INTRODUCTION

The main purpose of this publication is to present the findings of the studies carried out under the Disaster Mitigation Programme in Peru (PMDP). In addition, it attempts to elaborate - within space limitations - on some of the basic concepts involved in the identification of natural hazards, risk assessment, possible disaster scenarios, prevention and mitigation measures, emergency plans and public information.

The 1970 earthquake in Peru and the eruption of Nevado del Ruiz in Colombia produced death tolls of 67,000 and 23,000, respectively. Hurricane Andrew in southern Florida and the Northridge earthquake in Los Angeles, California, each caused approximately US$ 20 billion worth of damage. The January 1995 Kobe earthquake, Japan's most disastrous since 1923, caused material losses which have still not been calculated precisely, but probably amount to some US$ 90 billion.

The number of third-world victims and the material losses in developed countries caused by natural disasters have increased substantially in recent decades.

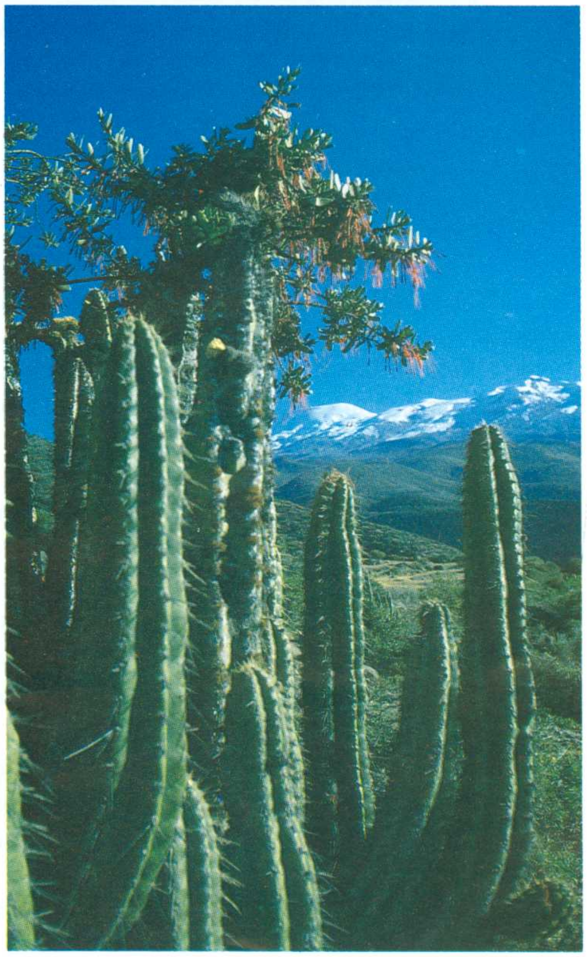
The main reasons for such large losses are the population explosion, which is causing cities to spread to high-risk marginal zones; socio-economic development, which is unable to make adequate provision for mitigation measures based on the lessons of past disasters; and the large concentration of assets at risk in developed countries.

Third world countries now have the knowledge and the experience to reduce such losses substantially. Unfortunately, these valuable tools are limited to groups of experts who find it difficult to work in cooperation with other specialists on a comprehensive approach to disaster prevention and mitigation. This tunnel vision causes confusion among the authorities and prevents them from taking sound political decisions to reduce the losses caused by natural disasters.

It is highly regrettable that simple knowledge which could save the lives of tens of thousands of people is not available to those who need it most. For example, people should be informed that adobe dwellings should not be built on soft, moist soil, because of the great amplification of seismic waves, or on floodable land, because they collapse completely if submerged under water. Likewise, it should be made a matter of common knowledge that placing a continous crossbeam at the thres hold of doors and windows increases earthquake resistance of buildings 200 to 300 per cent. The following are some basic rules: nothing should be built in the path of flash floods, on unstable slopes or in swampy areas subject to intense seismic activity and periodic flooding; nor should construction be carried out in places particularly vulnerable to natural hazards.

SOCIO-ECONOMIC DEVELOPMENT IN KEEPING WITH THE LESSONS ON THE NATURE OF PAST DISASTERS. MICROZONATION

In order to integrate and systematize research and the rules deriving from it, microzonation methods and techniques have been developed in Peru since the 1970 earthquake. All the natural phenomena likely to affect a given zone, such as earthquakes, floods and landslides, are studied. The zone is then divided into sectors of varying hazard. The safest sectors will be assigned to the largest urban components, such as high-density residential areas or major engineering works. The hazardous most sectors are assigned to outdoor recreation, crops or other appropriate uses. The microzonation methods and techniques - which have been refined and updated over the past 24 years - and their application to the land-use plan have become highly effective tools for mitigating the effects of extreme natural phenomena.



SETTING AND SNOW-CAPPED PEAKS OF THE AREQUIPA MOUNTAIN CHAIN.

In many cases major reductions in the cost of urbanization and construction are achieved by taking into account the topography when selecting the most appropriate sectors, thereby making it possible to reduce the amount of cutting and filling; the cost of laying foundations can also be considerably reduced by detecting the areas where the ground has the greatest supporting capability.

Nature must be preserved, especially the plant cover. Preservation not only prevents the loss of valuable crop land, which nature has taken hundreds or thousands of years to produce, but also lessens the magnitude of natural disasters. Depending on its density and thickness, soil with plant cover is capable of retaining between 10 and 50 times more water than bare soil. Floods are thereby diminished, and the sponge effect enables the water to be released gradually, regulating the supply of that vital liquid for human consumption and agriculture. A noteworthy forestation programme in the desert region of south-western Peru could yield excellent results. The modern use of Inca terraces could also be a source of productive work for thousands of people.

Natural disasters in Perú

With a surface area of 1,250,000 sq. km and a population of 23.5 million inhabitants, Peru is located in the west-central part of South America. The Andes range, which runs the length of the country from north to south, parallel to the Pacific coastline, is Peru's most striking geographical feature, resulting from the interaction of the Nazca and South American plates, one subducted under the other. This interaction generates a high level of seismic activity in Peruvian territory, giving rise to highly destructive earthquakes, such as the one in 1946, when Lima was completely destroyed and Callao razed by tsunamis, or the 1970 earthquake which, with its death toll of 67,000, was the western hemisphere's worst disaster of this century in terms of the number of victims.

The occurrence of heavy rains from January to April in the barren mountains of western Peru produces flash floods, known locally as huaycos; flooding also occurs when the large rivers draining into the Amazon river eastern basin overflow their banks. Both these phenomena cause major damage, destroying urban centres, highways and crops.

On the steep slopes of the Andes, when rains or tremors lower the resistance of rocks and soil and the load is increased in the direction of the slope, the balance is disturbed and numerous landslides of varying magnitud occur. The worst landslide in living memory happened in 1974, damming up the Mantaro river and seriously endangering the country's largest hydro-electric plant. The unforgetably tragic avalanche on the north peak of Huascarán, triggered by vibrations from the 1970 earthquake, buried the city of Yungay along with 13,000 of its inhabitants.

Adverse climatic changes cause heavy material losses. The El Niño phenomenon of 1982-1983 unleashed the worst rains since 1925, causing serious damage to population centres, vital public services and production infrastructure on Peru's north coast; the severe drought caused by El Niño in south-eastern Peru also affected Bolivia. According to the National Development Institute (INADE), the El Niño phenomenon in 1983 caused material losses equivalent to 6.2 per cent of the gross domestic product for that year.

Physical-political map of Perú and zones surveyed under the disaster investigation programme in Perú (IGN Map)

International decade for natural disaster reduction in Peru

In Peru, as in the great majority of third world countries, natural disasters considerably hamper economic and social development owing to the serious human and material losses to which they give rise.

Accordingly, the United Nations General Assembly, in its resolution 42/169 of 11 December 1987, designated the years 1990-2000 as the International Decade for Natural Disaster Reduction (IDNDR). The main objective of the Decade is to reduce the negative impact of natural disasters, particularly in developing countries, through national efforts and international cooperation.

This excellent initiative was proposed by Dr. Frank Press, President of the National Academy of