COUNCIL ON HEALTH RESEARCH FOR DEVELOPMENT

LE CONSEIL DE LA RECHERCHE EN SANTE POUR LE DEVELOPPEMENT

COHRED

African Consultative Process

Situation Analysis of Health Research in Cameroon

PEPARED BY

Dr Martyn T. SAMA - **National Focal Point ENHR**

Prof. Daniel N. LANTUM

Dr. David A. MBAH

Mr. Joseph T. FOGANG

Mr. Etienne M. MINKOULOU

Research for this work was performed under a grant from the Council on Health Research for Development (COHRED).
The opinions, findings and conclusions or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the Council on Health Research for Development.

Table of contents

List of acronyms

AIDS	Acquired Immune Deficiency Syndrome
APOC	The African Programme for Onchocerciasis Control
ARI	Acute Respiratory Infection
CAMNAFAW	Cameroon National Association for Family Welfare
CDD	Diarrheal Disease Control
CEU	Clinical Epidemiological Unit
CRM	Centre de Recherche Médicale
DNA	Deoxyribonucleic Acid
EPI	Expanded Programme on Immunization.
FLSH	Faculté des Lettres et Sciences Humaines
FMBS	Faculty of Medicine & Biomedical Sciences
GDP	Gross Domestic Product
GTZ	German Technical Assistance
HKI	Helen Keller International
HRP	Health Research Programme
IDRC	International Development Research Council
IFORD	Institut de Formation et de Recherche Démographique
IMPM	Institute of Medical Research and Medicinal Plants
IRZ	Institut de la Recherche Zotechnique
ISSEA	Institut Sous-Régional de Statistique et d'Economie Appliquée
MSF	Médecins Sans Frontières
NGDO	Non-Governmental Development Organization
NGOs	Non-Governmental Organizations
NIH	National Institute of Health
ORT	Oral Rehydration Therapy
SSI	Sight Savers International
STD	Sexually Transmitted Diseases
TDR	Tropical Disease Research
UNDP	United Nation Development Programme
UNICEF	United Nation International Children Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Executive summary

NATIONAL CHARACTERISTICS

Cameroon's national territory covers an area of 475,000 km^2 with a population of 13 million (1995), giving an average of 27.4 inhabitants per $km^{2..}$ The population is growing rapidly at a rate of 3.4 % per annum on average. The forecast for the year 2,000 predicts there will be 15-17 million inhabitants. There is very little data on the Cameroon health system. There are no up to date national data for the mortality rate of registered diseases. Available national statistics for the cause of death do not provide a very clear image of the predominant mortality structure. One can assume, however, that the number of cases of malaria and other endemic diseases has increased significantly. This leads one to assume that preventive and medical services are inadequate. The present inadequacy in preventive medicine is also to be seen in the low proportion of the population with access to primary health care.

Major improvements in health are likely to occur with interventions like good sanitation, education, water supply, personal hygiene, nutrition, immunization and specific treatment of diseases. But all disease will not be controlled, so health research will continue to play a vital role in seeking effective utilization of available means, as well as identifying new or improved preventive or therapeutic means to combat disease. To achieve these goals, health research has to balance limited resources with the actual needs for health, which requires setting priorities. To prioritize one needs to analyse the major causes of morbidity and mortality of the environment.

The principal contributor to health research is the Government through universities and research institutions, all under the Ministries of Higher Education, and Scientific and Technical Research. For research, it is estimated that Government invests only about 0.01 dollars per capita, less than 5% of the world's scientific work in health research in developing countries. Research in the country is supported mostly by bilateral and multilateral organizations.

HEALTH RESEARCH CONSTRAINTS

Major constraints facing health research include:

- inadequate planing, resulting from the lack of clear priorities ;
- inadequate, or lack of, research training or recycling for researchers, particularly in writing up research protocols;
- material resource constraints-equipment and maintenance;
- low priority accorded to health research.

PRIORITIES OF HEALTH RESEARCH

Areas of health research to be given priority include: infectious diseases, enquiries, population related problems, environment, nutritional diseases, degenerative diseases and neoplasm.

FUNDING OF HEALTH RESEARCH

Before June 1986 health research in Cameroon was generally well funded. As a result of the structural adjustment policy, since June 1986 until the present, there has been no national funding for health research. Moreover, researchers' salaries were reduced by 60-70%. The result has been demotivation, the brain drain, and a total breakdown of the health research apparatus.

Chapter One: Introduction

1.1 Geographic location and climate

Cameroon's national territory, which extends from 2º to 13º of latitude north between 8º and 16º longitude, covers a total area of 475,000 km^2. At its longest point the country stretches north-south for 1,300 km. The largest east-west distance of 700 km is in the south of the country. Situated between the Atlantic coast of the Gulf of Guinea and the Lake Chad basin, Cameroon sits on the divide between Central Africa and West Africa.

Topographically Cameroon comprises a coastal plain, a high plateau in the south and lowlands of the Lake Chad basin in the north. The vegetation ranges from the southern equatorial forest through a central savanna region to the grasslands of the north. A population of 13 million (1995) lives in a total area of 475,000 km^2 , with an average of 25 inhabitants per km^2, which is relatively dense compared to the neighbouring countries of Central Africa. This population is growing rapidly (3.4% per annum on average). Forecasts for the year 2,000 predict there will be 15-17 million inhabitants, with the number expected to reach at least 29 million in 2025. As in other African countries, the rapid increase in population is due to a rising birth rate coupled with a reduction in deaths.

Demographically, there is a regional imbalance, with a density ranging from 4.7 to 96.6 inh./km^2. The urban population is growing at a pace (6% per annum) and it was estimated that, in 1991, 42% of the total population lived in towns, in particular Douala and Yaounde. The number of economically active persons (39.4% in 1987) is rising, but more so for men than women. At 4.1% per annum, the active population is increasing faster than the total population. In 1987, altogether 65% of persons aged 15 and above made up the active population, of whom 25% were jobless, with unemployment rising as high as 40% in urban areas (1991 estimate). According to the 1987 census, 82% of the active population worked in the primary sector.

Population forecasts

Population forecasts (in 1000)	1995	2000	2005	2010	2015	2020	2025
National estimate.... United Nations:	13,346	15404	-	-	-	-	-
Low variant	13932	16,410	19,897	21,874	24,404	26,813	29,163
Mean variant.....	14,037	16,701	19,897	23,665	27,893	32,264	36,547
High variant..... Variant with constant	14,109	16,848	20,191	24,255	29,173	34,940	41,451
Fertility rate.....	13,892	16,540	19,842	23,962	29,108	35,551	43,642
World Bank.....	13,956	16,324	19,188	22,370	25,792	29,372	33,032

The fact that it has not been possible since World War II to lower the birth rate proves that it will be difficult to bring about a rapid decrease in fertility in the near future. On the contrary, the birth rate between 1915-55 (average) and 1990-95 (average) varies from 43.5 to 47.3 per 1,000 inhabitants. During the same period the average number of births per woman of childbearing age (total fertility rate) increased from 5.68 to 6.90. As the mortality rate has fallen on average by more than half between 1950-55 (27.3 per 1,000 inhabitants) and 1990-95 (average) (13.3 per 1,000 inhabitants), the population has grown at an ever increasing rate. This is also shown by the rise in natural growth from 1.62 (1950-55 average) to 3.56 (1990-95 average). While the period required for the Cameroon population to double was 43 years at the beginning of the 1950s, it had dropped to 20 years at the

beginning of the 1990s. This clearly indicates a sharp increase in population growth since the 1950s. Despite the success achieved in the general fight against mortality, infant mortality is still very high. For the five-year period of 1990-95 the United Nations estimated an infant mortality rate of 86 for every 1,000 live births. This figure means that, at present, nearly one infant in ten dies before its first birthday. The high rates of infant and child mortality result in the low life expectancy at birth of 55 years (average for 1990-95). Life expectancy of women is higher than that of men at 56.5 years (1990-55: average for men 53.5 years).

Chapter Two: Health

The Cameroon health system comprises both the state sector and a considerable private sector. At a central level, health is the responsibility of the Ministry of Health. Other ministries take charge of certain tasks in the health sector, for example the Ministry of Higher Education in charge of the training of medical personnel (doctors. nurses) while the Ministry of Scientific and Technical Research is in charge of health research.

The Ministry of Health is divided into four central divisions: the Department of Planning, Surveys and Statistics/DPSS, Public Health Services: the Department of Preventive Medicine and the Department of Public Hygiene. The Cameroon State health organization works at three different levels. The lowest is made up of health centres and specialized centres that ensure health care for the population at the local level. The second level comprises regional and district hospitals, offering, above all, general medical services. The highest level of state public health services consists of central provincial hospitals, which are equipped with specialized medical services.

In the past, national health policy was determined within the scope of the five-year plans and was oriented towards official objectives in the health strategy of the World Health Organization, which aimed at the provision of health services sufficient to cover fundamental needs. The most important state objectives for public health are the following:

- elimination of the imbalance in geographical distribution of health infrastructure, in particular the elimination of a lack of medical assistance in country areas and in isolated regions in the north of the country;
- ensuring better supplies of pharmaceutical products for the population (expansion of pharmaceutical and chemist networks);
- extension of the mother and child service, including intensification of training programmes for health and nutrition for women of child-bearing age;
- improvement of hospital and first aid capacities;
- campaign against infant mortality and child mortality by means of special preventive medicine, such as monitoring the weight of infants, more use of oral rehydration therapy/ORT, feeding programmes, extension of immunization campaigns and programmes to provide help in the form of foodstuffs targeted at vulnerable groups.

.

There is very little data on the Cameroon health system. There is no up to date national data concerning registered diseases or the mortality rate. The available national statistics concerning the cause of death do not provide a very clear image of the predominant mortality structure. That is why it is necessary to obtain international statistics in addition to national statistics to be able to analyse the Cameroon sector. Apart from the WHO, UNICEF is the body, which supplies most statistics concerning the development of Cameroon's public health services.

Data supplied by the above-mentioned international organizations as to the most frequent causes of disease do not provide a representative picture either. They are mainly confined to diseases that, in the past, reached epidemic proportions. It is, therefore, necessary to remember that the cases reported to the WHO by national health administrations often do not reflect the global importance of the epidemics concerned, especially as problems are frequently experienced in diagnosing diseases, and the epidemics in isolated regions have only been partially registered in the past.

According to the figures of the WHO, Cameroon experienced repeated outbreaks of cholera during the 1970s and 1980s, with a total of 211 cases reported to the WHO in 1973. During the second half of the 1970s the incidence of cholera declined. In 1979, for instance, only 16 cases of cholera were registered. During 1980 and 1981 this figure rose from 229 to 243. At the end of the 1980s it

appeared possible to stem, to a great extent, the propagation of cholera in Cameroon. While in 1988 there were only four cases of cholera reported, the provisional data for 1990 show a figure of 16 cases. The organization *Médecins sans Frontières Suisse/MSF-Suisse* did, however, indicate in 1991 that the northern parts of the country had experienced a serious outbreak of cholera. Between 10 May and 10 August 1991 a total of 1,374 cholera victims (of which 306 people died) were registered in the northern and extreme northern provinces. The extreme northern province was particularly hard hit, with 1,316 cases of cholera registered (of which 306 people died). In the meantime, the European Community has earmarked US$39,000 from its emergency fund for the fight against the epidemic. In addition, international aid organizations have sent 12 tons of medicine and aid products.

Although yellow fever seemed to have been effectively eradicated during the first half of the 1980s (1980: 7 cases: 1984: 1 case), a new epidemic apparently broke out between September and the end of November 1990, according to WHO information. The epidemic centred on the departments of Mayo Tsanaga in the extreme north province where 173 persons were affected by this epidemic (of whom 118 died). This represented a case fatality rate of 68.2%. In particular, it was infants and children (less than 15 years old) who contracted the disease. Seen globally, the yellow fever epidemic was one of the worst that Cameroon had ever reported to the WHO. This recent epidemic is probably the consequence of a much more serious one in the north east of Nigeria, which has been reporting yellow fever outbreaks to the WHO since 1986.

For Cameroon there are no up to date data on the propagation of malaria, which has recently re-appeared in force in western and central Africa. One can, however, assume that the number of cases of malaria has also increased significantly in Cameroon. In general terms, the recent explosion of epidemics leads one to assume that preventive medical service are inadequate. In addition, the concentration of epidemics in the northern regions of the country can be taken as an indicator of the still great regional disparities in health care. This is highlighted in the figure for yellow fever, where the drop in routine immunization programmes in favour of emergency vaccination programmes from 1960 onwards in French-speaking West Africa resulted in repeated outbreaks of yellow fever.

According to WHO estimates, quite apart from diseases of an epidemic nature cited above, there has been a significant increase in the number of transmissible diseases, such as gastro-intestinal diseases of parasitic origins, measles, sexually transmitted diseases, meningitis and polio. The type of diseases underlines very clearly the inadequacy of preventive medical services, such as vaccination campaigns, targeted programmes for the distribution of medicine and programmes to fight against diarrhoea.

Since the end of the 1980s there has been an increasingly rapid spread of AIDS. Between 3 August 1988 and 30 April 1991(registration date in each case), the number of persons contracting the disease in Cameroon, as reported to the WHO, increased from 62 to 429, which is a ratio of approximately 1 : 7. Just as in other Central African countries, AIDS could develop in Cameroon into one of the biggest health problems in the coming years. Compared to neighbouring countries, the incidence of AIDS cases is still quite low. While there were 36 cases of AIDS registered in Cameroon for every million inhabitants in 1991 (date of registration: 30 April 1991), in neighbouring Congo there were already a total of 2,405 cases of AIDS registered as of December 1990, a ratio of 1059 cases of AIDS per million inhabitants. In the Central African Republic the incidence is also appreciably higher than that in Cameroon, with 613 cases of AIDS per million inhabitants (date of registration: 30 June 1990; total number of AIDS cases 1,864). Nevertheless, it is of the utmost importance that a national monitoring programme for AIDS be set up in order to effectively limit the propagation of this disease.

UNICEF provides up to date figures for the development of vaccination programmes against the main infectious diseases affecting infants and young children, which is one of the most important indicators in estimating the effectiveness of preventive medical services. During the period 1981 - 1988/89 it was possible to note very clear progress in the extension of vaccination campaigns initiated by the WHO (Enhanced Programme of Immunization (EPI)). The level attained by immunization vaccination is, however, still unsatisfactory. In 1988-89 a total of 69% of children aged one were vaccinated against tuberculosis. In contrast, less than half of infants aged one had been inoculated against measles, polio and tetanus in1988-89. Taking these figures into account, it seems that WHO objectives, aimied at achieving complete vaccination coverage before 1990 against the main

infectious maladies affecting infants and young children for 75% of the population, had not been achieved. An extension of the vaccination programmes is urgently required in order to arrive at a quicker decrease in infant mortality among young children as well as deaths in the next few years.

Table 2.1: Immunization of infants and pregnant women by percentage of persons vaccinated

Type of vaccination	1981	1986/87	1988/89
Tuberculosis.....	8	77	69
Measles.....	16	44	48
Polio.....	5	43	51
Triple vaccination[1)]	5	45	53
Tetanus[2)]	-	26	32

Source: UNICEF

[1] Triple vaccination against diphtheria, whooping cough and tetanus.

[2] Vaccination against tetanus for pregnant women.

The present inadequacies in preventive medicine are also to be seen in the relatively low proportion of the population with access to primary health care. On average in the years 1985-88, only two fifths of the population (41%) had access to medical services at a distance of less than one hour's travel (town: 44%, country: 30%). At that time only one third of the population had access to drinking water. There was a marked difference in this context between town and country: while 43% of the urban population had drinking water, the figure was less than a quarter (24%) for the rural population. The gaps in preventive medicine are also evident from the fact that, in 1987-98, only 24% of diseases, involving diarrhoea in infants and children of less than 5 years, were treated with saline solutions (oral rehydration therapy-ORT).

Table 2.2 shows an overview of the main causes of deaths during the 1980s. This table is not representative of the total spectrum of causes of deaths since it deals with those deaths registered at medical establishments. However, the list shows that a series of causes of death could be reduced decisively by a health strategy involving effective preventive health care.

An effective grass roots health care system involving the local communities could almost entirely eradicate causes of death, such as measles diarrhoea, tetanus, malaria, malnutrition and pneumonia.

Table 2.2 Breakdown of the causes of death *

CAUSES OF DEATH	1983/84	1984/85	1985/86	1986/87
Acute diarrhoea.....	289	397	425	287
Meningitis.....	314	259	330	221
Tetanus.....	154	232	180	153
Measles.....	450	499	583	353
Malaria.....	261	345	374	305
Malnutrition.....	158	135	243	148
Anaemia.....	101	161	202	113
Pneumonia.....	235	174	311	203
Bronchopneumonia.....	171	210	333	183
Gastro-intestinal diseases.....	115	252	258	171
Total	**2,248**	**2.664**	**3.239**	**2.137**

* **in medical establishments.**

Between 1979 and 1988 the number of hospital beds rose by 27.3% from 22,999 to 29,285. The increase in hospital bed capacity goes practically hand in hand with the increase in population. While in 1979 there were 363 inhabitants per hospital bed, the comparable figure for 1988 was 370 inhabitants per hospital bed.

The density of doctors in Cameroon is relatively low. Between 1973 and 1987 the number of doctors more than doubled, rising from 400 to 888. From one general practitioner per 15,500 inhabitants in 1980, the ratio had gone down by 1987 to an average of one doctor for every 11,800 inhabitants. The situation in dental health care is not favourable, although progress has been achieved recently in this sector, as is shown by the increase in the number of dentists from 10 in 1980 (859,100 inhabitants per dentist) to 48 in 1987 (218,600 inhabitants per dentist). As far as the remaining specialized medical personnel are concerned (chemists, nurses, and auxiliary nurse), there was a marked increase in personnel starting from the second half of the 1970s. The sustained increase was geared to a strategy of primary health care. This, in turn, will add significantly to the number of personnel in preventive medical services during the 1990s.

Table 2.3 Doctors, Dentists and other Medical Personnel

MEDICAL PERSONNEL	UNIT	1973	1975	1980	1985	1887
Doctors……	NUMBER	34	435	533	771	888
Inhabitant per doctor	1000	.	.	15.5	11.2	11.8
Dentist ……	Number	17	19	10	43	48
Inhabitants per dentist……	1000	.	101	859.1	230.5	218.6
Pharmacists	Number	99	2.336	72	191	201
Nurses	Number	1.850	2.336	2,726	4,875	5.418
Auxillary nurse	Number	1.608	2.132	3.140	5.347	6.520

Nutrition: Table 2.4 summarizes some of the findings of the National Nutrition Survey conducted in 1978. The study found that 21.0 percent of children between 3 and 59 months old were chronically malnourished[1] and 4.7 percent acutely malnourished.[2] According to one measure of maternal malnourished (triceps skinfold thickness) 13.6 percent of mothers were malnourished. The data showed that malnutrition is a greater problem in rural than in urban areas. It is also less of a problem in Yaounde and Douala than in other urban areas. Not shown in Table 3 are significant regional differences. The prevalence of maternal malnutrition and acute malnutrition in children is higher in the northern part of the country than the national average. [3.] The pattern of chronic malnutrition in children is somewhat different. Its prevalence in the west, east and north west is higher than the national average (31z, 26.7z, and 24.2z respectively), unlike the north (21.1z) which falls very close to the average.

[1] Defined as less than 90z of the standard height for their age.
[2] Defined as less than 85z of the standard weight for their height in children 3-59 mos
[3] However, in contrast to the protein deficit found among northern children, the protein consumption of northern mothers is higher than that in other regions.

Table 2.4 Measures of malnutrition, 1978

	Children		
	Chronic[1]	Acute[2]	Maternal[3]
Yaounde/Douala	11.8	1.5	2.8
Urban	19.4	2.2	3.1
Rural	22.4	5.3	14.8
All Cameroon	21.0	4.7	13.6

1 child between 3 and 59 months old with less than 90% of the standard height for their age

2 children between 3 and 59 months old with less than 85% of the standard height

3 mothers with a triceps skinfold thickness of less than 7.5mm

Source: Cameroon National Nutrition survey 1978.

The study found malnutrition to be related to illiteracy, population density, inadequate childcare, inadequate diet, recent illness of the child, and insufficient and poor utilization of health services. Water, also plays a significant causal role. Efforts to address nutritional problems in Cameroon have been hampered by a lack of in-depth understanding of nutritional problems, and by the diversity of and lack of coordination between ministries and NGOs (non-governmental organizations) and the Centre for Nutrition and Food Technology involved in nutrition research programmes.

Family planing services are very limited because of prevailing pro-natalist attitudes. Until the establishment of the Cameroon National Association for Family Welfare (CAMNAFAW) in 1987, family planning was not promoted as a programme and the small minority of couples who sought services relied on private and rather discreet services offered by a few daring physicians. The absence of services and relevant expertise in this area has diverted a growing number of desperate individuals and couples towards clandestine abortion. Although traditionally intensive breast-feeding contributes to birth spacing, young and working women abandoning the practice do not always adopt modern contraception (contraception practice among women of child-bearing ages is a low 3 %). The lack of a national population policy constitutes an obstacle to both Government and NGO initiatives in this field. In recent years, church-sponsored groups have been actively promoting natural family planing methods, as concern over teenage pregnancy, illegally induced abortion, abandoned children, and juvenile delinquency have begun to alarm public opinion.

Health Sector policy: Past development plans have sought to achieve total coverage of the population in basic health care services by the year 2000. The strategies outlined for achieving this general policy objective included reducing regional disparity in services, satisfying primary health care needs, providing basic medication to unprivileged groups, improving preventive health care, and promoting and supporting community participation in planing, controlling and funding health care activity. To develop the human resources for implementing these strategies, the Government set up a University Centre for Health Sciences (CUSS), which was to train the health team (physicians, midwifes, nurses, pharmacist and other key paramedical personnel) in one institution, thereby building the community health-care spirit from the classroom. However, the details of the government sector policy, its operational strategy and quantitative objectives have never been clearly defined and articulated. In the absence of comprehensive programme targets, training in CUSS increasingly shifted away from stated objectives and physician training drifted back to classical medicine, drastically reducing the community health content of the curriculum. The sector orientation has been reflected in the increasing attention paid to urban high cost hospital care to the detriment of primary health care services.

Chapter Three: Current status of health research

3.1 Introduction

Significant improvements in health are likely to occur with interventions like sanitation, education, water supply, personal hygiene, nutrition, immunization and specific treatment of disease. But not all diseases will be controlled, so health research will continue to play a vital role in seeking effective utilization of available measures, as well as identifying new improved preventive or therapeutic means to combat disease.

The major goals of this health research would therefore be:

- to improve existing interventions
- to seek new, better and more cost-effective measures.

In order to achieve these goals, health research has to balance limited resources with the actual needs for health and this requires setting priorities. It should be born in mind that health research priorities might differ from priorities of health implementation.

To prioritize one needs to analyse the major causes of morbidity and mortality of the environment.

Priorities are more difficult to establish in our environment, where causes of morbidity and mortality outweigh by far the resources at our disposal. But we have to prioritize, if the research has to contribute to our development and serve as an essential tool for development. Research by priorities will reduce conflicts and duplication between different research teams and health programmes and maximize the use of scarce resources at our disposal.

Research priorities in Cameroon are different from those of developed countries because we are dealing with diseases of poverty due to infections, deficiencies and excessive reproduction.

For some of the diseases no highly efficacious, inexpensive simple control strategies are available in this environment, and even if some control measures exist their applications have constraints like high cost, taboos, complex technology and less efficacy. They are:

- Respiratory diseases
- Diarrhea diseases
- Circulatory diseases
- Low birth weight infants
- Malaria
- Injuries
- Malnutrition
- Neoplasm
- Tuberculosis
- Maternal mortality
- AIDS and S.T. D.
- Trypanosomiasis
- Hepatitis
- Leprosy
- Filariasis
- Helminthiasis (other)

The most prevalent of these diseases in the ten provinces and over the last five years have been malaria; diarrhea diseases, helminthiasis and S.T.D./AIDS

3.2 Areas and organizations involved in health research

To achieve our goals research in Cameroon is now being carried out in the following areas and by the following organizations or institutions:

- The principal contributor to health research is the Government through the institutions of research and the university, all of them under the Ministries of Higher Education, Scientific and Technical Research respectively. Among the institutes of research involved in health research are the Institutes of Medical Research and Medicinal Plants, the Nutritional Centre, the Institute of Social Sciences, the Institute of Agricultural Research for Development, Centre Pasteur, OSTROM, and OCEAC.
- In the university the Medical School carries the heaviest load in health research, but other faculties, such as the Faculty of Science, the Faculty of Letters and the Biotechnology Centre, are involved in different aspects of health research.
- The Ministry of Health, especially its Division of Epidemiology, carries out applied, social and operational research. Other ministries involved with some aspects of health research are the Ministries of Agriculture, Animal Husbandry, and Planning and Regional Development. Among the multilateral organizations involved in subsidizing research there are WHO,UNDP, UNICEF, World Bank, OCEAC and the bilateral organizations including USAID, IDRC (Canada), IWHC (New York), JPHIEGO (Baltimore).

The types of health research that are actually being carried out are the following:

3.2.1 Biomedical and fundamental research

This approach seeks to discover new interventions (vaccines, drugs and diagnostic tools) or improve on existing ones to render them more effective and cost-effective.

Development of vaccines constitutes the most important component of this type of research, since it prevents both morbidity and mortality. In Cameroon biomedical research is mostly carried out by the University Institute of Research and certain faculties (IMPM, CUSS, Faculty of Science, TDR/CUSS project, HRP/CUSS project).

3.2.2 Applied Research

Here the intention should be to modify and test the manufacturing process of drugs and vaccines, making them easier to use and to discover new methods. This is a major priority in developing countries, where control measures are inadequate or non-existent.

In our environment, we seek to improve existing technologies for wider and more cost-effective use. Most of the research that the Ministry of Health undertakes, like drug resistance studies and vector control studies, falls under applied research. Some applied research is carried out in CUSS, like using community women's participation to improve high-risk pregnancy care in rural Cameroon (HRP project). IMPM also does some applied research, particularly in schistosomiasis, trypanosomiasis and malaria.

3.2.3 Epidemiological Research

This is designed to classify the diseases of the environment, test new diagnostic and preventive approaches and evaluate prevalence, incidence and endemicity rates of different diseases, as well as evaluate the risk factors involved. This type of research, even though expensive as it requires

monitoring of an extensive population living with and unfavourable road infrastructure, is necessary for health planning and evaluation, as well as data collection and distribution.

In Cameroon some of these studies are carried out by CUSS and other research institutions like IMPM and OCEAC. The Ministry of Health and other private bodies, like IFORD, have also been involved in some epidemiological research.

3.2.4 Operational and health systems research

This seeks to apply existing knowledge to different socio-cultural aspects of the environment to achieve improvement in the health system in a progressive procedure. It involves health services research and systems analysis. Some of its components are training, health education, planing supervision and community involvement. An example of this has been our study on the role of community women in improving high-risk care rural areas of Cameroon.

The Ministry of Health, CUSS, OCEAC and IMPM carry out this type of research. Generally limited to a circumscribed area, it may be cheaper.

3.2.5 Social research

This seeks to investigate the economic, culture, anthropological, intersectional, agricultural, nutritional, educational and community participation and compliance.
The Ministry of Health carries out some social research on the behavioural factors in disease control, effect of health education and drug compliance. In CUSS some social research is being carried out into the study of the socio-cultural determinants of acceptance or non-acceptance of contraception in the rural areas (LEKE & al), and contraceptive studies on family planning.

The constraint here may be generalizability, because these studies are area specific, similar to operational research.

3.3. Constraints on health research

- Low priority accorded to health research;
- Lack of conceptual approach to health as an instrument for development;
- Inadequate health planning from lack of precise priorities;
- Deficiencies in research management;
- Poor coordination of research and involvement of major stakeholders;
- Inadequate funding, both from Government and private sector; most funding agencies are external;
- Material resource constraints-equipment and maintenance; equipment all comes from the developed world; inadequate technology for research;
- Dissemination of research findings is inadequate; inadequate reporting system; I
- Insufficient local institutional strengthening in research capability;
- Manpower constraints from lack of precise priorities, and transfer of personnel to other projects;
- Inadequate, or lack of, research training or recycling for researchers ;
- Poor infrastructure for roads, transport system, and access to rural areas etc;

3.4 Funding of health research

The average expenditure on health by developing countries is about 3% for the poorest countries, increasing to 4-5% for middle income countries (World Bank 1989).

Non-governmental assistance varies from country to country in Africa. It is estimated that 70-85% of the total expenditure on health are spent on curative services, while only 10-20% go to preventive services like maternal and child health, F.P, breast feeding. (Walsh 1988).
Less than 5-10% go on community services that exert great influence on health, such as vector programmes, education for health, hygiene and disease monitoring.

For research, the developing countries collectively invest about 0,01 dollars per capita, while WHO estimates that more than 20 dollars per capita is invested annually in health research by the developed countries.

According to WHO (1986) less than 5% of the world's scientists work in the developing countries in health research.

The international agencies that support research include WHO, UNDP, the World Bank.

WHO does this through its agencies like TDR, CDD (Diarrheal Disease Control), HRP, ARI (acute respiratory infections) and AIDS programmes.

Bilateral agencies, like USAID, Herman Aid, Swiss, Canadian international Development Research Centre, support research efforts through a small proportion of the health budget.

The priority diseases for which research is funded by TDR are:

- Malaria, *Schistosomiasis*, leprosy, leishmaniases, try-panosomiais and Filaria while HRP supports research on family planning, infertility, and maternal health. Most of these monies are spent on biomedical research and institutional strengthening, with only a small fraction being invested in epidemiological, social or economic research.
- National governments, like the US through the Department of Defense NIH, centres for disease control (CDC), and AID, spend large sums of money on tropical disease research. Very little is spent on research by local government for lack of capability.

- Private foundations: Several private foundations in the US and other industrialized countries fund tropical health-related research, such as Rockefeller. MacArthur and Wellcome. The Rockefeller Foundation has established a network of clinical epidemiology with scientists from 3^{d} world countries collaborating with counterparts in industrialized countries. The Foundation supplies limited funds for each clinical epidemiological unit (CEU) while assisting in the training of faculty for periods of 3 to 18 months in one of their four main training centres. Pharmaceutical manufacturers have been very involved in malaria vaccine research and *schistosomiasis*. In Cameroon the major research funding agency is the Government, with private sector participation being minimal. We receive bilateral and multilateral assistance from WHO, World Bank and UNDP for specific projects.

Health priorities for implementation and research also include:

- Immunization for childhood diseases;
- Oral rehydratation therapy for diarrhoea;
- Acute respiratory infection;
- Vitamin A deficiency leading to blindness;
- Family planing- birth spacing and limiting family size with delay of first pregnancy until after adolescence and reducing grand multiparty;
- Malaria control in endemic areas: chemoprophylaxis for infants and pregnant women, cure of the acute attacks and vector control;
- Health education concerning the importance of personnel hygiene;
- Other diseases of parasitic nature;
- Onchocerciasis control: The African Programme for Onchocerciasis Control (APOC) with collaboration from WHO/TDR and through NGDO like HKI, SSI, Global 2000, etc conducts research and implements control programmes in Onchocerciasis.

Guidelines for predicting success of funded research projects include:

1. present status of research and opportunities for advancement;
2. Expertise of the investigators;
3. Appropriateness of the budget;
4. Record of the institution and scientists involved;
5. Facilities available at the institution;
6. Equipment needs;
7. Stability of the research team;
8. Political climate;
9. Commitment of the investigators;
10. Type of research pursued;
11. Application of results destined for a large population.

3.5 Future orientation

New biotechnology research techniques offer a historic opportunity for rapid discovery of a new look at prevention, diagnosis, epidemiological surveillance and treatment of the endemic diseases of the tropics.

Many new vaccines and drugs will be produced and licensed through this technique, but these new products have to undergo clinical trials before being utilized.
Besides, these biomedical techniques would also open up new avenues through: purified viral proteins from recombinant DNA, genetic variants, synthetic polypeptides, recombinant viruses and bacteria.

In spite of these prospects there must be an appropriate strategy for implementation and delivery to the target population most in need. Scientists, policy makers, and the communities must work together for research to have meaning and purpose.

Continuing investment in health research must be sustained and research funding increased in order that the predicted health techniques become operational.

A programme to increase any areas of research must include strengthening of local institutions in developing countries, linkages among scientists with common interests, community involvement and more training, as well as funding actual investigations.

This improvement could be in the application of the biotechnology techniques:

- To develop new and improved vaccines, drugs, diagnostic, techniques;
- identity large field sites for epidemiological studies and trials;
- Examination of the role of communications and new media in health promotion and training;
- capacity building for operation and health service and policy research;
- Improving management information systems, with special accent on serving the health system.

Operation and health service research especially directed towards a population-based provision of health solutions, with the participation of the local authorities: one such approach has been the use of community women in pilot zones to improve the identification of high-risk pregnancies in the rural areas in Cameroon (LEKE $ al; 1988).

Improvement of the efficiency and management information: even though most of the conditions causing the highest number of casualties in our developing countries are preventable, our very limited resources call for careful planning and selection of health and research priorities.

Figure 3.1 Areas of Health Research in Cameroon

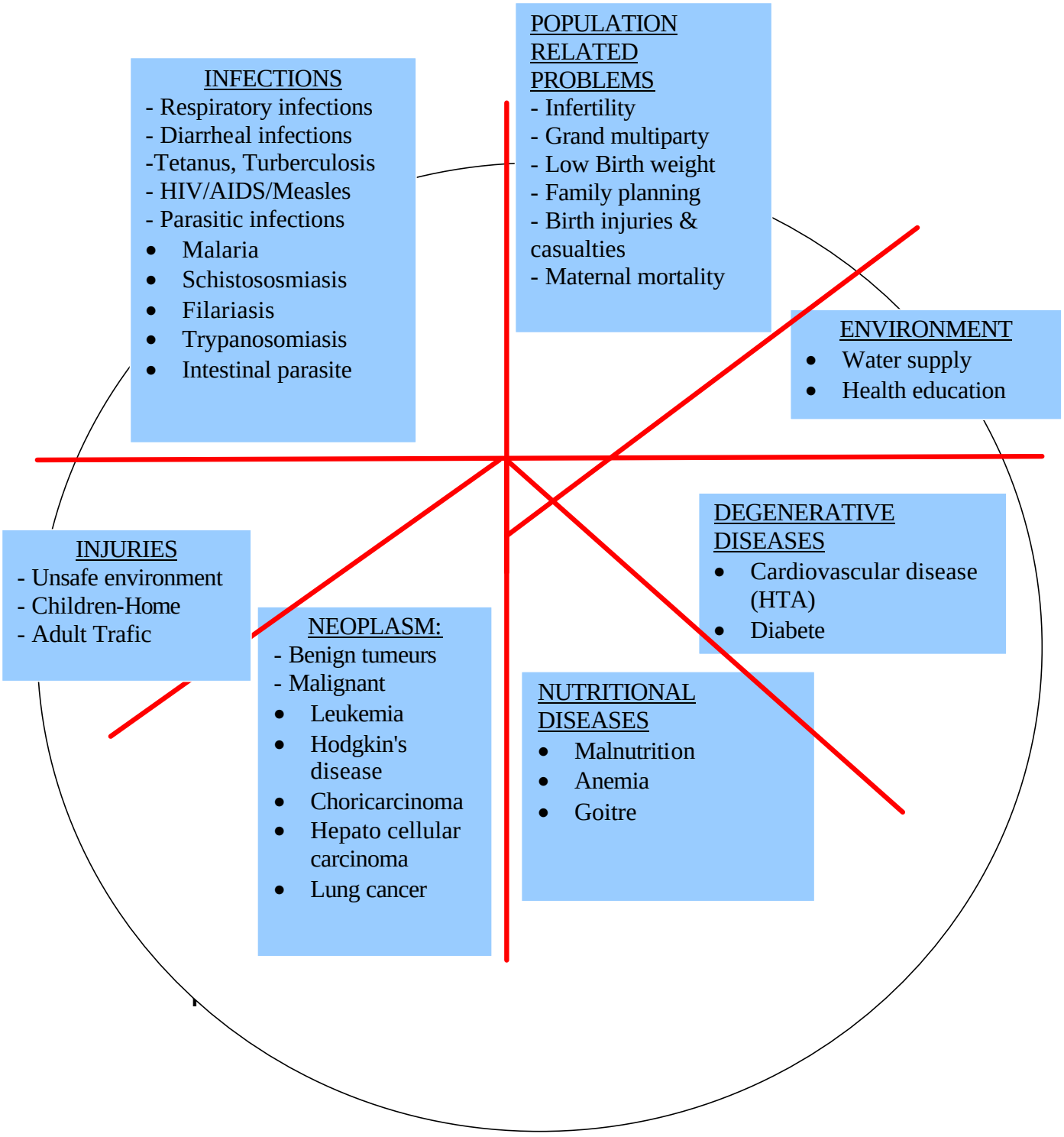


Figure 3.2 : Organizations involved in health research and types of research carried out

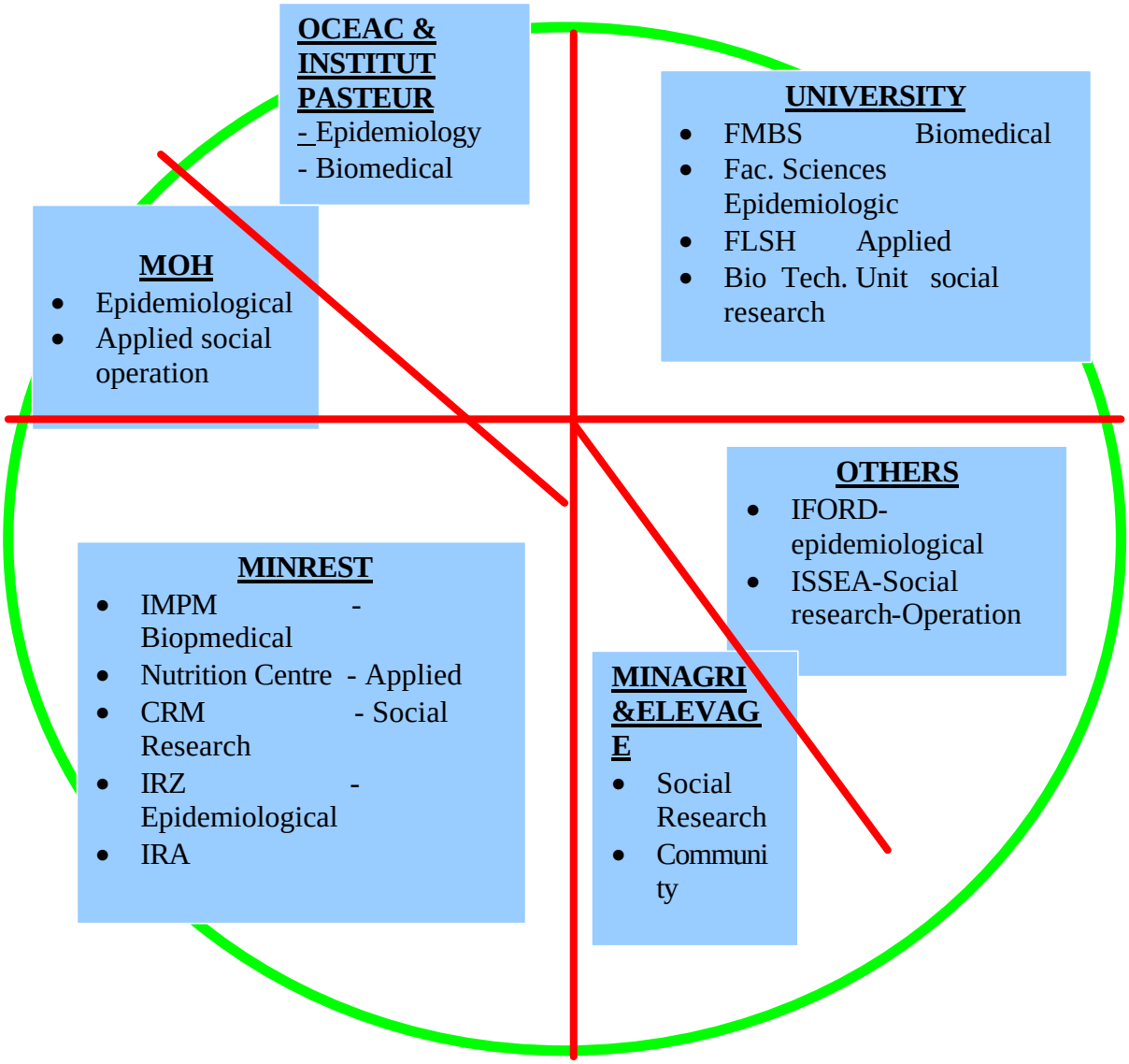
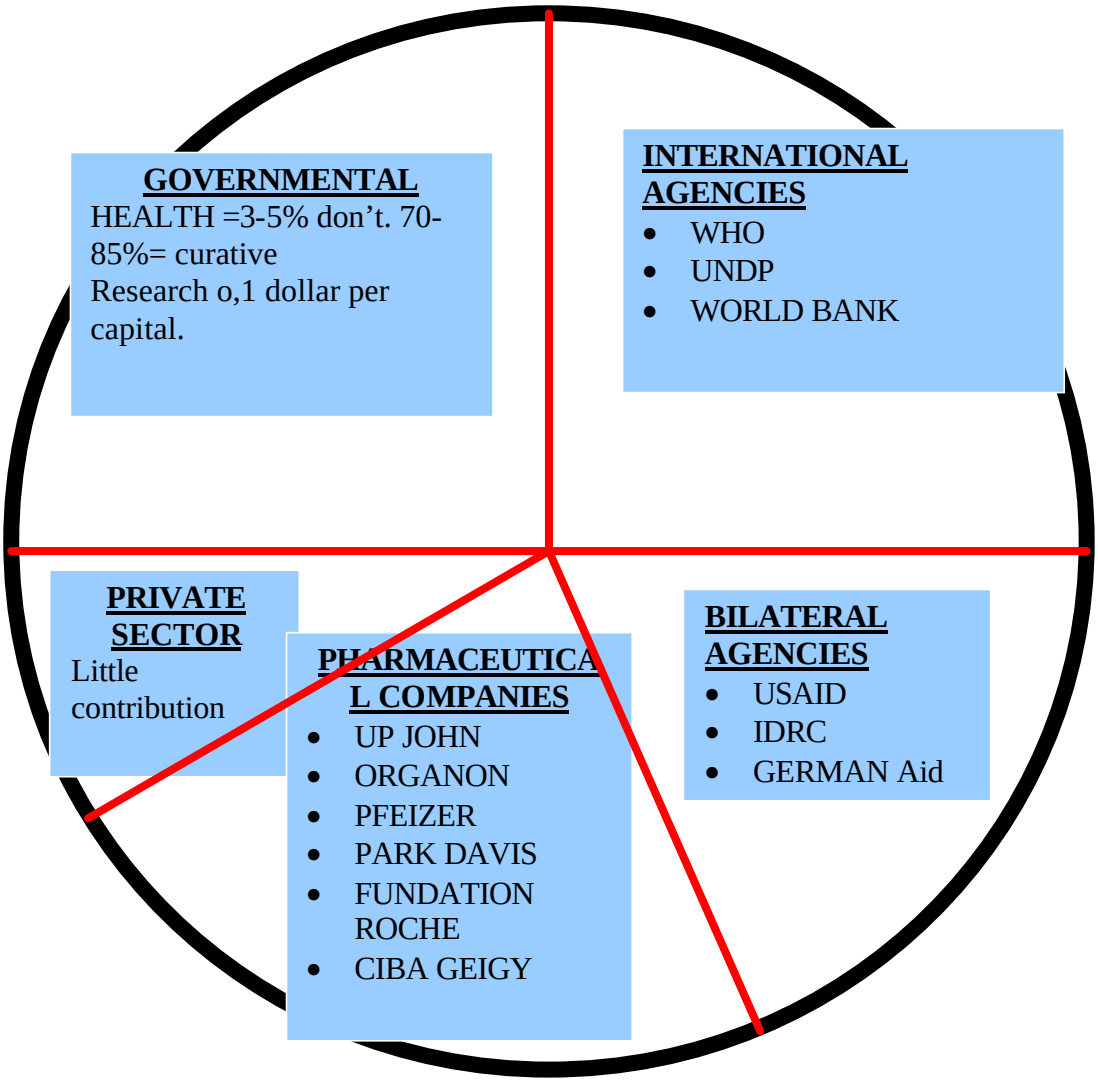

OCEAC & INSTITUT PASTEUR
- Epidemiology
- Biomedical
UNIVERSITY
FMBS Biomedical
Fac. Sciences Epidemiologic
FLSH Applied
Bio Tech. Unit social research
MOH
Epidemiological
Applied social operation
OTHERS
IFORD- epidemiological
ISSEA-Social research-Operation
MINREST
IMPM - Biopmedical
Nutrition Centre - Applied
CRM - Social Research
IRZ - Epidemiological
IRA
MINAGRI &ELEVAGE
Social Research
Community

Figure 3.3: Funding of Health Research



Chapter Four: Case studies

4.1 Cameroon Demographic and health survey (EDSC): Preliminary report 1991

This is the bilingual preliminary report of a survey of certain demographic and health indicators. It looks at fertility rates, infant/child mortality, desirability of children among the married, contraceptive knowledge and use, birth control, immunization of children, prevalence and prevention of diarrhoea in children below 5 years, prenatal and neonatal medical care, as well as the nutritional status of children in Cameroon. The information in the survey was obtained with the use of a questionnaire administered to households, individual women, husbands, and focus groups within the communities. As a preliminary report it contains only certain results of the survey. It also explains sampling procedure and composition, and data processing procedures.

The report contains some interesting elements of the health and demographic situation of Cameroon. For instance, total fertility rates have dropped from 6.1 to 5.9 in the four years running from 1987-1991.The highest fertility in women of child-bearing age is between 20 and 34 years, and drops as they grow older. This varies with residential area - Douala and Yaounde record the lowest rates - and rises as one leaves these areas for the rural areas.

Concerning knowledge and the use of contraceptive methods, seven out of ten women knew at least one contraceptive method. A similar proportion of men knew of at least one method. However, modern methods were more known than traditional ones. Female sterilization was the most widely known modern amongst both men and women, while periodic abstinence was the most widely known traditional method. The degree of use was, on the contrary, very low in both men and women. Men tended to use traditional methods, while only young educated and urban women accepted modern methods. Contraceptive prevalence rates are higher to the south of the country (centre-south-east-region and the litoral-north-west/south-west axis). Most of the modern methods are obtained from public health establishments.

A high proportion of men (81.9%) and women (3/4) wanted more children. However, mostly women below the age of 35 wanted child spacing.

Concerning health care, more than 3/4 of the children involved in the household survey were born of mothers, who had received prenatal care (including vaccination against neonatal tetanus) in a health establishment. Furthermore, a concurrent high proportion of births were assisted by a health professional. Paradoxically only 40% of the children had received complete doses of vaccines for the six targeted diseases of the Expanded Programme of Immunization (EPI), while 21.6% had not received any vaccines at all. The level of education of the mothers and the area of residence (urban or rural) were important factors.
Breastfeeding is very widely used, although it is supplemented with the use of the bottle from about the age of 1 year.

Infant mortality rate stands at 65 per thousand, child mortality is 65.6 per thousand while infant-child mortality is at 126.3 per thousand. As a preliminary report it is evidently lacking in all health and demographic indicators. It is almost exclusively geared towards maternal and child care.

4.2 Ascariasis and Trichuriasis in Cameroon

RC Ratard, MT Sama et al, Tulane University School of Public Health and Tropical Medicine & Institute of Medical research (IMPM)

4.2.1 Abstract

A national survey of Ascaris lumbricoides and Trichuris trichuria was carried out in Cameroon on more than 22,000 children from a random sample of 512 schools. Prevalence rates of both A. lumbricoides and T. trichuria infection were very low in the tropical zone (below 5%). They increased markedly in the equatorial zone, Guinea, to 60-85% for A.lumbricoides and 85-95% for T.trichuria. In the Equatorial Zone with Cameroon -type climate, prevalence were slightly lower: 50-70% for A. lumbricoides and 70-90% for T. trichuria infections. Environmental conditions are the main factors explaining these differences. Other factors (altitude, population density and urbanization) were not important. The entire population of the villages selected from distinct climatic zones of Cameroon were also examined. The age group distribution of A.lumbricoides and T. trichuria infections indicated acquisition early in life, reaching a peak in early childhood, followed by a stable prevalence rate.

4.2.2 Introduction

Interest in the common intestinal helminthes Ascaris lumbricoides, and Trichuris trichuria has been renewed by growing evidence of their adverse effects on young malnourished populations and the potential benefits of targeted chemotherapy (BUNDY et al., 1990). The population infected was estimated at one billion for a. lumbricoides and 500 million for T. trichuria (WHO, 1987). Prevalence estimated for these parasitic infections are often based upon limited surveys not representative of large areas (CROMPTON & TULLEY, 1987; PROST, 1987); very few countries have carried out extensive surveys.

As part of a comprehensive *schistosomiasis* research and training project sponsored jointly by the Republic of Cameroon and the United States Agency for International Development, we had an opportunity to collect data on A. lumbricoides and T. trichuria infections in the context of a national *schistosomiasis* survey (RATARD et al.,1990) conducted from October 1985 to November 1987). In addition, we evaluated the distribution of infection among all age groups by means of surveys of selected villages from different ecological zones.

Cameroon situated on the coast of west central Africa, stretches from 2^0 to 13^o N latitude and from 9^0 to 16^0 E longitude. It has a continuous succession of climates, from lowland rain forest in the south to near desert in extreme north. Human populations show a comparable diversity with over 200 tribal groups represented among the approximately 10,000,000 inhabitants.

4.2.3 Materials and methods

Climatic regions of Cameroon

The distribution of infection was evaluated with regard to climatological as well as geographical and administrative divisions. The northern half of the country (north of 6^0) lies in the tropical climate zone, and the southern half in the equatorial climatic zone.

The provinces of Extreme-north and north, and most of Adamawa province, are in the tropical zone characterized by a short rainy season. The northern-most region of the country receives 500 to 900 mm of rain annually, while most of the North Adamawa provinces receives 900-1,500 mm of rain annually, on 60-75 d (ETIA, 1980). The amount of sunshine is high, around 3,000 h/year (67% of daytime hours). Temperatures are high except in the Adamawa plateau: the mean annual temperature is 28^0 C, with large variations during the day and high mean maximal temperature during the dry season (40^0 C).

The equatorial zone is characterized by abundant rainfall and, although there are dry periods, it rains every month of the year (150-260 d/year). The amount of sunshine varies from 1,000 to 1,900 h/year (22-43% of daytime hours). Mean temperatures in any month do not exceed 30^0 C. the Centre East, and South Provinces have a Guinea-type climate, with 2 rainy and 2 dry seasons and a total annual rainfall of 1,500 to 2,000 mm. The littoral, west, southwest, and northwest provinces have a Cameroon-type climate, with one long rainy season of about 9 months followed by a brief dry period, and receive between 2,000-10,000 mm of rain annually (GWANFOGBE & MELINGUI, 1983).

Sampling plan for the national survey

We used a stratified, random-cluster sampling procedure with the 5th grade (primary school) as the basic sampling unit (RATARD et al., 1990). The stratification units chosen were administrative divisions, which were originally set up with regard to geographical, ethnic and sociological factors that could influence disease patterns.
Sampling units were selected from a complete list of the public and private elementary schools were selected at random with chances of being selected at proportional to the school population.
In the north and extreme-north provinces, school attendance rates, estimated from the last national.

Table 4.1: Distribution of Ascaris and Trichuris infection

Province, cliamatic zone and division.	No. of stools examined	No. of stools Ascaris	Positive Trichuris
Extreme North province **1.Tropical zone** **la Sahara zone**			
Logone Chari	579	6 (1.0%)	14 (2.4%)
Diamare	615	15 (2.4%)	20 (3.3%)
Mayo Tsanaga	557	41 (7.4%)	13 (2.3%)
Kaele	554	4 (0.7%)	29 (5.2%)
Mayo Sawa	474	19 (4.0%)	13 (2.7%)
Mayo Danay	698	7 (1.0%)	19 (2.7%)
Total for Province	3477	92 (2.6%)	108 (3.1%)

North province **Ib. Sudan zone**			
Beoue	544	11(2.0%)	31 (5.7%)
Faro	198	7(3.5%)	36 (18.2%)
Mayo louti	469	7(1.5%)	34 (7.2%)
Mayo Rey	511	4(0.8%)	15 (2.9%)
Total for province	1722	29(1.7%)	116 (6.7%)
Adamawa province **Ib. Sudan zone**			
Vina	513	23 (4.5%)	83 (16.2%)
Mayo Banyo	321	102 (31.8%)	113 (35.2%)
Mbere	440	33 (7.5%)	94 (21.4%)
Djerem	280	30 (107%)	90 (32.1%)
Faro Deo	303	25 (8.3%)	22 (7.3%)
Total for province	1857	213 (11.5%)	402 (21.6%)
Centre province **2. equatorial zone** **2a. Guinean zone**			
Mefou	683	474 (69.4%)	625 (91.5%)
Lekie	1029	717 (69.7%)	1002 (97.4%)
Nyong Kelle	770	462 (60.0%)	711 (92.3%)
Nyong Soo	531	448 (79.9%)	546 (97.3%)
Nyong Mfoumou	328	273 (83.2%)	322 (98.2%)
Haute Sanaga	335	246 (73.4%)	292 (87.2%)
Mbam	1374	930 (67.7%)	1217 (88.6%)
Mfoudi	280	91 (32.5%)	178 (63.6%)
Total for province	5360	3641 (67.9%)	4893 (91.2%)
East province **2a. Guinean zone**			
Boumba Ngoko	282	255 (79.8%)	276 (97.9%)
Lom Djerem	622	348 (55.9%)	419 (67.4%)
Haut Ngong	408	343 (84.1%)	374 (91.7%)
Kadey	450	328 (72.9%)	382 (84.9%)
Total province	1762	1244 (70.6%)	1451 (82.3%)
South province **2a. Guinean zone**			
Dja Lobo	364	296 (81.3%)	358 (98.4%)
Ocean	239	166 (69.5%)	226 (94.6%)
Ntem	271	221 (84.5%)	266 (98.2%)
Total for Province	874	683 (78.1%)	850 (97.3%)

Litorial province 2b. Cameroon zone			
Mongo	620	378 (61.0%)	535 (86.3%)
Wouri	475	276 (58.1%)	406 (85.5%)
Nkam	246	151 (61.4%)	217 (88.2%)
Sanaga Maritim	1048	505 (48.2%)	932 (88.9%)
Total for province	2386	1310 (54.8%)	2090 (88.7%)
West province 2b. Cameroon zone			
Noun	556	285 (51.3%)	250 (45.0%)
Bambouto	292	146 (50.0%)	236 (80.8%)
Menoua	213	134 (62.9%)	186 (87.3%)
Mifi	566	386 (68.2%)	469 (82.9%)
Haut Nkam	615	417 (67.8%)	491 (79.8%)
Nde	238	148 (62.2%)	169 (71.0%)
Total for province	2480	1516 (61.1%)	1801 (72.6%)
Northwest province 2b. Cameroon zone			
Menchum	256	151 (59.0%)	109 (42.6%)
Ndonga mantung	241	136 (56.4%)	38 (15.8%)
Momo	164	108 (65.9%)	101(61.6%)
Mezam	317	204 (64.4%)	115 (36.3%)
Bui	207	102 49.3%)	34 (16.4%)
Total for province	1185	701 (59.2%)	397 (33.5%)
Southwest province 2b. Cameroon zone			
Manyu	232	110 (47.4%)	158 (68.1%)
Ndian	218	157 (72.0%)	178 (81.7%)
Meme	341	198 (58.1%)	296 (86.8%)
Fako	269	157 (58.4%)	219 (81.4%)
Total for province	1060	622 (58.7%)	851 (80.3%)
Total survey	**22166**	**10051(45.3%)**	**12959 (58.4%)**

Census, were much lower than in the other provinces (35% versus 90-95% attended school). Because of the low attendance rates, the survey method in these two provinces was modified to ensure adequate representation of the overall child population. In the villages with selected schools, all children from the appropriate age group living in the community were invited to participate.

Community survey

Villages were selected from distinct climatic zones of Cameroon. From the tropical zone, Sudan-type climate: Douloumi; from the equatorial zone, Guinea-type climate: Kindig in the Savannah area, Mfou in the forest area, and Yaounde (Obili quarter)in an urban area; from the equatorial zone, Cameroonian type climate: kumba (Nkoto quarter) in each village or section of a town, a complete census was conducted and a house to house survey was carried out. Visits were repeated until samples were collected from>95% of the population enumerated in the census.

Specimen collection and examination

Approximately 2 g of faeces were collected from each participant using a 4 ml plastic tube with a snap-cap, pre-filled with 5 mg of sodium azide. Applicator sticks were used to mix the samples thoroughly. Samples were later examined at the central laboratory in Yaoundé by a thick smear technique, using a 43mg Kato-katz teemplate (WHO, 1983). For quality control, 10% of the examinations were repeated by a supervisor. Children infected with Ascaris were treated with pyrantel pamoate, 10 mg/kg in a single dose.

4.2.4 Results

National survey

They survey was carried out over a 2 year period in 512 schools; 22166 children participated (table 1). Prevalence rates of both A. lumbricoides and T. trichuria infection were low in the tropical zone, below 5% in the Extreme -north and north provinces. Towards the South of the tropical zone, in Adamawa province, some areas had higher prevalences: 15% of A.lumbricoides and 40% of T.trichuria infection in the town of Ngaoundere and 50-70% in the Mayo Banyo division. Infection prevalence rates increased radically in the equatorial zone, Guinea-type climate, where the highest were found: 60-85% (interquartile range, Q1-Q3) for A.lumbricoides infections and 85-90% for t. trichuria infections. In the equatorial zone with Cameroon type climatic prevalence were slightly lower 50-70% for A.lumbricoides and 70-90% for T. trichuria infections.

Within climatic zones, there appeared to be no difference in prevalence between rural villages, small towns and cities or between high and low altitude areas.

Table 4.2: Prevalence of ascaris and Trichuris by age group in five selected communities in Cameroon

Age group (years)	No. Ex.	No. infected with Asc.[a]	Tri.[a]
1. Doulomi			
0-4	18	0	0
5-9	85	1 (1.2%)	0
10-14	85	1 (1.2%)	0
15-19	28	1 (3.6%)	0
20-44	38	0	0
>44	4	0	0
Total	258	3 (1.2%)	0
2.Obili			
0-4	23	4 (17.4%)	0 (39.1%)
5-9	29	7 (24.1%)	25 (86.2%)
10-14	18	4 (22.2%)	14 (77.8%)
15-19	23	7 (30.4%)	19 (82.6%)
21-44	67	12 (17.9%)	33 (49.3%0
>44	10	1 (10.0%)	3 (30.0%)
Total	170	35 (20.6%)	103 (60.6%)
3.Kindig			
0-4	38	13 (34.2%)	22 (57.9%)
5-9	52	13 (25.0%)	36 (69.2%)
10-14	38	8 (21.1%)	29 (76.3%)
15-19	16	4 (25.0%)	12 (75.0%)
21-44	70	20 (28.6%)	39 (55.7%)
>44	60	18 (30.0%)	39(65.0%)
Total	274	76 (27.7%)	177 (64.6%)
4. Mfou			
0-4	36	11 (30.6%)	18
5-9	46	16 (34.8%)	32
10-14	36	13 (36.1%)	29
15-19	33	14 (42.4%)	23
21-44	63	178 (27.0%)	31
>44	10	21 (20.0%)	6
Total	224	73 (32.6%)	139
5. Kumba			
0-4	47	21 (44.7%)	12 (25.5%)
5-9	150	100 (66.7%)	59 (39.3%)

10-14	147	78 (53.1%)	65 (44.2%)
15-19	67	31 (46.3%)	34 (50.7%)
21-44	176	65 (36.9%)	79 (44.9%)
>44	49	17 (34.7%)	17 (34.7%)
Total	636	312 (49.1%)	266 (41.8%)

[a] Abbreviations: Asc.=Ascaris, Tri.=Trichuris.

Community surveys

Results of the community surveys were similar to those of the national survey. The village in the tropical zone had an extremely low prevalence of both A. lumbricoides and T. trichuria in all age groups and both sexes. The villages in the equatorial zone had much higher prevalence (Table 4.2)

Infection with A. lumbricoides was acquired very early in life: prevalence in the 0-4 year age groups ranged from 17 to 44% in the equatorial villages. The prevalence increased in childhood, reached a peak and then slowly declined. There was no significant difference between age groups except in Kumba, where the peak prevalence was among children aged 5 to 9 years (Table 3)
Comparison by sex, after stratification by age group, showed no significant difference except for A. lumbricoides infections in Kumba, where female infection rates were consistently higher than males after 5 years.
For T. trichuria infections, the trend was very definite (significant differences in 3 of 4 communities declined or remained stable.

Table 4.3: Comparison of uninfected vs infected rates by age group in four selected communities in Cameroon

Ascaris			
X^2	P	X^2	
2. Obili			
2.74	0.74	26.83	<0.001
3.Kindig			
2.07	0.83	6.69	0.24
4. Mfou			
3.45	0.63	13.81	0.016
Kumba			
34.52	<0.001	9.75	0.08

[a] numbers of communities correspond with those in Table 4.2

4.2.5 Discussion

Large geographical differences in prevalence have been observed in several other countries in Africa: from 1 to 98% for a. lumbricoides in Nigeria (OOMEN, 1974; kALE, 1977), 0 to 79% in Ghana (ANNAN et al., 1986), and 6 to 66% in Ivory Coast (NOZAIS et al.,1981). Several countries have extremely low prevalence, such as Chad (BUCK et al., 1970), Mali, Burkina Faso, Mauritania, Niger and Senegal (PROST,1987). In Cameroon the few prevalence surveys for intestinal helminthes carried out in villages of the northern provinces showed very low rates of infection (FOBA PAGOU et al., 1980; GRANIER et al., 1985; RIPERT et al., 1983).

Environmental conditions play a major role in the transmission of both of these parasites. A.lumbricoides and T. trichuria eggs mature inside their shell while in the environment before becoming infective. It takes 2 to 3 weeks for the infective larvae to develop. Ascaris eggs remain dormant under dry conditions while Trichuris eggs are much less resistant to desiccation. A

combination of heat and low humidity is detrimental to the survival of the eggs and direct exposure to sunlight will kill them. The nature of the soil may also influence the maturation of the eggs; those deposited on clay survive better than those on sandy humus (BEAVER,1952).

In Cameroon, prevalence is very low in the dry, hot and sunny environment of the tropical zone with rainfall less than 1,500 mm annually. Sunshine for 67% of daytime hours means annual temperatures of 28^{o}C, very sparse vegetation and sandy soils, in the equatorial zone prevalences are uniformly high: above 1500mm rainfall annually, 20 to 40% sunshine, mean temperature of 24 to 26^{0} C, dense vegetation, soils richer in clay and less permeable. Similar observations were made in West Africa. In a comprehensive review of the geographical distribution of ascariasis in parts of west Africa,PROST (!987) concluded that high prevalence were observed in areas receiving more than 1400mm of rainfall annually.

Seasonal variations in transmission rates could not explain the differences observed. For example, in the equatorial zone, with Guinea-type climate, the divisions of Mefou and Lekie were survey in October and November 1985 in the middle of the main rainy season; Nyong kelle, Nyong Soo, Nyong Mfoumou and Haute Sanaga were surveyed in from December 1985 to march 1986 during the dry season; Mban and Mfoundi in April 1986 during the 'small' rainy season; the East province was surveyed in January and February 1987 during the dry season and the south province in April during the 'small' rainy season. All of these surveys showed the same very high prevalence rates, above 80%. The survey in the equatorial zone Cameroon-type climate was also carried out during rainy and dry seasons and the season did not influence the results. The tropical zone was surveyed almost entirely during the rainy season. A longitudinal study with surveys every 6 months carried out in the school at Makenene, Mbam division did not show any variation with the season (data not presented).

Altitude was cited as a possible environmental factor to explain some differences in distribution of these infections in Tanzania, where prevalence was lower at low altitudes (CROMTON &TULLEY, 1987). No such pattern was observed in Cameroon .

As in other studies in West Africa (PROST,1987) urbanization was not a major factor in determining prevalence, sanitation, socio-behavioural factors, agricultural practices, and nutritional behaviours have a more discrete influence on the distribution of these parasites and are not obvious in a national survey.

Common estimations of global prevalence of intestinal nematodes suggest that A lumbricoides infection is more prevalent than T. trichuria (ARFAA,1986). BUNDY (1986). However, it was suggested that this might not always be true. The better resistance to adverse environmental conditions of Ascaris eggs have been invoke to explain the usually higher prevalence of Ascaris infections (ARFAA,1986). The geographical distribution of infection by T. trichuria and A. lumbricoides was similar in Cameroon, but the prevalence of T. trichuria infections was consistently higher in the present study.

The age group distribution of A. lumbricoides infections follows the patterns reported by other authors: early acquisition in life, peak in early childhood, then stable prevalence (FORRESTER et al., 1988; ELKINS etal.,1986; BRUNDy etal., 1987). The prevalence of ascariasis among men and women does not differ significantly (ARFAA,1986) except in a few areas where prevalence among females may be higher (ELKINS et al., 1986), as was the case in Kumba.

A better transmission of Ascaris and Trichuris in the tropical zone would be great help in planing future control programmes. This information would be valuable for establishing priorities by region, age sex for programmes to reduce the adverse effects of intestinal parasitism in children. Such programmes, which might include drug therapy, environmental and behavioural modification, should be initiated in the population groups with exceptionally high infection rates.

4.2.6 Acknowledgement

This work was supported by the USAID-Cameroon health Constraints to Rural Production project no. 1608-0408.1.

References

Annan, A., Crompton, D.W T., Walters, D.E.&Arnold, S.E. (1986). An investigation of the prevalence of intestinal parasites in pre-schoolchildren in Ghana. Parasitology, 92, 209-217.

Arfaa, F.(1986). Ascariasis and Trichuriasis, In:Strategies for Primary Health Care, Walsh, J & Warren K.S. (editors) Chicago: University of Chicago Press, pp. 178-188.

Beaver,P.C. 91952). Observation on the Epidemiology of ascariasis in a region of high hookworm endemicity. Journal of parasitology, 38, 445-453.

Buck, A.A.Anderson, R.J. Sasaki, T,T. & Kawara K, (1970), health and Disease in Chad. Baltimore: Johns Hopkins Press.

Bundy, D, A, P,(1986). Epidemiological aspects of Trichuris and trichuriasis in Caribbean communities. Transactions of the Royal Society of Tropical Medicine And Hygiene, 81. 987-993.

Bundy, D. A. P., Wong, M. S. Lewis, L. L. & Horton,J. (1990). Control of geohelminths by delivery of targeted chemotherapy through schools. Transactions of the Royal Society of Tropical Medicine and Hygiene, 84, 115-120. Crompton, D. W. T. & Tulley, J. J. (1987). How much ascariasis is there in africa? Parasitology Today, 3, 123-127.

Elkins, D. B., Haswell-Elkins, M. &Anderson. R. M. (1986). The epidemiology and control of intestinal helminths in the Pulicat Lake region of Southern India. I. Study design and pre-and post-treatment observations on Ascaris lumbricoides infection. Transactions of the Royaal Society of Tropical Medicine and hygiene, 80, 774-792. Etia, P. M. (1980). Climate. In: atlas of the United Republic of Cameroon. Paris: Editions Jeune Afrique, p. 16.

Foba-Pagou, Paris: Kegoum, E., Same-Ekobo, A.,A., Eben-Moussi, E., Faucher., Carrrie, J. & Ripert, C. (1980). Etude épidémiologique des helminthiases intestinales (ascaridiose, necatorose, teniasis, biharziose) dans la ville de Maroua (Nord Cameroun). Bulletin de la Société de Pathologie Exotique, 73, 171-178.

Forrester, J. E. Scott. M. E., Bundy, D. A. &Golden, M, H. (1988). Clustering Of Ascaris lumbricoides and Trichuris trichuria infections within households. Transactions of the Royal Society of Tropical Medicine and Hygiene, 82, 282-288.

4.3 Estimation of the number of cases of schistosomiasis in the country: the example of Cameroon

RC Ratard, MT Sama LE Kouemeni et al, Tulane University School of Public Health and Tropical Medicine & Institute of Medical research (IMPM)

4.3.1 Abstract

An estimate of the number of *schistosomiasis* infections in Cameroon was based on a statistically representative national prevalence survey carried out in the entire country. The number of cases of infection by Schistosoma haematobium was estimated to be 393 900, and 419 600 for S.*mansoni* a total of 813 500. Taking into account the dual infections the total number of cases was 719 100 (95%) confidence interval: 392 900-1 027 800). A current World Health Organization estimate extrapolating from the results of limited epidemiological surveys showed 2 239 591 cases for Cameroon, an estimate 3.1 times higher than the more accurate estimate based on the national survey. *Schistosomiases* being a focal disease, prevalence observes in limited foci are not representative of regional prevalences. Prevalence survey data in the literature are biased toward reporting only positive results. Therefore, extrapolations made on limited surveys may lead to an overestimation of the number of cases of *schistosomiasis*.

Table 4.4. Relation between prevalence rates among children and the general population for Schistosoma haematobium and s. *mansoni* in Cameroon

Location	Reference[a]	Species[b]	year	Prevalence rates children[c]	Total	Ratio (total/childr en)
Katoual, Extreme-north	1	Sh	1989	35.8	9.9	0.28
Minawa, Extreme-north	1	Sh	1989	8.4	2.9	0.34
Zongoya, Extreme-North	1	Sh	1989	20.2	7.6	0.38
Douloumi, North	2	Sh	1987	70.3	32.2	0.46
Kindig, Centre	3	Sh	1986	51.3	18.9	0.37
Kumba, South-west	4	Sh	1988	15.2	27.9	0.54
Koza, Extreme-North	5	Sm	1981	28.0	16.3	0.58
Tala Mokolo, Extreme-North	6	Sm	1985	76.0	38.1	0.50
Mayo Guerleo, Extreme-North	5	Sm	1983	5.0	2.6	0.52
Nkolbisson, Centre	7	Sm	1982	62.0	31.0	0.50
Minkama, Centre	8	Sm	1978	17.0	13.2	0.77
Bafia, Centre	8	Sm	1982	24.0	18.6	0.77

Mean ratio[d]: sh=0.40 (0.21-0.57), Sm=0.61 (0.34-0.86)

4.3.2 Introduction

Schistosomiasis is one of the most common human parasite infections world-wide. Current estimate are that about 200 million may be at risk of infection (WHO, 1985). While prevalence data on *schistosomiasis* infection are available for a wide variety of foci, there is reliable information on prevalence for entire countries. Very few countries have carried out systematic surveys or have comprehensive screening programmemes for *schistosomiasis*. The most comprehensive work

[a] References: 1,ANYANGWE, 1990; 2, NDAMKOU, 1989; 3, RATARD et al., 1990; 4, **SAMA 1990**; 5, RIPERT et al., 1983; 6,GRANIER et al., 1985; 7, SAME EKOBO et al., 1983; 8, RIPERT et al., 1982.

[b] Sh=S. haematobium, sm=S. *mansoni*.

[c] Children aged 10-19 years.

[d] 95% confidence interval in parentheses.

available on the global distribution of *schistosomiasis* is a compilation of limited surveys done in different countries (DOUMENGE et al., 1987)

Attempts to estimate the number of *schistosomiasis* infections country-wide are based on extrapolation of data gathered from limited prevalence surveys (IAROTSKI & DAVIS, 1981). The infected population is calculated by multiplying the population at risk by the average prevalence rate. Estimating the number of infections from nation-wide surveillance system data has seldom been attempted in endemic areas, given the uncertainties of the information collected.
The aim of this study was to estimate the number of *schistosomiasis* infections based on a statistically representative national prevalence survey carried out in Cameroon and to compare it with estimates obtained by other methods.

4.3.3 Materials and Methods

The data were collected during a national survey of *schistosomiasis* in Cameroon in 1990-1987 (RETARD *et al.,* 1990), to provide prevalence data on children's infection . The sampling plan was designed to obtain prevalence rates representative of those in the divisions and provinces. The age group selected ranged from 10-19 years.
To estimate prevalence rates for the general population, we extrapolated from the prevalence rates among those aged 10-19 years. This extrapolation was based on the results of several surveys in villages in the entire population was examined. This villages were located in different ecological areas of the country, in the following provinces: Extreme-north (ANYANGWE, 1990; GRANIER *et al.,* 1985; RIPERT *et al.,* 1981 1983), North (NDAMKOU,1989), Centre (RETARD & GREER, 1992; RIPERT *et al.,* 1978, 1982 ; SAME EKOBO *et al.,* 1983).and South-west **SAMA,1990**
The ratio between prevalence in the general population and the 10-19 years age group is shown in table 1. The ratio ranged from 0.28-0.54 with a mean of 0.40 for *schistosoma haematobium* infections, and from 0.50-0.77 with a mean of 0.61 for *S. mansoni* infections. Therefore, to estimate the mean prevalence in the general population we multiplied the prevalence among children age 10-19 years by 0.40 for urinary *schistosomiasis* and by 0.61 for intestinal *schistosomiasis*. The 95% confidence internals were calculated to obtain a low and a high estimate of the prevalence. The population of each province was multiplied by these calculated prevalences in the overall population to estimate the mean total number of cases, together with a high and a low estimate. For each province the proportion of dual infections among persons infected was calculated and used to estimate the number of persons infected without counting dual infections as 2 cases.

4.3.4 Results

The results of these calculations are presented in table 2. The number of cases of infection by S.haematobium was estimated to be 393,900 (206 300-340 000), and 419, 600 (238 100-602 400) for S. *mansoni*. These represent a national prevalence of 3.9% for S.haematobium and 4.1% for S.*mansoni* infections. The average number of cases reported by the passive case detection system is also presented: the number represented only 2.7% for S.haematobium and 1.9% for S. *mansoni* infections.

The estimated total number of cases of *Schistosomiasis*, obtained by adding the separate estimates for S. haematobium and S. *mansoni* amounted to 813 500 (44 400-1 162 400). However, there were some dual infections. As expected, the proportion of dual infection was high in the areas with prevalences of both s.haematobium and S. *mansoni*, that is the Extreme-north and north provinces (respectively 10% and 20%). In the other provinces the prevalence of dual infections was very low (0-1%). Taking into account the dual infections the total number of cases was reduced to 719 100 (392 900-1 027 800).

Table 2. Estimated number of cases of *schistosomiasis* in Cameroon.

Province	**Estimated pop.1984-1985**	Urinary *schistosomiasis*						Intestinal *schistosomiasis*			
		Prevalence		Estimated passive proportion				Prevalence		Estimated passive proportion.	
		Obser. (10-19)	Estim. (total)	Total on. total no. of cases	Case detection . years	reported case (%)	obser. years	(10-19)	Estimated (total)	Reported case detection (%)	
Extreme-North	1644000	35.2	14.1	231800	7500	3.2	8.9	5.3	87100	3500	4.0
North	941000	27.0	10.8	101600	850	0.8	35.6	21.4	201400	1800	0.9
Adamaoua	406000	1.7	0.7	2800	120	4.3	19.9	11.9	48300	600	1.2
North-West	1135000	0.0	0.0	0	10	-	1.5	0.9	10200	20	0.2
South-West	756000	1.7	0.7	5300	500	9.4	0.3	0.2	1500	40	2.8
West	1300000	1.0	0.4	5200	100	2.0	1.3	0.8	104000	150	1.5
Litoral	1464000	5.8	2.3	33700	750	2.2	0.5	0.3	4400	600	13.6
Centre	1650000	0.4	0.2	3300	150	4.5	5.4	3.2	52800	850	1.7
South	403000	0.6	0.2	800	5	0.6	0.6	0.4	1600	30	1.9
East	470000	4.9	2.0	9400	550	5.8	0.7	0.4	1900	150	7.9
Cameroon	10169000	-	3.9	393900	10535	2.7	-	4.1	419600	7740	1.9

4.3.5 Discussion

Validity of the extrapolation

The extrapolation we used is valid only if there is a good correlation between prevalence in the 10-19 years age group and that in the overall population. The distribution of *schistosomiasis* (whether urinary or intestinal) by age group was consistent in all villages surveyed in Cameroon. Prevalence was low before 5 years of age, increased until 15-19 years, and then decreased rapidly in adulthood. The decrease was sharper for s. *haematobium* than for *s. mansoni* infections. This distribution would not apply to areas in which cases were imported.

Overestimation of number of schistosomiasis cases

The total number of infections estimated from this study was 719 100 (392 900-1027 800) for Cameroon. A recent estimate gave 2 239 591 cases (1 261 355-3 267 963) for Cameroon (WHO, 1989, an estimate 3.1 times higher than the more accurate estimate based on the national survey (3.2 times higher for the low and high estimates). The highest estimate based on the national survey, the upper 95% confidence limit, was still lower than the minimum estimate by WHO (1989) (1 027 800 versus 1 261 355).

Several factors limit the validity of extrapolations made on limited surveys or on national passive case detection data.

Schistosomiasis is a focal disease with very uneven distribution in some regions. Prevalence observed in limited foci are not representative of regional prevalences. In areas where *schistosomiasis* is focal prevalence survey data in the literature are biased towards reporting only positive results. Cameroon is a typical example of this.

For the Extreme-North province, with a prevalence of 14.1%, there are 10 references on s.haematobium (DOUMENGE et al.1987); for the North province, with a prevalence of 10.8% there is a single reference; and for Adamawa province, with a prevalence of 0.7%, there is not a single reference. Extrapolations made for these 3 northern provinces of the country tended to extend urinary *schistosomiasis* further than shown by the national survey (SAME EKOBO, 1984). References concerning the Extreme-North province dealt with the more intense foci in the western and the eastern areas. There is no reference in the literature to the northern tip or the centre of that province, where *schistosomiasis* endemicity is lower (RATARD et al., 1990). In the centre province foci of s. *mansoni* are rare; most of them have been surveyed and the results have been published. There are few infections among the population outside these foci. Extrapolations to entire regions based on these results would tend to overestimate the prevalence of *schistosomiasis*. This seems to be the most important bias in the current estimates of the number of *schistosomiasis* infections.

Examination techniques are not standardized; prevalence reported will depend heavily on the sensitivity of the parasitological method used. This is particularly important for intestinal *schistosomiasis* since common parasitological techniques use from a few milligrams (disrect examination) to one gram (concentration methods) of stools.

Surveillance detects only a minority of the cases, Estimates based on passive case detection data would be a gross underestimate of the actual number of cases are reported.

In conclusion, countrywide estimate of the number of *schistosomiasis* cases needs to be interpreted with caution if the basis of the estimation is a collection of references from isolated foci.

CHAPTER FIVE: ECONOMIC CRISIS AND PARALYSIS OF SCIENTIFIC HEALTH RESEARCH

5.1 Economy and crisis

From the early seventies to the mid-eighties the Cameroonian economy registered steady growth. However, since 1986 Cameroon has suffered from simultaneous declines in the prices of all its major exports (petroleum, coffee, cocoa, and cotton), aggravated by the depreciation of the dollar vis-à-vis the CFA franc. As a result, the Cameroonian economy is currently experiencing a severe economic and financial crisis.

With a per capita GDP of US$ 955 and 10.9 million inhabitants in 1987, Cameroon's diversity in terms of human and natural resources gives it considerable potential for economic growth. Indeed, throughout the 1970's and early 80's, economic growth was high (about 8 percent per annum in real terms, much higher than the estimated 3.2 percent annual rate of population growth). In the period following independence, Cameroon relied heavily on agriculture, which still remains the key economic sector, employing about two-thirds of the population and generating 40 percent of export receipts. However, petroleum became a major source of growth after 1978. When petroleum production peaked in 1984/85 it accounted for more than 45 percent of Government revenues and almost two-thirds of total merchandise exports.

Petroleum revenues boosted private and (particularly) public spending, enabling gross fixed investment to grow at an average real rate of 7% during the first half of the 1980's and to maintain a high level of 20% of GDP. Despite large capital expenditures, the Government was able to maintain a balanced budget until the mid-1980's without extensive recourse to foreign borrowing. Foreign financing amounted to only about 6% of total expenditures until 1984/85. Even in 1988/89, the external dept was only projected at US$ 3,119 million equivalent, or 27 percent of GDP, while annual external debt service was projected as 23 percent of exports of goods and services (before rescheduling).

Since 1985, the fall in the US dollar- denominated prices of Cameroon's major export commodities (petroleum, coffee, cocoa, and cotton) and the depreciation of the US dollar have exposed major structural weaknesses in the economy and have plunged it into deep recession. Between 1985 and 1987 the dollar depreciated by 40% against the CFA franc. Over the same period Cameroon's terms of trade deteriorated by 47%. Thus Cameroon's balance of payments went from a current account surplus of 3.9 percent of GDP in 1984/85 to a deficit of 8.8 percent in 1986/87.

These factors brought economic growth in Cameroon to a halt. The economy stalled in 1986/87, with GDP falling by 3 %. It is estimated that GDP fell by 9 % in 1987-88 and by a further 6-7 percent in 1988-89. Per capita GDP fell an estimated 19 % from 1986-87 to 1988-89. Investment and imports are about 50 percent and 40%, respectively, below their levels of three years ago. The fall in export earnings, combined with capital flight (a function of uncompetitive interest rates), has produced a sharp contraction in the liquidity of the domestic banking system, which further constrains economic activity. Government revenues have also suffered. In 1986-87 for the first time Government operations recorded a large deficit (12% of GDP). This deficit has been financed by a build-up of domestic arrears, a drawdown of bank deposits, and an increase in foreign borrowing. These factors have contributed to the slowdown in economic and scientific research activity and the illiquidity of the banking system.

Available data on household economic activities and income flows in Cameroon are very poor.

The serious recession that Cameroon has experienced since 1986 has reduced the incomes of several vulnerable groups of the population and threatens others. So far, the main incidence has been in parts of the private sector. The cuts in government spending on major investment projects have curtailed employment in the heavy construction sector.

In addition to the decline in employment, the economic crisis and the resulting cuts in public expenditures have led to deterioration in a number of basic public services designed to help the poor, notably public health services and primary education. Budget cuts have aimed particularly at a non-personnel expenditures, with the result that the public health services are bereft of medicines and other supplies. From 1986-87 **to 1988-89 the health sector funding was reduced by 10.6 percent..**

Before June 1986 health research in Cameroon was generally well funded. Each researcher was supplied the necessary equipment and personnel, with a budget to enable him to carry out research work. Since June 1986 to the present date, as a result of structural adjustment policy, there has been no national funding for health research. In addition researchers salaries were reduced by 60-70%. The result has been demotivation, the brain drain, and total breakdown of the health research apparatus.

References

Alionou, E. and others. (1988). L'interface des soins de santé de base et des soins primaires. Pahou Health Development Project, Benin.

Brunet-Jailly, J. (1991). Health Financing in the Poor Countries: Cost Recovery or Cost Reduction? PRE Working Papers . PHN WPS No. 692. World bank. Washington,D.C.

Cameroon Country Profile (1992)

COHRED DOCUMENT 97.6. ENHR Development in Thailand Council on Health Research for Development (COHRED)

COHRED DOCUMENT 99.3 Evolution of Health Research Essential for Development in Ghana. Council on Health Research for Development. (COHRED)

Walsh J.A.(1988). Establishing Health Priorities in the Developing World (UNDP)

Feachem, Richard G., Tord Kjellstrom, Christopher J.L. Murray, Mead Over, and Margaret A. Phillips. (1991). The Health of Adults in the Development World. World Bank, Population and Human Resources Department, Washington D.C.

Gwatkin, Davidson, R. (1991). The Distributional Implications of Alternate Strategic Responses to the Demographic-Epidemiological Transition. Paper Prepared for the National Academy of Sciences, Workshop on the policy and planing Implications of the Epidemiological Transitions in LDCs. Washington D.C.

Ministry of Public Health (1989). Proceedings of the Workshop for the creation of a National Epidemiology Board in Cameroon, 17-20 October, Yaounde, Cameroon.

Knippenberg, R. and others, (1990). "The Bamako Initiative: Experiences in Primary Health Health Care Benin and Guinea." Children in the Tropics. No. 184/185, International Children's Center, Paris.

Ministry of Public Health (1989). Note de conjocture. Service des Statistiques Sanitaires.

Walsh J.A. (1988). Rapport sur le fonctionnment technique du centre pasteur du cameroon 1980-1987

Rockefeller Foundation Conference Center Bellagio-Italy

Science at Work (1983). WHO/TDR UNDP/World/Bank.

Staff Appraisal Report Republic of Cameroon (1990) Social Dimensions of Adjustment Project Volume 1.

UNICEF (1992). Achieving The Health Goals in Africa. Paper Prepared for the International Conference on Assistance to African Children, Dakar, Senagal. November.

Vaughan, J.P (1991). "Health personnel Development in Sub-Saharan Africa.' PHN World Bank. Unpublished. Washington, D.C.

WHO The work of WHO 1986-1987, Biennial Report of the Director General

WHO Evaluation of Strategy of Health for all by year 2000. Seventh Report on the world Health Situation. Vol. 6

WHO (1990)."Programmeme for Control of Diarrhoeal Diseases." Interim Programmeme Report 1990. WHO, Geneva.

World Bank. (1992c). "The public/private Mix at the District Level." paper prepared at the world Development Report consultation on District health Systems. November. M'Bour, Senegal.