I. INTRODUCTION

Among natural disasters of various types, floods occupy an unenviable second place, in terms of numbers of persons affected and extent of physical damage. Furthermore, the frequency of flood events have, in recent years, increased substantially.

During the 1960's, there were 151 internationally recognised flood disasters. In the 1970's, this figure rose to 222 separate events. The number of people killed as a direct result of the floods, likewise, doubled from 24,000 in the 1960's to 47,000 in the following decade. These figures do not account for flood-related deaths and disabilities that occur during the period following the event.

The major factor causing floods are often different types of ecological imbalances, such as unusually heavy rainfalls, deforestations or over-grazing. Sometimes floods are also caused as a secondary effect of another disaster such as earthquakes, tsunamis or hurricanes. The impact of floods, on the other hand, is dependent on the resistence of the existing physical and organisational structure of the threatened region. Weak systems, are more liable to break down under stress than stronger ones.

In the developing world a chronic infrastructural weakness coupled with frequent flooding result in disasters almost every year.

PROBLEM STATEMENT

Major floods in any limited area acts as a disruptive force to the existing epidemiological structure in a community. Depending on the situation, different components of this structure are disturbed to a greater or lesser degree. This disturbance usually manifests itself, epidemiologically, by changing the "normal" patterns of morbidity in certain diseases endemic in the community. Thus, an increase in the incidence of a specific communicable disease after flooding, may be seen as a function of some alteration in a component of the epidemiological structure of the affected community caused by the flooding.

The components of the epidemiological structure that are susceptible to alteration by floods, are many and varied. Vector levels and modes of contacts are frequently affected, raising exposure levels. Rats or snakes are forced out, causing, not only an increase in the probability of being bitten but also greatly increasing the transmission of certain diseases such as leptospirosis. Contamination of the water supply systems by flood waters can occur and chlorination of water may be disturbed; refrigeration systems for foods may breakdown. All these factors may cause increased incidence of water-borne diseases such as gastro-enteric conditions. On-going vaccination programs may be arrested causing a lagged rise in diseases among children. On the other hand, indiscriminate and unhygienic inoculations during a stress period can give rise to increases in hepatitis cases. Epidemiological notification systems may break down due to unusual pressure on the health care system. Changes have been observed in occupational and behavioural patterns among children and adults, during floods, exposing them to potentially higher risk of diseases such tetanus, leptospirosis, and diseases associated with exposure to flood waters and sewerage.

In short, a serious flood can produce a violent intervention in the existing epidemiological structure in a community via one or several component elements of the setup. Within this context, the broad question that poses itself is: How can the existing epidemiological system in a community with limited resources, be strengthened to cope more efficiently during flooding ?

Based on the general relationships between the incidence of communicable diseases and ecological disruption caused by flooding, the study will focus on four transmissible diseases already reported or suspected elsewhere in similiar conditions. These are leptospirosis, hepatitis, tetanus and typhoid fever. (See Annex 1)

The choice of these four diseases is further justified by the fact that these are conditions which are clinically serious and well-defined, requiring specific medical care and whose diagnosis is based generally on objective, laboratory criteria or on a typical clinical picture.

Secondly, these are also diseases requiring compulsory notification in a number of countries including Brazil, and thus, in principle, are covered by the official system of epidemiological notification.
The study proposes to address this question by examining the pre-flood and post-flood levels of incidence of these communicable diseases whose demographic patterns and temporal evolution would reflect weaknesses and inefficiencies in the public health system. A knowledge of the profile of the epidemiological structure of the community by this type of analyses is fundamental to the planning and preparedness of communicable diseases control programs in case of floods.

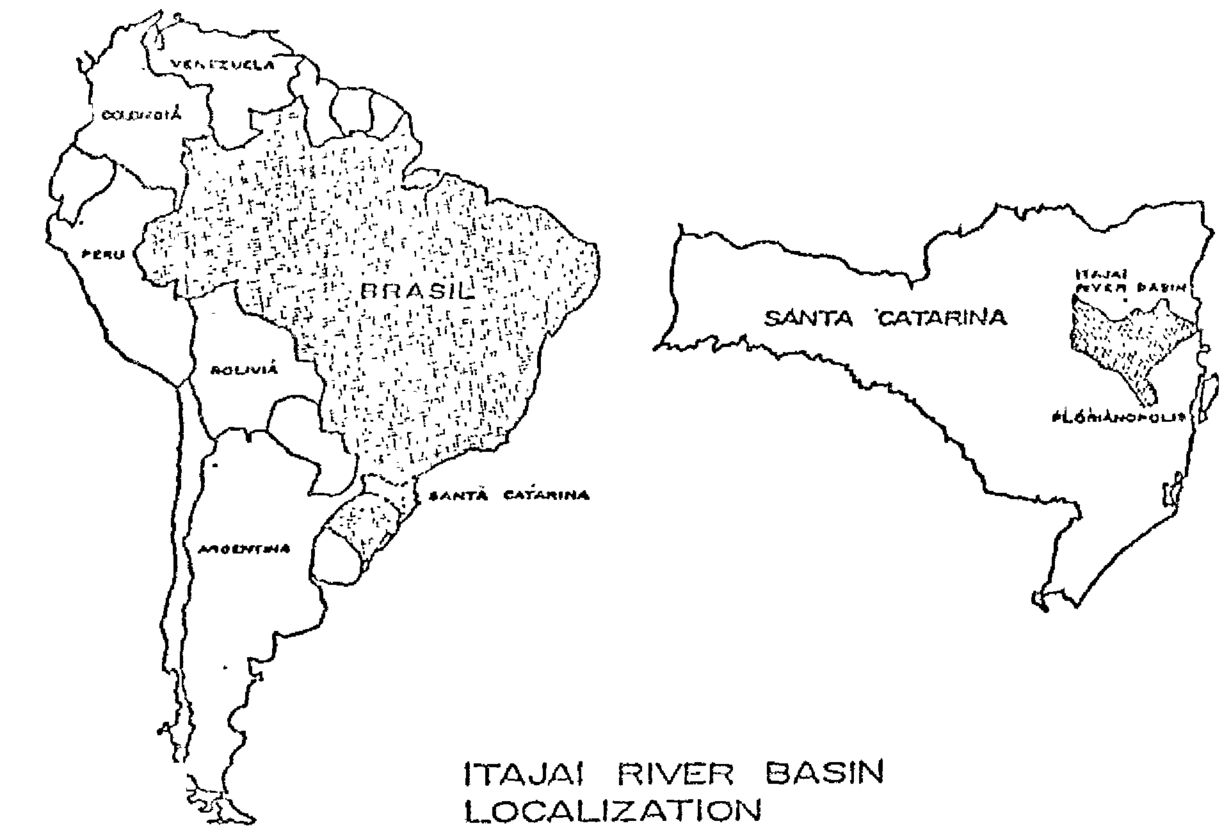
II. STUDY BACKGROUND

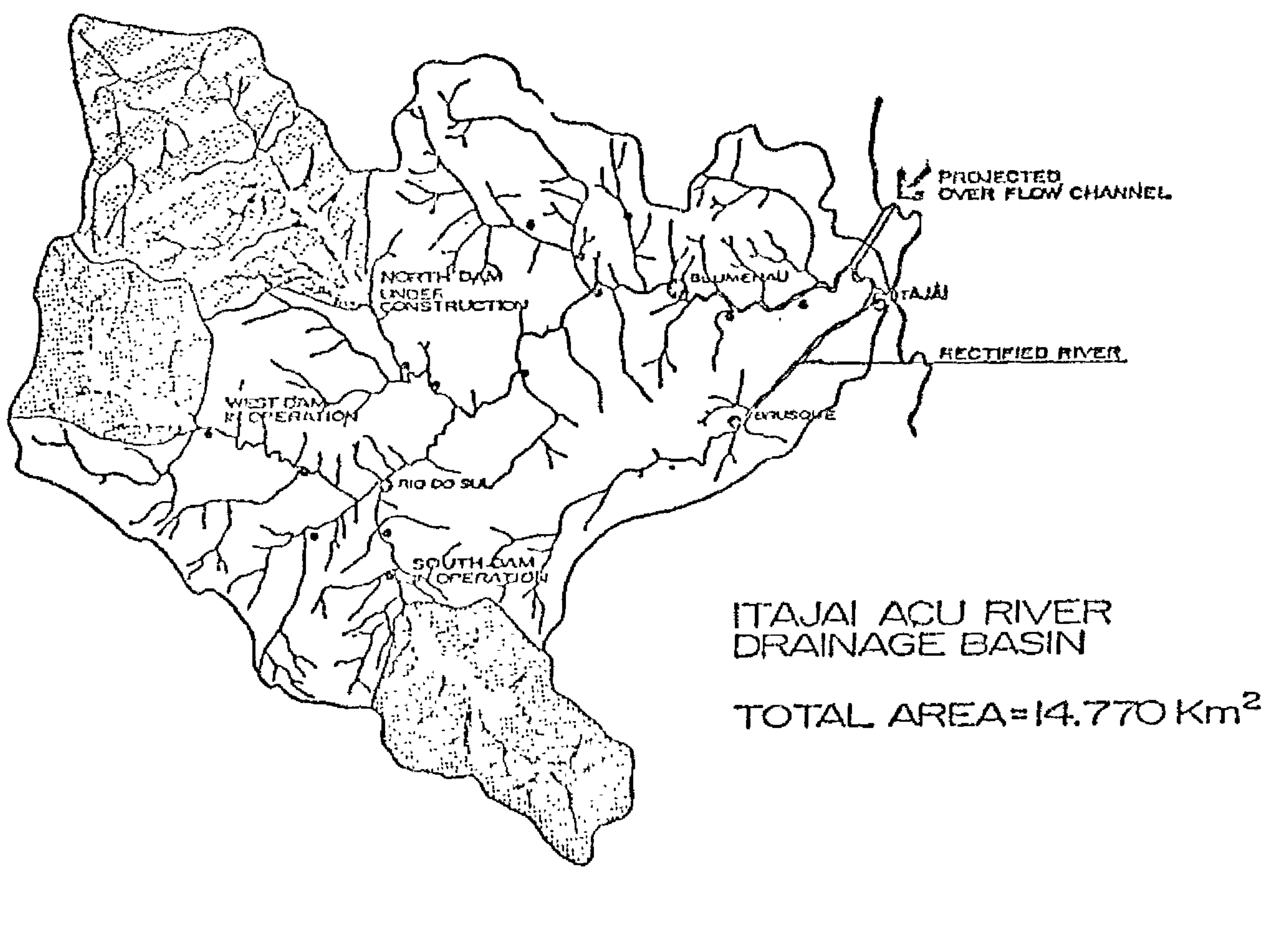
Throughout history, China and India have been known for their frequent floods but recently South America is rapidly closing the gap. In 1983, The League of Red Cross and Red Crescent Societies launched international appeals on eight occassions to assist flood victims in South America. More than 1.6 million people were reportedly affected by severe flooding in five Latin American countries.

Among these, Brazil suffers from serious floods at regular intervals in the Amazon (caused by the thawing of the Andes), in the Ribeira Valley of the State of Sao Paulo and the Itajai River Basin of the State of Santa Catarina. Of these areas, the State of Santa Catarina is frequently and seriously affected by disasters resulting from floods.

The Itajai Valley, the region chosen is particularly well-suited for the study in terms of its representativeness of the flood prone areas of Brazil, in terms of urbanisation, industrialisation and the agrarian structure comprising of small farms as well as exhibiting a high flood freqency. (See Figure 1) The main cities in the vulnerable area are Blumenau (160,000 population), Itajai (86,000 population), Brusque (41,000 populatio) and Rio do Sul (36,000 population). There is a total of about 850,000 persons exposed annually to severe flooding in this region. (See Figure 1).

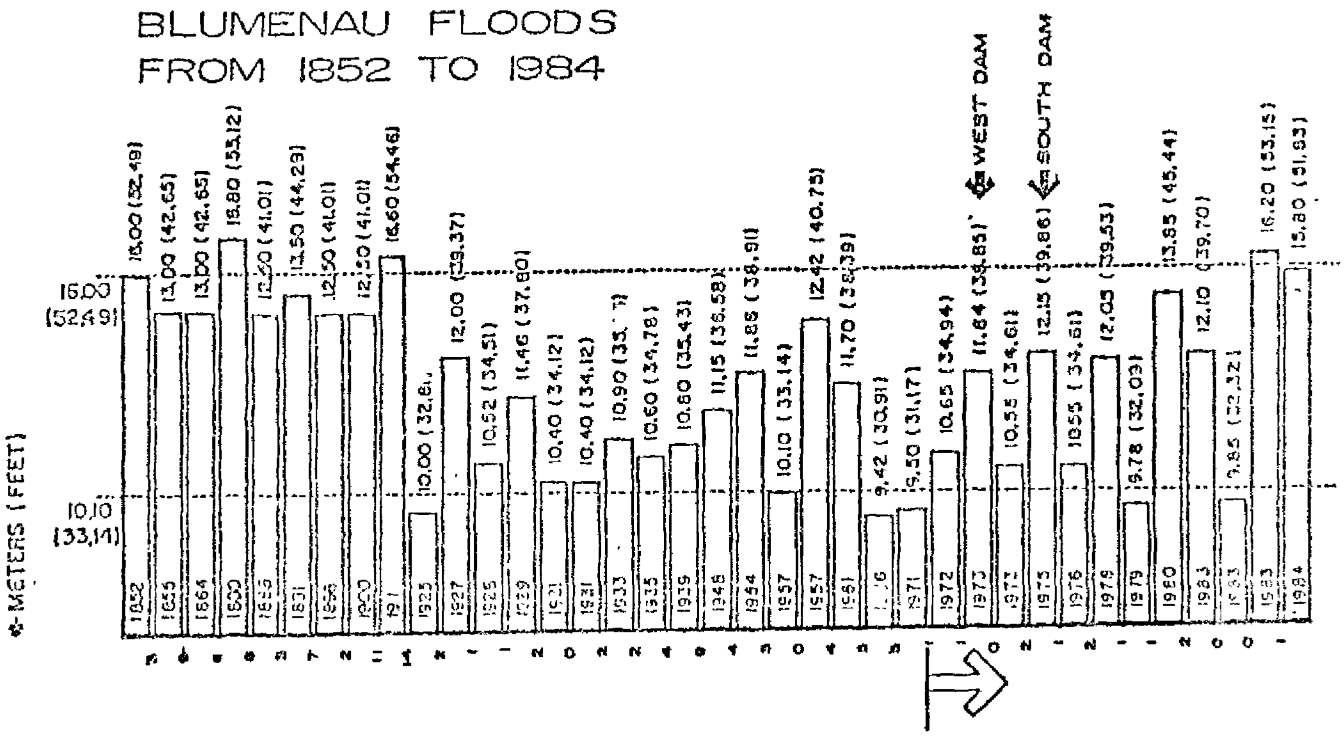
FIGURE 1


VENEZUELA
PERU
BRASIL
BOLIVIA
ARGENTINA
SANTA CATARINA
SANTA CATARINA
ITAJAI RIVER BASIN
ITAJAI RIVER BASIN
LOCALIZATION


PROJECTED
OVER FLOW CHANNEL
NORTH DAM
UNDER
CONSTRUCTION
BLUMENAU
ITAJAI
RECTIFIED RIVER
WEST DAM
IN OPERATION
BRUSQUE
RIO DO SUL
SOUTH DAM
IN OPERATION
ITAJAI ACU RIVER
DRAINAGE BASIN
TOTAL AREA=14.770 Km²

The earliest recorded flood in the Itajai River Valley was in 1852, one year after the founding of the city of Blumenau.
Since then 37 major floods have occurred. During the years 1970 through 1984, there has been a rapid increase in frequency; floods in the Itajai Valley; occurring at the rate of one per year; sometimes more (see Figure 2).

FIGURE 2



In 1983; three floods were recorded and special projects were established to minimise damages caused by these events. Mainly, structural and civil engineering interventions were planned and some executed. However; it still remains to plan and implement a complete flood preparedness program for the communities; civil defense and public health and emergency care workers.

The cities affected with the greatest frequency are Blumenau, Gaspar, Ilhota and Itajai; located on the lower stretch of the river. In 1984, the city of Brusque was also severely flooded. These cities have, on the average, 70 % to 80 % of their area flooded. (See Annex 2)

Serious damage is caused by reduction in the number of jobs and loss of work-days due to various flood-related sequellae. Leptospirosis and tetanus have both been unofficially reported as serious problems (personal communication with C. Pessanha, Santa Catarina Civil Defense,1984). Hepatitis was well in evidence during the aftermath of the 1983 floods possibly due to unecessary inoculations against typhoid ( ). There were at least 18 fatalities related to the 1983 floods. With regard to infant mortality, there is no reason to suppose the impact of floods to be significantly different from that of Peru, where it jumps to about 5 times its pre-flood level (Maskrey,A.; Centro de Estudios Y Prevencion des Desastres, Lima, 1984)),

III. OBJECTIVES

The objectives of the study have been largely developed as a function of the real gaps and needs identified by the official report of the Santa Catarina Civil Defense Organisation (restricted distribution document). Its members include the Municipal Civil Defense Committees (COMDEC); Civil Defense Nucleii (NUDEC); National Department of Waters and Electrical Energy (DNAEE); Santa Catarina Power Utility (CELESC); University Foundation of Blumenau; State Highway Department; State Department of Agriculture; Brazilian Institute of Architects (IAB).
The principal need identified by the report was the development of a medium to long term flood effects attentuation program for which general directives should be developed to allow for the integration of the activities of various sectors, forming a single global plan.
The study objectives are therefore, oriented towards the development of this multi-sectoral plan for flood relief and rehabilitation from public health perspectives. Additionally, objectives are also formulated for scientific value of the epidemiological observations of these diseases in relation to flooding conditions and their applicability elsewhere, especially, since research on the topic seems to be few and fragmentary.

<u>Intermediate:</u>

- Evaluate the possible association between the annual flooding of the Itajai River Basin and the incidence of in the four study diseases.

- Identify the vulnerable groups at higher risk of contracting the four study diseases during and after the flooding

Final

- Improve public health control and epidemiologic surveillance of communicable diseases in the region by providing information on the communicable disease susceptible to increase incidence directly or indirectly due to floods.

- Provide valid scientific information and analyses for effective planning and implementation of preventive programs vis-a-vis flooding in Santa Catarina Province within the existing public health and medical systems through the identification of groups and areas at higher risk of disease.

- Develop recommendations for strengthening components in the epidemiological system found to be influenced by the floods by proposing strategies for control within the public health care system.

IV. MATERIALS AND METHODS

The study will analyse retrospective data drawn from the official epidemiological surveillance system, on the following transmissible diseases:

(i) leptospirosis
(ii) hepatitis (virus A and B)
(iii) tetanus
(iv) typhoid fever
(See Annex 1 for epidemiological profiles of these diseases)

The principal source of the data will be the Registry of the Epidemiological Surveillance System of Santa Catarina State, because the four study diseases form part of the group of diseases requiring compulsory notification by all medical institutions in Brazil. Data on sex, age, diagnosis, reporting hospital, diagnostic laboratories (if other than hospital) and address will be drawn and categorised by month according to the date on the form. All records for the years 1982, 1983 and 1984 whose addresses of residence fall within the municipal areas of Blumenau, Itajai and Brusque will be selected. The three cities were chosen due to their high susceptibility and regular flooding experience in the last decade.

Furthermore, Brusque has an added advantage of serving as a control for the years 1982 and 1983, when it was not flooded while the other two were. In 1984, however, Brusque was also severely flooded.

As with all registry data analysis, validity and completeness remain fundamental concerns. The study will attempt to address these by chec-king two monthly case totals from the register against : (i) the sum-total of cases in that month from all individual medical institutions; (ii) the sum-total of laboratory tests in that month with the outcome of interest. Evidently, those cases who never entered the health care system at all will be lost. This loss may be expected to be the least in the case of tetanus due the gravity of the condition whereas in the case of leptospirosis or hepatitis, a number of subclinical or atypical cases may spill into classification of general febrile conditions.

The main bias entering the study data may be that of selection. The relative probability that a person from the target population will be a member of the study population have to be estimated since not all persons manifest the disease at the same intensity and not all have similiar access to the medical system. There are, however, statistical methods to estimate the magnitude and direction of the bias and correct for it. (See Berkson, J., 1946, Limitations of the Applications of the Four-Fold Table Analyses to Hospital Data. Biometrica Bulletin 2: 47-53; Hutchinson,G.B. and Rothman, K.J.,(1978) Correcting a Bias. New England Journal of Medicine 299: 1129-1130; Kleinbaum,D.G. et al (1981) Selection Bias in Epidemiologic Studies; American Journal of Epidemiology 113: 452-463).

Secondly, the data may reveal an information bias resulting from misclassification of the disease status. Sensitivity and specificity estimates can be developed to correct for such distortion using a sample of laboratory test results. Various methods exist to deal with this type of bias. (See Keys, A. and Kihlberg, J.K. (1963) The Effect of Misclassification of Estimated Relative Prevalence of a Characteristic. American Journal of Public Health 53: 1656-1665; Fleiss, J.L. (1973) Statistical Methods for Rates and Proportions NewYork, Wiley and Sons)

The analyses of the data will focus on two specific areas: (i) the seasonal distribution of the incidence of the disease as reflected by the notification system, specially in relation to the floods; (ii) incidence of the disease by population groups in the pre and post flood periods in terms of vulnerability and risk factors.

Statistical methods for categorical data analyses will be used to estimate types and extent of risk and vulnerability. Time trends, seasonality and significant changes in monthly incidence will be analysed by statistical techniques traditionally developed for industrial quality control that have proved themselves to be applicable to epidemiological phenomena. Among others, the CUSUM technique for signalling significant increases in incidence for periodic data and the Box-Jenkins integrated auto-regressive moving-average methods appear to be appropriate for this particular study.

The methodology will necessarily have to be reworked and adjusted according to the actual conditions on the field and a detailed version will be developed at that time.

V. RESOURCES

The research study is a joint venture between the University of Sao Paulo School of Public Health and the Center for Research on the Epidemiology of Disasters (University of Louvain) with active collaboration of the Civil Defense of the State of Santa Catarina.

1. University of Sao Paulo (USP)
    - will provide technical and scientific expertise, documentation and bibliographical support and partial administrative and

physicial services.

- will direct the data collection and provide field supervision
- will undertake institutional co-ordination between Civil Defense, Secretary of Public Health and other local authorities of Santa Catarina Province.
- will assure collaboration of regional and local authorities.

2. Civil Defense of Santa Catarina Province
   - will provide the use of their data banks and partial logistical and transportational services

3. Centre for Research on the Epidemiology of Disasters (CRED)
   - will provide specialised scientific and technical support
   - will provide computer assitance in processing and analyzing the collected data
   - will provide bibliographic and documentation support via Interlibrary Linkage System of University of Louvain
   - will provide partial and administrative and logistic service

4. Pan American Health Organization (PAHO)
   - will provide technical and administrative support
   - will provide bibliographic research services via Cross Referenced Service of the Emergency Relief Office, Washington D.C.

VI. PLAN OF ACTIVITIES*

Description	N° of months	Chronology in months
1. Preliminary site visit to Itajaí Valley, and reconnaissance of local institutions and resources	2	0-1
2. Selection and Organization of Team	1	2-3
3. Detailed development of protocol and data collection forms	2	4-5
4. Data collection on the field	3	6-8
5. Verification and processing of data	2	9-10
6. Interim progress report	2	11-12
7. Analyses of data	2	13-14
8. Preparation of first draft of final report	2	15-16
9. Presentation and Publication of Final Report	2	17-18
TOTAL	18	

* The total time foreseen is indicated here in sequence. However certain activities maybe undertaken simultaneously.