, the NMIMR conducts tests entrusted by the Ministry of Health on samples which are found difficult to examine by the hospitals managed by the Ministry of Health. In particular, the NMIMR has been designated as one of West Africa's reference laboratories regarding EPI-related poliomyelitis and measles by the WHO. The NMIMR is also a reference laboratory for the diagnosis of sickle cell disease which is peculiar to Africa. The excellent diagnostic function of the NMIMR is expected to play an important role in the planned research on HIV/AIDS and drug-resistant TB is included in the next the project-type technical cooperation.

The monitoring function of the NMIMR is essential for the prevention of infectious diseases and professional judgements on appropriate intervention measures are essential based on monitoring information of disease-affected areas and means of infection. The NMIMR also enjoys an excellent reputation in this field, particularly in regard to the eradication of poliomyelitis.

## (2) Linkage of Various Functions

In order for the results of the research and other activities of the NMIMR to benefit the people of Ghana, it is essential for its functions to be linked with each other together with the creation of a cooperation regime involving various external organizations. As described earlier, the workshop held during the field survey period saw the agreement of all parties that cooperation between the NMIMR, the Ministry of Health, the Ministry of Education and the University of Ghana, etc. with a view to disseminating the achievements of the NMIMR throughout Ghana is essential to improve the country's public health. The scheme of this vital linkage is illustrated below.

### Linkage Diagram of Function



### 1) Linkage Between Research/Surveillance and Training/Seminar

Acting as a centre for excellence in the field of basic medical research, the NMIMR can provide training on professional skills and epidemiological knowledge for the researchers of medical research institutes and inspectors of the inspection facilities of the Ministry of Health. In return, the NMIMR can expect the feed-back of information from those personnel trained at the NMIMR. The dissemination of the research and survey achievements of the NMIMR to external organizations through both practical and academic training is essential for the technical improvement of public health throughout Ghana.

### 2) Linkage Between Research/Surveillance and Diagnosis/Monitoring

The testing units of the NMIMR conduct work to identify bacilli and to pinpoint the causes of diseases as such work is often found to be technically difficult by organizations belonging to the Ministry of Health. The Epidemiology Unit gathers data on areas contaminated by infectious diseases and the distribution of pathogenic organisms, etc., functioning as a vital source of information for infectious disease control by the Ministry of Health. If new and more accurate diagnostic techniques are developed to improve the diagnostic capability of medical institutions, it will become possible to obtain more accurate information on diseases and their causes and the monitoring of such information will enable the precise and speedy implementation of measures to prevent infectious diseases. Conversely, the feedback of information to the NMIMR will enable the NMIMR to concentrate its efforts on highly urgent research themes with the end result of larger benefits for local people.

### 3) Linkage Between Training/Seminar and Diagnosis/Monitoring

The purposes of the practical and academic training are manpower development and the exchange of information, both of which directly contribute to the technical improvement of infectious disease control in Ghana. The accurate information on infectious diseases and their geographical distribution obtained by the diagnostic and monitoring activities will allow the Ministry of Health to control infectious diseases by appropriate measures. Through the practical and academic training, the

diagnostic techniques developed by the NMIMR and information on infectious diseases will be externally disseminated. The feedback of field information to the NMIMR by the trainees will enable the practical and academic training at the NMIMR to reflect the actual field conditions, giving the activities of the NMIMR greater social impact.

As discussed above, the NMIMR is expected to intensify and link its research, training and monitoring activities and to establish a cooperative relationship with other organizations with a view to externally disseminating the achievements of these activities. The next the project-type technical cooperation featuring infectious disease control also aims at improving the research capability through technical guidance and improving the capability of those engaged in medical care.

The master concept for the implementation of the Project is consolidation of the environment to assist the activities under the next the project-type technical cooperation through the construction of new facilities and the provision of new equipment and to contribute to improving public health in Ghana through the improved activities of the NMIMR, mutual cooperation with other organizations and the application of the achievements of various activities.

## 2-2-2 Basic Concept of the Project

### (1) Contents of the Project and Configuration of New Facilities

The structure of the research units of the NMIMR and their activities have changed with their times reflecting specific social requirements. At the time of the NMIMR's establishment, the research units in such clinical fields as physiology, pathology and hematology were prominent as the NMIMR functioned as a research institute for medical science of the University of Ghana Medical School(UGMS). Subsequent years, however, have seen a gradual rise of those units dealing with infectious diseases and mal-nutrition which are problems requiring urgent attention in Ghana. In anticipation of such a change, the basic concept of the NMIMR at the time of its establishment included 54 general-purpose laboratories.

Today, the Physiology Unit and Hematology Unit, established at the beginning, have been integrated to other units while such new research units as the Nutrition Unit, Immunology Unit and Epidemiology Unit have been introduced as new independent units. The scope of the activities of the Parasitology Unit has been expanded with the unit commanding more space than before. The disorderly allocation of the available laboratories to various units, however, has failed to establish a functional layout of the research laboratories, etc. in the existing building. In addition, there is a safety hazard as P2 level experiments are conducted on the ground floor which sees the busy movement of visitors. In order to improve this situation, the Renovation (rehabilitation) plan for the existing facilities involves the relocation of those research units handling hazardous pathogens to the first floor to improve the safety aspect inside the existing building.

As it is planned that the research under the next the project-type technical cooperation will involve the handling of hazardous pathogens, including HIV/AIDS and drug-resistant TB bacilli, the existing of P3 level laboratories is assumed. In the field of molecular biological techniques which have already been transferred to the NMIMR, two research themes are proposed under the next project-type technical cooperation. Another area in need of improvement is that of the laboratory animal rooms as breeding and testing are currently conducted in the same rooms, making it difficult to obtain accurate test results.

The request made by the Ghanaian side includes the construction of an administration building in view of the NMIMR's plan to increase the number of administration staff to full strength. The NMIMR has already made a request to the Ministry of Education for an increase of the recurrent budget (personnel cost). However, the number of research staff is currently below full strength and priority should be given to vitalising research activities by means of increasing the number of research staff given the present austere budgetary situation of the Government of Ghana. Consequently, it is judged that the construction of an administration building is less urgent.

Technical cooperation in the field of electron microscopy by the Government of Japan commenced when one electron microscope (EM) was given to the UGMS prior to the establishment of the NMIMR. The EM owned by the NMIMR was the second EM to be provided by the Government of Japan and has now been used for some 20 years. During this period, excellent EM operators and researchers have been trained and the said EM is currently used by domestic researchers for microbiological structure analysis. The replacement of the EM under the Project is, therefore, judged to be highly appropriate. It is planned to use the existing EM, the resolution of which has declined, for student training and to install a new EM in the renovated next room.

The contents of the Project based on the basic design study are outlined below.

1) P3 Laboratories

- Provision of two P3 level laboratories (for the Bacteriology Unit and Virology Unit) and anterooms.
- Provision of a training laboratory (to accommodate approximately 12 persons) and a common laboratory for the shared use of precision equipment with a configuration designed to allow independent rooms to accommodate unified molecular-biological research which is currently conducted by various units in the future.
- Relocation of the existing maintenance unit to provide electrical and mechanical workshops with a view to creating a system capable of the maintenance of the P3 laboratories as well as laboratory animal facilities.
- Relocation of the vehicle and inventory control room to facilitate centralised control by means of the centralisation of the equipment and material storages.



## **2) Laboratory Animal Facilities**

- Provision of breeding rooms (four for small and medium size animals and one glass cutting room), two animal raising rooms for general testing, two animal raising rooms for the testing of infectious diseases and animal laboratories.
- Provision of washing/sterilisation rooms, feed preparation/storage rooms, a waste treatment room, clean corridors and contaminated corridors to support the breeding and other rooms listed above with clearly defined lines of flow.
- Isolation of poultry, goats and monkeys from the animal raising zone.
- Employment of simple and economical air-conditioning, water supply and drainage systems to reduce the maintenance burden.
- Introduction of an incinerator to process infectious as well as biological waste.

## **3) Conference Hall**

- Provision of a conference hall with a seating capacity of approximately 120 to widely disseminate the research achievements of the NMIMR and to function as a place for the exchange of information and technology regarding the prevention of infectious diseases.
- Provision of two seminar rooms with a seating capacity of approximately 20 for use as seminar rooms, unit meeting rooms and research/survey work rooms.
- Relocation of the temporary canteen on the first floor of the existing building so that it can be used for seminars and study meetings.

## **4) Renovation of Existing Facilities**

- Location of the Epidemiology Unit and Nutrition Unit on the ground floor and the Immunology Unit and Parasitology Unit on the first floor with a view to securing the safety of the NMIMR and to improve the efficiency of all units concerned.
- Provision of researchers' room (2 - 4 researchers per room) to accommodate visiting researchers and short-term JICA experts.
- Renovation of the existing laboratory animal rooms, library and storage rooms (for reagents/consumables and stationary).
- Planning of the conversion of the existing meeting room to an accounting office/chief accountant's office.

- Planning of the installation of a new EM in the room (currently used as a storage room) next to the Electron Microscopy Unit.
- Planning of air-conditioning/ventilation systems and water supply, drainage and gas piping, etc. where deemed necessary.

Table 2-2-1 Points for Facility Planning & Management

<b>On Facility Planning</b>
1) Maintenance <ul style="list-style-type: none"> <li>- Easy maintenance and secure Bio-safety</li> </ul>
2) Energy <ul style="list-style-type: none"> <li>- Stable supply of Elec./Steam/Water</li> <li>- Good Heat Efficiency</li> </ul>
3) Marmattern Countermeasure - Sand absorption <ul style="list-style-type: none"> <li>- shut of sand/dust to Labs, A/C Plants, especially for HEPA filters</li> </ul>
4) Save-energy <ul style="list-style-type: none"> <li>- exchangeable space arrangement for P3 and P2 level experiments</li> <li>- ditto for Bacterial and Virus experiments</li> <li>- save elec. consumption for Animal House</li> </ul>
5) P3 Level Safety Measure <ul style="list-style-type: none"> <li>- Bio-hazard measure for researcher also adjacent environment</li> <li>- conformity with WHO Biosafety guideline(1993)</li> </ul>
<b>On Operation and Management</b>
6) Set-up and Training of Biosafety Control System <ul style="list-style-type: none"> <li>- Appointment and Truing of Chief Biosafety Manager</li> <li>- Assignment and Training of Handling Staff</li> </ul>
7) Biosafety Control Regulations for NMIMR <ul style="list-style-type: none"> <li>- Safety handling code with each pathogens</li> <li>- Safety handling code for DNA related experiments</li> </ul>
8) Training of Maintenance Engineer <ul style="list-style-type: none"> <li>- Engineer for A/C and Electro Mechanical</li> <li>- Engineer for Labo Equipment Maintenance</li> </ul>

## 2-3 Basic Design

### 2-3-1 Design Concept

The objectives of the Project are to strengthen the research, training and diagnostic functions of the NMIMR to improve the prevention of infectious diseases in Ghana, aimed at by the next phase of the project-type technical cooperation and by the NMIMR, by means of constructing new facilities and providing new equipment and to contribute to the general prevention of infectious diseases in Ghana as well as in West Africa. The conditions to be examined for the successful implementation of the Project are outlined below.

#### (1) Natural Conditions

##### 1) Temperature and Humidity

As the mean maximum temperature at the project site is as high as 28 - 34°C, a floor plan and cross-section plan allowing good ventilation will be required to ensure comfortable space. The mean humidity of as high as 86% demands the installation of an air-conditioning system in each laboratory to protect the research equipment.

##### 2) Rainfall and Solar Radiation

The annual rainfall is approximately 970 mm, of which some 60% is concentrated May to July, making the adoption of measures to deal with squalls and to shut rain out of the buildings necessary. Given the strong solar radiation in the dry season, special attention must be paid to the thermal insulation performance of the roofing and exterior wall materials. Sufficiently deep eaves and openings in the east and west walls should be considered to prevent any undesirable rise of the room temperature due to direct sunlight.

### 3) Harmattan

The constant wind is the weak southwestern monsoon from March to November. The dry northwestern Harmattan from the Sahara Desert from December to February brings sand dust, making it necessary to ensure the good airtightness of openings. Anti-sand dust measures will also be required for the air-conditioning filters.

### 4) Site Shape and Landscape

The existing facilities of the NMIMR are located at the centre of the site and the distribution of the new facilities is planned to the north and south of the existing facilities. The distance from the existing facilities to the perimeter fence is approximately 60 m. The site gently slopes and has many trees which were planted 20 years ago. In principle, these trees will not be felled and a harmonious landscape between the existing and new facilities will be planned.

### 5) Safe and Functional Facilities

As the planned facilities are laboratories handling highly hazardous pathogens causing infectious diseases, the primary emphasis will be placed on the safety of researchers and prevention of the contamination of the surrounding environment. Special attention should also be paid to the equipment layout and lines of flow in each laboratory so that the emphasis on safety does not unreasonably disrupt the research and laboratory testing functions. The contents of the new facilities should be determined in view of adaptation to future changes of the research activities which are likely to occur given the character of the NMIMR.

## (2) Social Conditions

### 1) Conformity with Master Plan

The NMIMR is located on the campus of the University of Ghana and constitutes part of a medical complex conceived 20 years ago. A layout plan which does not interfere

with the original contents of the Master Plan should be considered as requested by the Vice-Chancellor of the University.

## 2) Control of Visitors

Given the many domestic and foreign visitors to the NMIMR and the absence of nearby buildings, night security is an important consideration in the running of the NMIMR. As the planned facilities will handle infectious pathogens, the configuration of the rooms should prevent free access by outsiders.

## 3) Pitched Roof

The existing complex of the University of Ghana (Legon Campus) was designed in the 1950's and the two and three-story buildings with tiled roofs create an elegant landscape over a vast hilly area. As the existing NMIMR building was constructed 20 years ago with a pitched roof, a similar pitched roof is planned for the new building to maintain harmony with the existing landscape.

## (3) Local Construction Industry and Use of Local Materials

### 1) Simple Detailing and Construction Methods

The productivity of the local workforce in Ghana is not well than that of Southeast Asia and the construction capability is similarly small. Accordingly, complicated detailing will be avoided and adequate construction schedule will be planned using simple construction methods.

### 2) Use of Easily Maintained Local Materials

In view of post-handing over maintenance and repair, locally available construction materials will be used as much as possible. Those materials which are unavailable in Ghana will be procured in Japan and/or third countries.

### 3) Local Subcontractor

While the construction capability of local construction companies considerably varies from one company to another, it is difficult to lease heavy construction machinery in Ghana. Consequently, the work schedule will be planned assuming the use of a local construction company with the required heavy machinery as a local subcontractor.

### (4) Maintenance by NMIMR

#### 1) Reduction of Running Cost

Durable and weatherable materials will be used to reduce the running cost. The selected air-conditioning system and electrical installations will be those which are capable of reducing the lighting and heating costs. Measures to reduce electricity consumption will also be recommended to improve the overall financial balance of the NMIMR.

#### 2) Easy Maintenance of Building Services

The Project plans the use of an air-conditioning system for clean air circulation and bio-hazard control. Even though such a system is standard in Japan, it is believed that the maintenance and repair of this type of system will still prove difficult in Ghana at present. Therefore, simple basic units will be individually installed where possible and interchangeable spare parts will be introduced to establish a system which is easy to maintain.

#### 3) Technical Guidance on Operation and Maintenance

The present maintenance staff (seven persons) of the NMIMR are fully capable of maintaining and repairing ordinary building service systems and equipment. In regard to the new air-conditioning and ventilation systems, on-site guidance on these systems will be provided at the time of their installation, followed by training on operation, inspection and repair prior to their final handing over. The emphasis of this training will be placed on preventive maintenance, including regular inspection.

## (5) Selection of Equipment and Equipment Grades

The NMIMR has been continuously provided with various equipment for some 20 years to assist the research themes adopted under project-type technical cooperation. While some of this equipment has now passed its expected life, much of the existing equipment is still in good working order. Therefore, the scope of the new equipment to be provided will avoid the duplication of existing equipment in view of the effective use of that existing equipment in good shape.

- The highest priority will be given to that equipment which is required for the research planned under the next phase of the project-type technical cooperation and the minimum quantity of general-purpose equipment will be selected.
- In the case of precision equipment and expensive equipment of which the use will be specified, the purpose of use and timing of the commencement of use under the project-type technical cooperation will be clarified prior to selection.
- The principal rule will be the effective use of existing equipment to avoid any duplication of equipment, particularly in the case of animal experimental equipment.
- In regard to existing equipment which is currently out of order, spare parts will be provided for that equipment which can be repaired with such parts exchange. The replacement of HEPA filters for safety cabinets, etc. will be considered as long as they can be obtained in Japan.
- The in-house maintenance and repair capability of the NMIMR is technically limited as far as electronic equipment and precision equipment are concerned. This situation makes the checking of the availability of local agents for new equipment before selection necessary. If there is no local agent, manufacturers will be encouraged to appoint local agents in Ghana so that an appropriate maintenance and repair system can be established between the NMIMR and local agents of the equipment manufacturers.

## 2-3-2 Sizes of Principal Rooms

### (1) P3 Laboratories

#### 1) Size of P3 Laboratories

As bacteriological research and virological research involve different types of pathogens, two separate P3 laboratories will be provided as originally requested. As a P3 laboratory has a high operation and maintenance cost due to the intensive use of electricity for air-conditioning and other purposes and the need to regularly replace HEPA filters, etc., the requested laboratory sizes have been reduced to minimise the running cost while meeting the requirements for the planned research under the next project-type technical cooperation.

In the case of the bacteriological laboratory, the planned work mainly includes the culture of drug-resistant tubercle bacilli, the identification of strains and drug sensitivity testing. The laboratory size is determined based on the assumption that one handler and one instructor will be involved with one safety cabinet. Instead of the requested central laboratory table, a movable laboratory table is planned to allow different equipment layouts to suit changing requirements and to ensure the high efficiency of laboratory use. Consequently, the planned size is reduced to some 40% of the originally requested size. This laboratory is planned to function as a TB reference laboratory together with a preparation room.

The size of the virological laboratory is determined based on its use as a general-purpose laboratory. Research on HIV/AIDS is planned under the next phase of the project-type technical cooperation although the detailed testing methods have not yet been decided. The Immunology Unit also plans to use this laboratory. One safety cabinet will also be provided for this laboratory with a movable laboratory table to ensure an appropriate equipment layout according to the requirements. As a result, the laboratory size is reduced to some 60% of the originally requested size.



Both laboratories will have a two-sided, free-standing electric autoclave to reduce the cost of high pressure steam supply and autoclave maintenance.

Table 2-3-1 Size of P3 Laboratories

P3 Labo:	Requested		Planned	
	Floor Size	Large Equipment	Floor Size	Large Equipment
Bacterial Related	46 m <sup>2</sup> (4 persons)	<ul style="list-style-type: none"> <li>- two safety cabinets (1300mm)</li> <li>- central fixed laboratory table (3600mm)</li> <li>- through type autoclave</li> </ul>	18 m <sup>2</sup> (1 or 2 persons)	<ul style="list-style-type: none"> <li>- one safety cabinet (1300mm)</li> <li>- movable laboratory table (1800mm)</li> <li>- free-standing autoclave</li> </ul>
Virus Related	46 m <sup>2</sup> (4 persons)	as above	29 m <sup>2</sup> (1 or 2 persons)	<ul style="list-style-type: none"> <li>- one safety cabinet (1300mm)</li> <li>- two movable laboratory table (1800mm)</li> <li>- free-standing autoclave</li> </ul>

## 2) Size of Training Laboratory

As an affiliated research institution of the UGMS, the NMIMR provides guidance for several medical students every year who hope to establish a career in the research field. Meanwhile, the Ministry of Education intends to increase the educational opportunities at home to prevent a brain drain and to promote scientific and technical research in Ghana. From fiscal 1998, it will become compulsory for medical students in Ghana to undergo research training at domestic research institutions. Accordingly, the NMIMR plans to increase the number of students accepted for training.

In the field of technical training, the Virology Unit accepts 17 trainees a year on EPI and the training generally lasts 20 days, during which the normal research activities of the unit are halted. In addition, trainees are also sent to the NMIMR every year by the Ministry of Health and other related organizations although the number and timing, etc. are irregular. The planned size of the new training laboratory will accommodate some 12 trainees and will also have sufficiently large enough space to provide training on the operation of large medical equipment. Training for TB

inspectors and other laboratory diagnosis training is already planned under the next phase of the project-type technical cooperation.

The NMIMR has a plan to unify molecular biology, currently dealt with by various units, in the future and this plan is supported under the project-type technical cooperation. In view of such a probable development, the common laboratory where existing precision equipment will be commonly used and the training laboratory will be designed under the Project to allow their possible use as molecular biology laboratories in the future.

**Table2-3-2 Past Training at NMIMR**

Objectives	Contents	No. of Trainees
< Ministry of Health > EPI Training Course (every year; some 20 days)	Polio diagnosis, vaccination and yellow fever prevention, etc. Some 100 people are invited to attend the opening and closing ceremonies	17
< Ministry of Health > Prevention of infectious diseases (every year; one year)	Acceptance of trainees and researchers in regard to the prevention of infectious diseases; the training takes place at various units depending on the fields of speciality	10 - 20
< Ministry of Education > Research guidance for medical students and post-graduates (every year; one year)	Part of the education at the UGMS; from fiscal 1998, research work at a research institution will become compulsory	varies (5 - 10)
< Ministry of Education > EM-related training (every year; irregular length)	Acceptance of medical and biological researchers and practical training using EM for other universities	some
< Ministry of Education > Parasitology (1996; three weeks)	Guidance on diagnosis and testing methods for parasitological laboratories in Ghana	12
< IFPRI/WHO > Nutrition Training Course (6 Nov. - 31 Dec, 1996)	Training of local instructors on nutrition improvement and intake of micronutrients	30

Note: IFPRI: International Food Policy Research Institute (USA)

Source: Materials obtained by the field survey team

## (2) Laboratory Animal Facilities

### 1) Existing Condition of Laboratory Animal Unit

Existing facility for this unit has 7 rooms for animal breeding / experiment ( 4.6 m x 6.9 m ) on first floor of NMIMR main building. Additionally, this unit has 3 rooms for quarantine, Head and staff office on the same floor. Also, unit enclosed a space of corridor for Breeding of Sheep, or sterilisation and stock of bedding materials and animal feed. Feed production shed ( 45 sq.m ) is located on court yard.

Past record of animal usage (supply) shows on the following Table, but number of animal usage of NMIMR inside shows vary each year. This unit supply almost same number of animals outside of NMIMR, for Universities or Research Institutes, also has experience to export animals to adjacent foreign countries. Prices per one animal for saling (1997) is laser cheap, for example, 800 cedis for Mice, 1,500 cedis for Rabbit, but 5,000 cedis for Guinea Pig.

On the same Table, there are compared by total number of annual supply (1996) and requested annual demand. Requested annual demand means aggregated number of investigation sheets which were distributed to each unit. Each unit of NMIMR filled future usage ( demand ) of animals from own research plan. If compeare with 1996 supply and future projection, both number are similar except Humster ( 294 vs 1,050 ) requested by Parasitology unit for their special research plan.

Table 2-3-3(a) Experiment Animals - Actual Supply and Request

	Usage of NMIMR			Supply to Outside			Total Supply 1996	Requested Number
	1994	1995	1996	1994	1995	1996		
Mice	1,160	1,240	2,090	1,020	1,037	1,172	3,262	3,850
Rat	990	800	1,400	761	802	1,055	2,455	2,100
Humster	340	157	294	-	-	-	294	1,050
Guinea Pig	115	110	145	92	83	163	308	250
Rabbit	78	150	228	17	22	32	260	350
Grass Cutter	53	44	24	-	-	-	24	80
Fowl	63	33	33	-	-	-	33	80
Sheep	2	3	3	2	3	3	6	3
Monkey	2	2	2	-	-	-	2	10

Source: NMIMR

Following table shows usage plan of experimental animals which submitted by each research unit at same time. NMIMR has a Research Plan 2000 as draft document, also JICA Technical Cooperation's Plan not decided actual type of animals and demanded numbers yet. Therefore, there are some discrepancies within research plan and requested animals for experiments on this stage.

Table 2-3-4(b) Research Plan with Animal Experiments

Bacteriology Unit	- E.coli Studies - Preparation of Media - TB study	Histopathology Unit	- Malaria - Anemia - Bonemarrow Studies
Immunology Unit	- Malaria - Antisera	Chemical pathology Unit	- Toxicological Studies - Heabal Studies
Parasitology Unit	- Malaria - Schistosomiasis	Nutrition Unit	- Breast Feeding - Weaning Foods
Virology Unit	- Arbo viral Studies eg. Yellow Fever - Rubella - Measles	Labo Animal Unit	- Microbiological Monitoring - Grasscutter Domestication - Comparative Biological Stdy - Pyrogen Testing - Establishment of Cell Lines

Source: NMIMR

Study team surveyed existing numbers of breeding animals and usable equipment such as animal cages / racks. Preserving existing number of animals, Team decided to enforce the quality-up of animals. Next table shows actual species and number of animals which used 4 month from June 1997. The last two columns shows existing numbers of animals counted by team (except fowls, sheeps monkeys).

Table 2-3-3(c) Usage of Labo Animals (1997)

Species	Purpose	Number of Usage						No. of Brdg	
		JUN	JUL	AUG	SEP	OCT	TOTAL	SEP	NOV
Mice	Balb/c	60				135	195	327	260
	C57BL	15		22			37	127	155
	ddY	145	226	144	361	18	894	337	265
Rat	Wister			50	90		140	153	208
Humster	Syrian					20	20	59	55
Guinea Pig	Mix							40	40
Rabbit				2			2	43	51
Grasscutter	Wild							13	11
Number of Experiments		4	2	5	8	5	24		

Source: NMIMR

## 2) Size of Animal Breeding Rooms

Different breeding rooms will be provided for different types of animals to prevent contamination by animal-specific bacilli, etc. The standard floor area is approximately 20 m<sup>2</sup> which is generally considered a rational size to accommodate racks and working space. Under the Project, the animal raising racks will be placed on two side walls to ensure uniform air circulation and a basic unit size of 3 m x 6.4 m is planned.

In view of the types of laboratory animals, four breeding/raising rooms will be provided to house mice, rats/hamsters, guinea pigs and rabbits respectively and clean air will be supplied to all rooms. In the case of grass cutters which are the same size as rabbits, only exhaust facilities will be provided as these are a wild species. The housing capacity of the breeding/raising rooms is given in the next Table.

Table 2-3-4 Capacity of Animal Breeding Rooms (Room Size: 3 m x 6.4 m)

(Unit: heads)

Animal	Body Weight	Maximum Number	Number for Laboratory Use	Required Capacity
Mice	18 g	5,000	1,000 - 3,500	1,600
Rats	200 g	1,000	200 - 700	1,000
Hamsters	80 g	1,000	200 - 700	200
Guinea Pigs	300 g	400	80 - 280	250
Rabbits	2,000 g	80	56 - 16	150

Note: The number for laboratory use is calculated at a rate of 20 - 70% of the maximum capacity.

Source: Guidelines on Buildings and Equipment for Laboratory Animals

As the Project plans to house rats and hamsters in the same room, the number of cages for these two types of animals must be decided in accordance with their actual demand. Because of the intended use of ready-made racks and existing cages in some rooms, the actual number of animals to be housed will vary depending on the number of cages to be installed.

### 3) Size of Animal Experiment Rooms

Two animal laboratories are planned to serve general testing and infection testing. While it is usually preferable for different laboratories to be provided for different types of testing, this incurs a huge electricity cost due to air-conditioning and lighting, etc. Accordingly, the use of clean racks is planned for ordinary testing while negative racks will be used for infection testing. Based on the number of cages which can be accommodated by the ready-made racks, the animal laboratories can house the number of animals shown in the next Table.

Table 2-3-5 Housing Capacity of Animal Exp. Laboratories

(Unit: heads)

Animal	Animal Exp. Lab. (Clean Racks)			Infected Animal Exp. Lab. (Negative Racks)			Requested Capacity
	No. of Racks	No. of Cages	Housing Capacity	No. of Racks	No. of Cages	Housing Capacity	
Mice	2	50	200-250	2	50	200-250	1,000
Rats	2	32	96-128	2	32	96-128	700
Hamsters	1	6	48-64	1	16	48-64	200
Guinea Pigs	2	18	18-36	2	18	18-36	200
Rabbits	2	18	18	2	18	18	100

As the fertility of each animal depends on the breeding conditions and feed, the number of animals available for laboratory testing fluctuates. In addition, careful coordination between the testing (demand) and scale of breeding (supply) is required as most tests specify the sex and age of the animals to be used.

### (3) Conference Facilities

#### 1) Size of Conference Hall

The conference hall of the existing building has a floor area of approximately 75 m<sup>2</sup> (10.8 m x 6.9 m) and uses a room which was originally intended as the administration office. At present, seminars with some 100 participants are held 2 - 3 times a year and, in some cases, upto 200 people pack the room. Generally speaking, the existing space can only seat 50 - 70 people and those who cannot sit

down tend to sit on benches in the arbor located in the courtyard, waiting for inside seats to be vacated.

The NMIMR expects to increase the number of seminars and study meetings, etc. for the wide dissemination of its research achievements to researchers of other organizations and those involved in medical care. In particular, as it hopes to increase the number of participants to its monthly meetings on research progress (in-house seminars) to around 100, it has requested a new conference hall with a seating capacity of approximately 120. Examples of the seminars, etc. held in the existing conference room are listed as below.

Table 2-3-6 (a) Past Seminars/Study Meetings at NMIMR

Date	Subject	Participants
December, 1994	Child Nutrition and Survival/JICA	100
January, 1995	Schistosomiasis and EPI Vaccine Trials/JICA	160
April, 1996	Lymphatic Filariasis in Ghana	200
June, 1996	Persistent Diarrhoeal Diseases/JICA	150
March, 1997	Malaria Research in Ghana/DANIDA	200
September, 1997	HIV/AIDS Research in Africa/JICA	150 (planned)
November, 1997	African Malaria Vaccine Testing Network/DANIDA	200 (planned)
Monthly Meeting (In-House Seminar)	The research subjects and progress are reported in turn by the various research units	50

Source: NMIMR

The floor of the new conference hall will be flat to allow its use for various purposes. While a seating capacity of approximately 120 is planned as requested, this can be altered to suit different occasions by replacing unwanted tables and additional chairs obtained from outside.

## 2) Size of Seminar Rooms

The existing building of the NMIMR has only one small meeting room (12 seats) in addition to the conference hall and the original conference room is used as a library. As various committees are given the priority of using such limited meeting space, the research units have hardly any space for their own study meetings or for preparation and analysis work.

Two 20 seat meeting rooms were requested during the field survey period and it is now planned to respond to this request. A partition wall will be introduced between the two rooms so that the removal of this wall can create space to accommodate some 40 people.

The existing conference hall and small meeting room are currently used in the following manner.

Purpose of Use

Small seminars, etc.	:	20 - 40 people
Orientation during training period	:	10 - 20 people
Internal study meetings	:	10 - 20 people
Preparations and analysis for		
Epidemiological surveys	:	5 - 10 people
Monthly committee meetings, etc.	:	8 - 25 people
(as per the next table)		

Table 2-3-6 (b) Committees of NMIMR

Name	Number of Members
Management Committee	15
Scientific and Technology Committee	18
Appointment Committee	8
Monthly Fellow Meeting	25
Coordination Committee	13
Finance Board	11
Advisory Board	17

Source: NMIMR



### 2-3-3 Basic Design

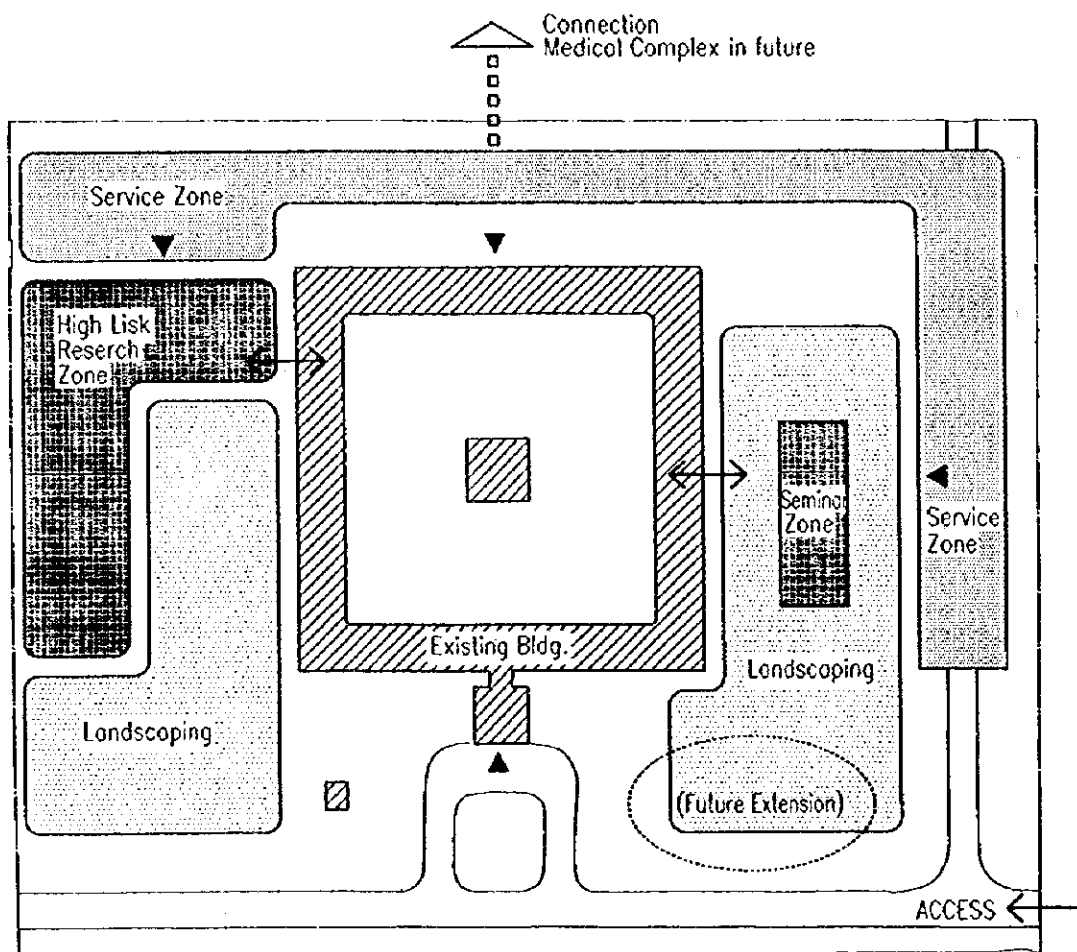
#### (1) Layout Plan

The NMIMR is situated on the Legon Campus of the University of Ghana and has a site area of approximately 44,200 m<sup>2</sup> (some 260 m in the north-south direction and some 170 m in the east-west direction). The square shaped existing building (some 83 m long in each direction) is located at the centre of this site. The distance from the exterior wall to the perimeter fence is approximately 60 m in the case of the north and south sides and some 300 m in the case of the west side at the back of the existing building.

While it is possible to locate the new facilities at the west side, the University of Ghana has had a long-standing plan for the last 20 years to construct a medical complex in this location. Consequently, the use of the north and south sides for the new facilities is planned so as not to interfere with the University's master plan. The introduction of the following functional zones is envisaged in the layout plan.

- Seminar and public relations zone : the conference hall will be located on the north side which will provide easy access from the main gate, creating a seminar and public relations zone
- Research and training zone : the existing facilities of the central section will be designated a research zone, the functions of which will be improved by Renovation
- High risk research zone : a high risk research zone will be introduced to the far south of the existing building to prevent any accidental entry by outsiders

The new P3 laboratories will be connected to the existing building via a new first floor bridge to provide access while preventing entry by outsiders to these laboratories from the ground floor. Careful consideration will be given to the distance between the buildings while ensuring harmony between the new and existing buildings as well as with the overall landscape of the premises to create pleasant exterior space. In deciding the ground levels of the new buildings, the difference of floor levels between the new buildings and the existing building and its auxiliary buildings will be taken into consideration to minimise banking and cutting.



**LAYOUT PLAN**

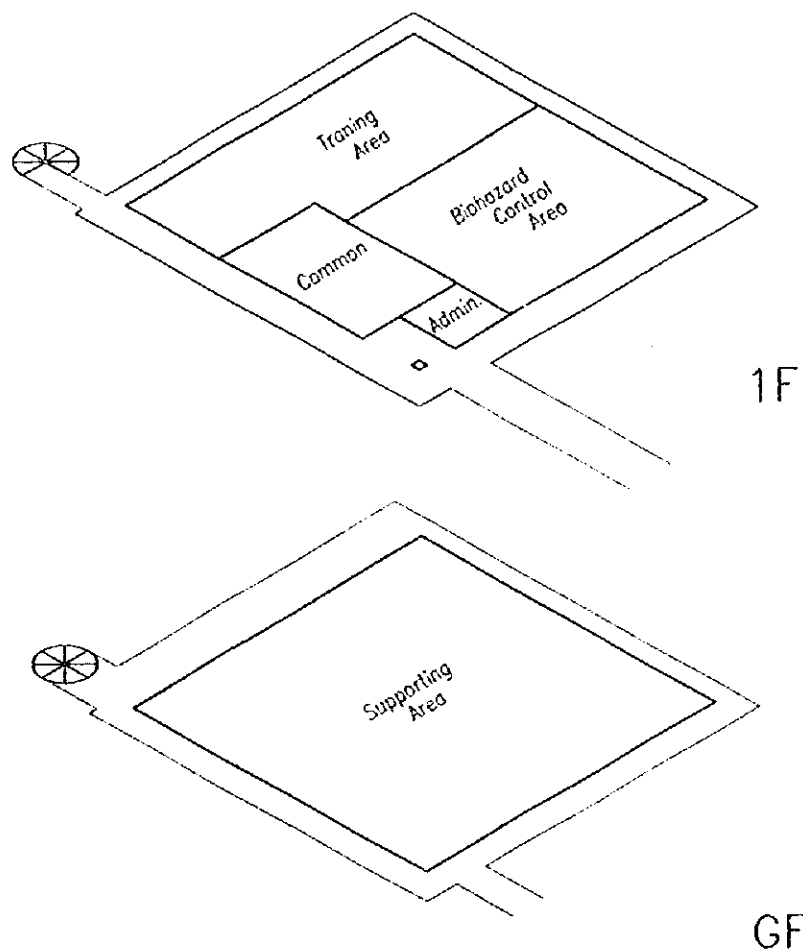
(2) Building Plan

1) Floor Plan

a) P3 Laboratory Building

GF: - Supporting area

1F: - Biohazard Control (P3) area  
- Training (analysis) area  
- Administration (monitoring) area

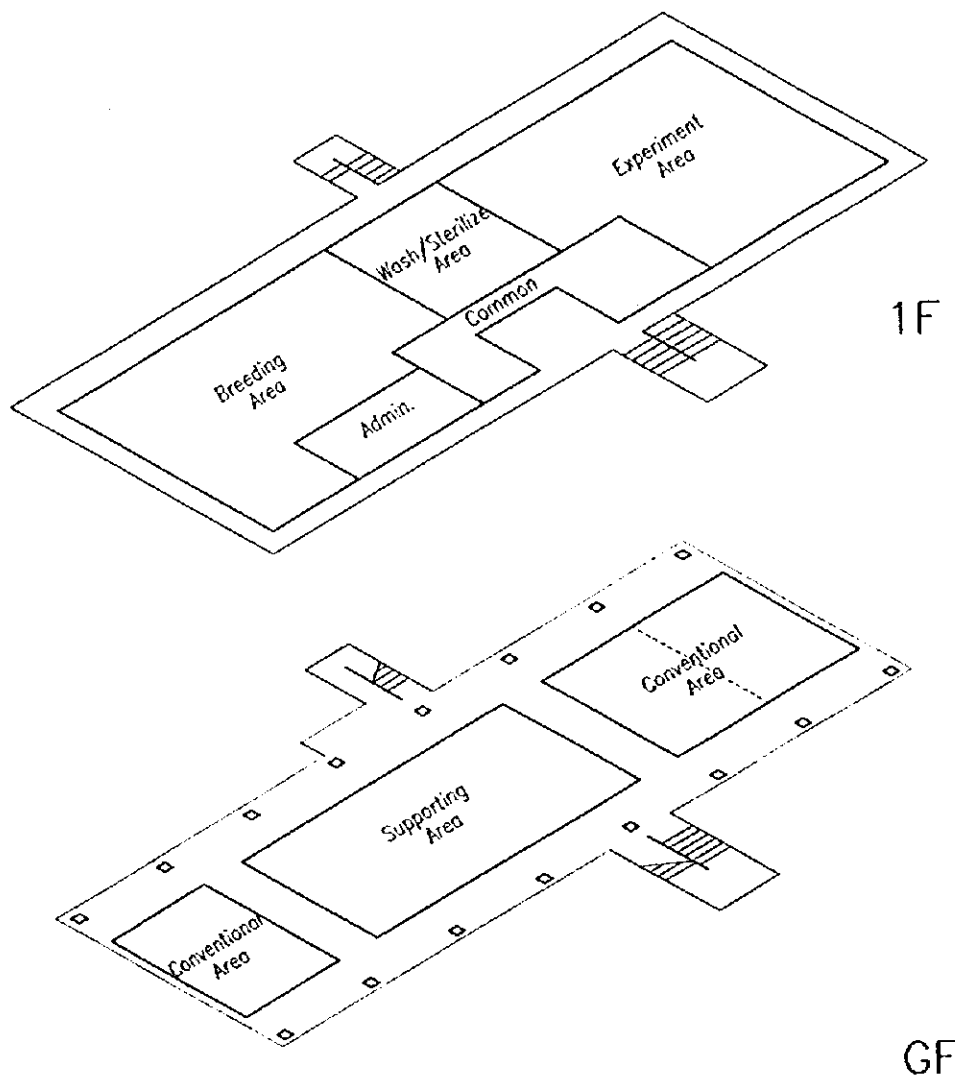


**ZONING OF P3 LABORATORY BLDG.**

b) Laboratory Animal Building

- GF:
- Supporting area
  - Conventional animals area

- 1F:
- Breeding animal area
  - Experiment animal area
  - Washing/Sterilisation area
  - Administration area

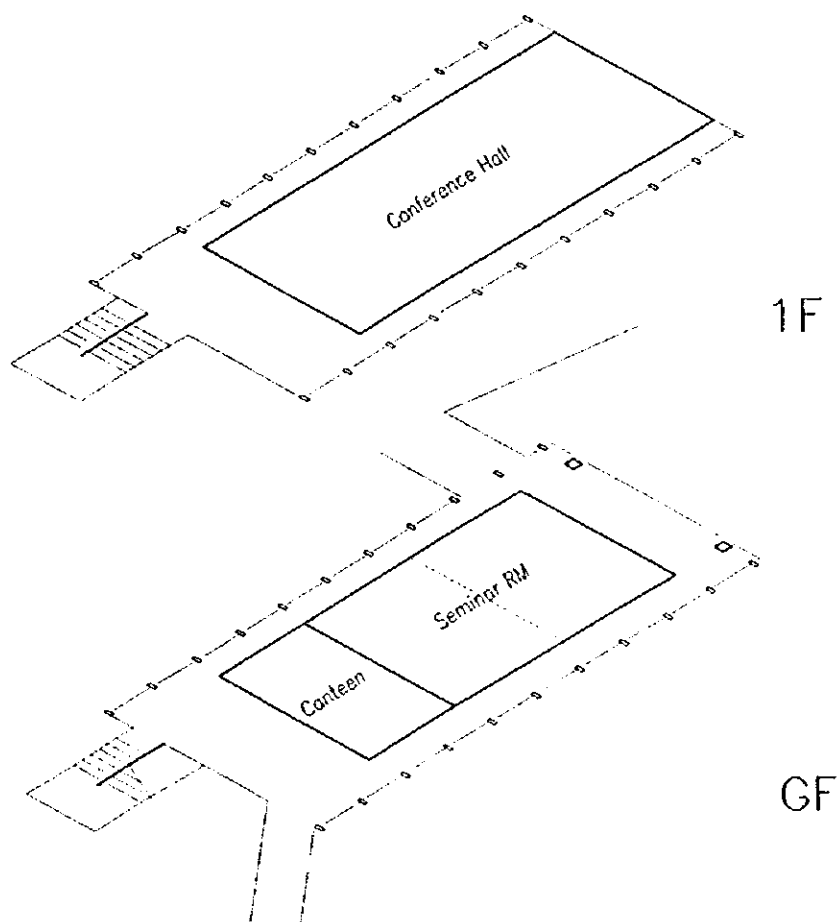


**ZONING OF LABO ANIMAL BLDG.**

c) Conference Hall Building

GF: - Seminar/Canteen area

1F: - Conference area



Based on the sizes of the principal rooms described above, the planned floor area of each building to be constructed under the Project is shown in the next Table.

Table 2-3-7 Floor Area of Planned Major Rooms

1. P 3 Laboratory Building (Total Floor Area: 792 m<sup>2</sup>)

Room Name	Persons	Reason of Area Planning	Planned Area(m <sup>2</sup> )
Maintenance Workshop	7	8 workbench 9m <sup>2</sup> /bench + Machine Space (9m <sup>2</sup> ) = 81m <sup>2</sup> , A/C, Plumb, Elec. Carpentry, each 2 benches (using existing ones)	81
Equipment Storage		Existing Equipment for repair	74
Store Keeper /Transport Office	11	Chief-Driver (10 Psns) x 2m <sup>2</sup> /psn = 20m <sup>2</sup>	21
Transport Parts Storage		Volume of Spare Parts	63
Machine Room		A/C, Generator, etc	134
Ground Floor (S-total)			373
Precision Inst. Lab		Equipment Arrangement	42
Training Laboratory	12	Two training table (! for 12 psn), One table for analytical equipment, Space for floor type equipment	116
Preparation Lab-1		Two persons and equipment space	18
Preparation Lab-2		Two persons and equipment space	23
P 3 Lab-1 (Bac)	2	Two persons and equipment space	21
P 3 Lab-2 (Virus)	2	Two persons and equipment space	28
Freezer Room		Ultra Freezer and Nitrogen Cylinders	7
Admin./Reg. Office	2	Staff for Monitoring(2 psns) x 6 m <sup>2</sup> /psn = 12m <sup>2</sup> , Monitor Panel	14
First Floor (S-total)			269
Other Areas		(Corridor, Hall, WC, etc.)	150
Total			792

(Related Facility)

Over Bridge:

72 m<sup>2</sup>2. Experimental Animal Building (Total Floor Area: 989 m<sup>2</sup>)

Room Name	Persons	Reason of Area Planning	Planned Area(m <sup>2</sup> )
Conventional Animal Rms.			
Monkey Quarantine-Experiment Room		Monkey Cage (13 No) and Quarantine / Experiment space	56
Fowl Breeding Room		Fowl (80 heads), Chick (30 heads)	20
Sheep Breeding Room		Net fence pen for ten Sheep	33
Post-mortem/Waste Room		Freezer for post-mortem and Waste material space	11
Breeding Equip. Store		Existing and Spare Equipment, such as cages and racks	11
Feed/Bed Material Store		Feed Bag and Sow chips for Bedding	69
Feed Preparation Room		Existing Area (40m <sup>2</sup> ) and new machine space	46
Storage/Machine Room			43
Ground Floor (S-total)			289

Room Name	Persons	Reason of Area Planning	Planned Area(m <sup>2</sup> )
<b>Breeding Rooms</b>			
Rabbit Brdg Room		Rack (3 Rep./2 Brdg) and working space	19
Guinea Pig Brdg Room		Rack (3 Rep./2 Brdg) and working space	19
Rat/Humster Brdg Room		Rack (3 Rep./3 Brdg) and working space	17
Mouse Brdg Room		Rack (3 Rep./3 Brdg) and working space	19
Clean Stock/Prep. Room		Stock for Clean Cages, space for Autoclave and Pass Room	22
<b>Exp. Animal Rooms</b>			
Autopsy/Observation Rm.	2	Lab table and working space	19
Animal Experiment Lab.	2	Lab table and working space	22
Animal Exp. Rooms		Clean Rack (5) and working space (20m <sup>2</sup> x 2 Rooms)	36
Infected Animal Exp. Lab.	2	Lab table, Safety Cabinet and working space	33
Infected Animal Rooms		Negative Rack (5) and working space (20m <sup>2</sup> x 2 Rooms)	36
Washing/Steril Room	5	Tables/Sinks for washing and working space	50
Clean/Dirty Corridors		Avoiding to cross-contamination	77
<b>Second Floor (S-Total)</b>			369
Other Area		(Corridor, Hall, WC, etc.)	331
<b>Total</b>			989

(Related Facility) Incinerator/Waste Disposal: 50 m<sup>2</sup>  
 Fenced Animal Yard: 105 m<sup>2</sup>  
 Car Parking: 30 cars

### 3. Conference Hall Building (Total Floor Area: 870m<sup>2</sup>)

Room Name	Persons	Reason of Area Planning	Planned Area(m <sup>2</sup> )
Seminar Room	20	20 psns x 2.5m <sup>2</sup> /psn x 2 rms = 100m <sup>2</sup>	103
Canteen	20	32 psns x 1.5m <sup>2</sup> /psn, Kitchen 14m <sup>2</sup>	63
Lounge		Necessary for guests receiving	50
W C		Male(1 Stl, 2 ur), Female(3 Stl)	41
<b>Ground Floor (S-Total)</b>			257
Conference Hall	117	117 psns x 1.2m <sup>2</sup> /psn = 140m <sup>2</sup> , Stage area	180
Prep/Furniture Storage		Nos. of Equipment and Furniture	16
Lobby		Necessary as waiting space	25
<b>First Floor (S-Total)</b>			221
Other Area		(Corridor, WC, etc.)	392
<b>Total</b>			870

(Related Facility) Walk way: 75 m<sup>2</sup>

## 2) Elevation and Cross-Section Plans

### a) P3 Laboratories

The main P3 laboratories are planned on the first floor as they will mainly be used by the Virology Unit and Bacteriology Unit, both of which are located on the first floor of the existing building. This location on the first floor is also desirable to prevent the careless intrusion of outsiders into these laboratories. A connecting bridge will be introduced between the laboratories and existing building at the first floor level to ensure easy access between the related facilities. The machine room and maintenance workshop, etc. serving the laboratories will be located on the ground floor.

A pitched roof will be employed for the P3 laboratory building to achieve harmony with the existing building and effective heat insulation by the roof. The loft space will be used for the installation of ventilation fans and exhaust duct space. The first floor will have a balcony to shade the exterior walls on the ground floor in order to prevent an excessive rise of the room temperature on the ground floor due to direct sunlight. Louvres will be introduced around the balcony to shut out direct sunlight and radiant heat. The balcony will be used for the installation of the outdoor air-conditioning system units and also for the placement of gas cylinders, etc. The standard floor height will be 3.6 m. A direct ceiling will be employed for the machine room and workshop on the ground floor for functional purposes while a ceiling height of 2.7 m will be secured for the laboratory rooms on the first floor.

### b) Laboratory Animal Building

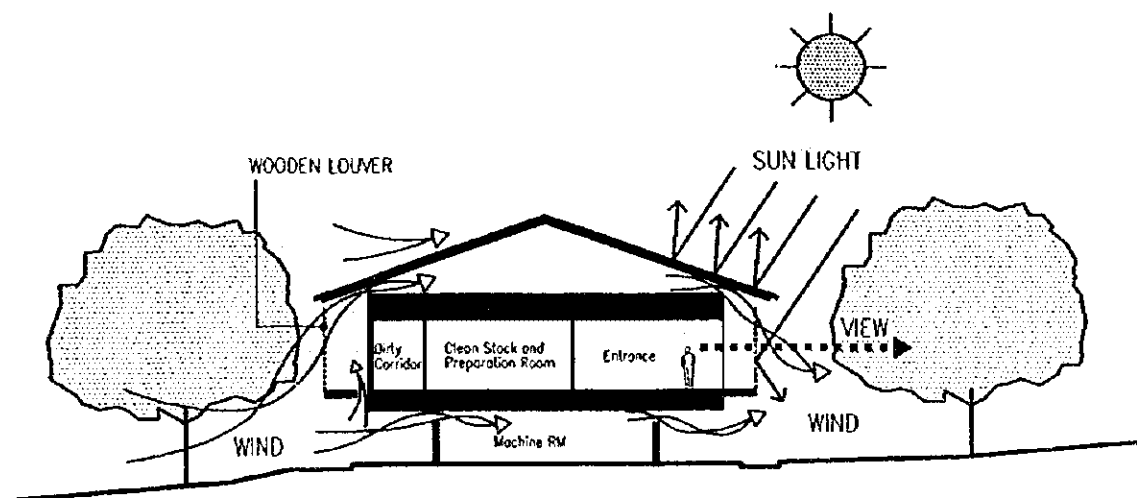
In regard to the laboratory animal building, the laboratory animal rooms are planned on the first floor to maintain the cleanliness of the breeding rooms and animal laboratories and to prevent the undesirable intrusion by rats and outsiders into these rooms. The breeding rooms of wild monkeys, sheep and chickens, feed preparation room and machine rooms, etc. will be located on the ground floor.



A pitched roof will be employed as in the case of the P3 laboratory building and a balcony and louvres will be introduced on the first floor to shut out direct sunlight and radiant heat. The floor height will be 3.6 m for the first floor to secure a ceiling height of 2.7 m. The floor height for the ground floor employing a direct ceiling will be 2.8 m.

c) Conference Hall Building

The conference hall which requires a high ceiling will be located on the first floor while the seminar room and canteen are planned on the ground floor. On the first floor level, an outside passage will be introduced to provide access to the conference hall and this passage will act to prevent the intrusion of direct sunlight into the ground floor rooms. Louvres will be installed on the first floor to shut out direct sunlight and radiant heat. The standard floor height will be 3.6 m for each floor and the ceiling of the conference hall will have a V shape to create pleasant space.



SECTION: LABO ANIMAL BLDG.

### 3) Renovation and Conversion Plan

The purpose of the Renovation and conversion is to re-arrange the research units which have so far been expanded in a disorderly manner in a rational way while locating those research units handling hazardous pathogenic organisms on the first floor to improve the safety and efficiency of the entire institute. Because of the relocation of certain units to the new facilities to be constructed under the Project, the following Renovation work will be necessary.

- a) Renovation of Laboratory Animal Rooms
  - Conversion to library and information corner
  - Conversion to research room of Nutrition Unit
  - Conversion of windowless room to infectious diseases data centre
  - Removal of existing air-conditioning duct
- b) Renovation of Workshop
  - Conversion to Nutrition Unit Laboratory
  - Installation of central / wall-mounted laboratory table
  - Conversion to accounting office and Chief Accountant's Office
- c) Renovation of Conference Room
  - Account unit and Chief Accountat Office

In addition, the following Renovation/conversion is planned as a result of the relocation of the rooms of various research units.

- d) New EM room
  - Conversion from warehouse and installation of laboratory tables
- e) Renovation/conversion of library and seminar room to visiting
- f) Invited Researchers' rooms
  - Installation of partitions, etc. in visiting researchers' rooms  
accommodating 2 - 4 persons

- g) Installation of partitions in each unit head office
  - These partitions are required because of the use of the office with other staff members
  
- h) Related building services work
  - Installation of ventilation fan and supply of electricity to draft chamber, gas chromatograph and atomic absorption apparatus, etc.
  - Provision of Water Supply/Drainage System and LPG supply to some laboratory tables

Following Table shows the concept of new research room allocation and related renovation works.