RISK ZONING, RESEARCH AND PLANNING FOR DISASTERS IN CENTRAL AMERICA: AN AGENDA FOR NEEDED CHANGE

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I. INTRODUCTION

Central America, with a landmass of a little over half a million square kilometers and a population nearing the thirty million mark has been subjected, historically, to a widerange of potential disaster triggering mechanisms. Large scale disasters such as the earthquakes in Managua (1972), Guatemala (1976), San Salvador (1986) and Limón, Costa Rica (1991) and Hurricanes Fifi (1974) and Joan (1988) constitute extremes in a geographical region where multiple communities are subjected annually to smaller scale physical and social disruption associated with seismic and volcanic activity; flooding and drought; landslides and avalanches.

In the present paper we attempt to provide a broad overview of various aspects relating to the "natural" disaster problematic in Central America. In a first section we provide a summary vision of an attempt made at risk zoning in the region seen from the viewpoint of both physical and social vulnerability. A second section deals with the prevalent institutional, administrative, legal and policy frameworks related to the prevention, mitigation and attention of disasters. And, in our third section we attempt to draw some general conclusions as regards needed changes in the orientation of both research and policy guidelines for the future.

The aspects dealt with in our paper derive principally from the results of a recently concluded six country study undertaken in Central America, under the auspices of the Central American University Confederation (CSUCA) and with the financial support of the International Development Research Centre (IDRC) of Canada (see CSUCA, 1990-91).

This study attempted to provide a comprenehsive overview of the social conditioning of disaster in the region as opposed to the study of the physical triggering mechanisms existing, aspects which have traditionally received a major part of the attention of the scientific and practitioner communities within and from outside of the isthmus.

Limitations of time and space inevitably require a selective approach to the problems we have put forward for consideration, and an at times possibly dangerous level of generalization.

II. RISK ZONES IN CENTRAL AMERICA: PHYSICAL AND SOCIAL VULNERABILITY TO DISASTERS

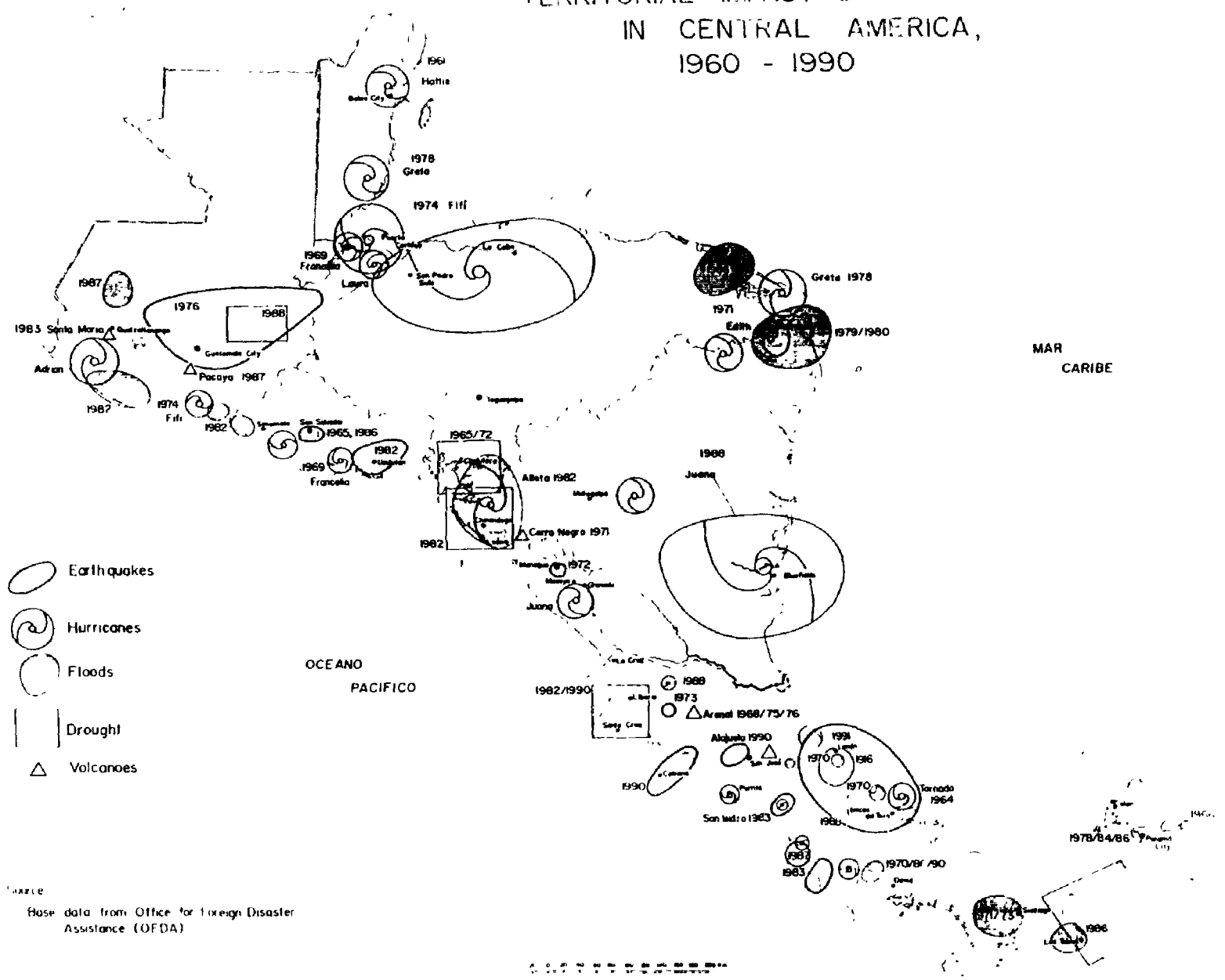
The geophysical characteristics of the Central American isthmus, with the confluence of various major tectonic plates (Cocos, Caribbean, North American, Nazca, Panamanian), extensive local fault systems and a climatic bipolarity typified, in a good part of the region, by an extended rainy season and an accentuated but shorter dry season, provide a backdrop of natural conditions conducive to such phenomena as earthquakes, volcanic activity, drought and flooding. The diverse and accentuated geomorphology of the region; extensive deforestation and overall environmental degradation; the reduced size of the different countries and a narrow interoceanic position (Pacific and Caribbean/Atlantic), add further dimensions to the range and nature of physical risks faced (landslips and avalanches, hurricanes, stormsurges and accentuated wave or tidal action) (see Lavell, 1991).

On a macro level, the range of physical risks and their spatial impact can be appreciated by a rapid examination of Map 1. On this map we have plotted the spatial impact of the more important disaster denominated events occurring in Central America between 1960 and 1991. The base data has been takes from the listings of the Office for Foreign Disaster Assistance of AID, an agency which has reported over seventy "natural" disasters during the period under consideration.

Three points are worthwhile mentioning as regards the content of the map. Firstly, we have only mapped the areal extent of the major impacts of the different events. However, many of these had a far wider overall impact, being considered "national" disasters in terms of their territorial coverage. This is the case, for example, of Hurricanes Joan and Fifi and the Guatemalan earthquake. Secondly, it can be appreciated from the overall spatial impact of the plotted events that a good part of the Central American population (rural and urban) has been subjected to the damaging effects of one or more major geophysical events during their life span. And, third, the risks and losses involved in terms of major events is compounded by the fact that all of the countries of the region suffer dozens of smaller scale phenomena each year, where the impact on social living conditions, production and public investment pass relatively unperceived and are very rarely evaluated.

These disasters and other lower level dislocations occur in a region fraught with poverty and severe problems of economic growth, and also in terms of public budgetary assignations for social, and medium and long term economic development programmes. According to the latest available data (mid 1980's) near to, or over 80% of the population of Honduras, Guatemala and El Salvador were living below the poverty line, and 70% of Nicaraguan, 28% of Costa Rican and 40% of Panamanian

TERRITORIAL IMPACT OF MAJOR DISASTERS IN CENTRAL AMERICA, 1960 - 1990



Source

Base data from Office for Foreign Disaster Assistance (OFDA)

families were in a similar situation (Menjivar and Trejos, 1990). The growth of GNP per capita was negative for all of the countries between 1980 and 1989, Nicaragua constituting the worst case (-32.1%) and Costa Rica the best (-8.3%). The external debt of all the countries is extremely onerous in comparison with the size of the GNP, ranging from 6.2 billion dollars in Nicaragua to 2.25 billion in El Salvador in 1988 (CEPAL, 1990; Menjivar and Trejos, 1990).

It is precisely the combination of diverse and repetitive physical triggering mechanisms in a highly vulnerable socio-economic media which provide the conditions for disaster occurrence in Central America, as is the case in many other regions of the developing (underdeveloping?) world.

The recognition that vulnerability to disasters is not directly related to the spatial and temporal distribution of major (or even intermediate level) geophysical events but rather to the impact of these on highly vulnerable social matrices offered the starting point for the CSUCA project's attempt to construct a typology of risk zones in Central America which combined potential "natural" and social "determining" factors. Starting from this premise the researchers linked to the project in the different countries attempted the construction of a classification or typology of risk zones, comprising various stages.

In a first stage, utilizing the disperse and many times imprecise data sources available (newspaper reports, governmental and non-governmental reports, international relief agency listings, etc.) the research groups proceeded to register the dates, locus and impacts of all dislocations caused by a wide range of geophysical or natural phenomena (seismic, vulcanic, climatological, oceanic, etc.), minimally during the present century, and with special attention to the period 1950-90. This information was then ordered according to locus and type of event allowing the postulation of a preliminary regionalization or zonification of physical risk in each of the countries. In a second stage, an attempt was made to typify the risk zones identified according to their levels of socioeconomic development, infrastructural and population densities and economic resources available at a local level (municipal), utilizing the available data sources (census, survey information, etc.).

The sum of these two complementary procedures allowed the proposition of a preliminary scheme or regionalization taking into account potential levels of vulnerability seen from a physical and social viewpoint.

The limitations of the analysis undertaken clearly derive from the levels of spatial disaggregation of available information, the dates of the information, and as regards the possibility of deriving clear inferences as regards potential levels of vulnerability using the socio-economic and demographic variables included in the analysis (population density, poverty, income and unemployment levels, local government expenditures/capita, housing conditions, etc.).

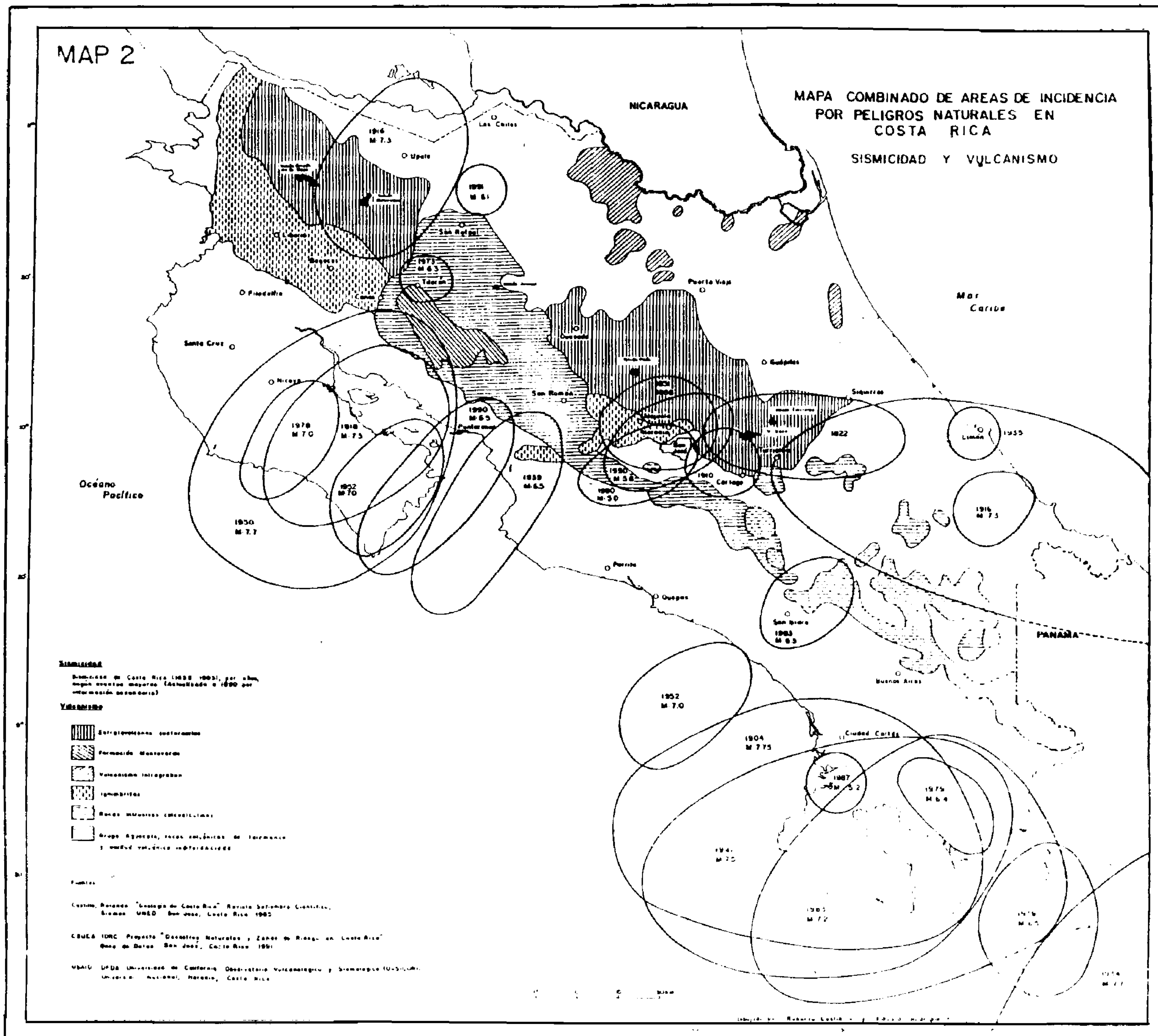
However, the overall objective of the analysis in terms of providing a systematic treatment of social as well as physical aspects of vulnerability to disasters, and the postulation of a spatially disaggregated approach to the consideration of disaster policy and planning was, we consider, basically fulfilled. The information generated and the regionalizations or typologies proposed, offer a more complete and provocative analysis of the problem in Central America than previously existed and at least provide a more solid basis for the consideration of policy and planning alternatives in the future.

Moreover, in an attempt to add further elements to the analysis of human vulnerability in each of the countries, and go beyond the hard objective social data derived from official census or survey sources, qualitative and quantitative field research was undertaken in over thirty communities located in some of the more physically vulnerable zones of Central America. Through a questionnaire survey of local population and governmental and non-governmental authorities, valuable information was obtained regarding the economic status and housing conditions of the population; their ideological conformation as expressed in attitudes and conceptions pertaining to the causes and possible solutions to the problem of physical risk; existing levels of social organization and the role and pertinance of government activity in terms of prevention, mitigation and attention of emergencies; existing warning mechanisms and their adequacy and limitations at a community and social level, etc. (see Wilches Chaux, 1988 for an excellent systematization of the components of human vulnerability).

In order to place the type of analysis undertaken in Central America in a more concrete framework, we will, very briefly, provide a summary view of the results of our studies in one of the countries, Costa Rica. Additionally, we will also indicate certain conclusions deriving from this analysis as they pertain to the problem of disaster policy and planning in that country (much of which we consider relevant for the other countries of the region).

In Maps 2 and 3 we have plotted the principle information gained from the historical reconstruction of the more important geophysical events, occurring in Costa Rica (drought, flooding, landslides, major seismic and volcanic activity).

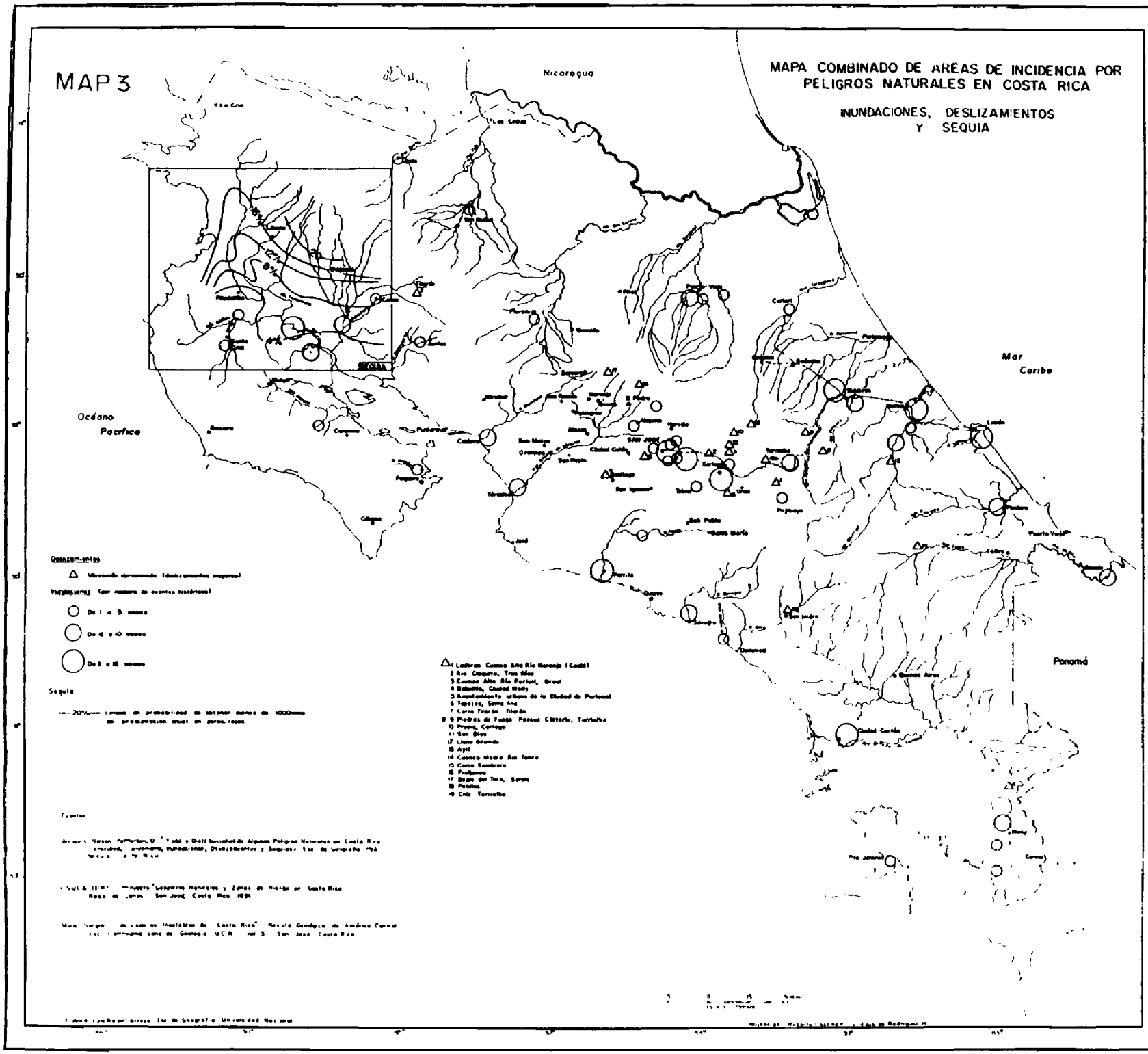
This information immediately transmits two very important conclusions in terms of future policy and practice. Firstly, the spatial incidence and temporal recurrence of events is such that a good part of the country and its people are subject to risk from geophysical phenomena, including both concentrated urban as well as dispersed rural populations. And, secondly, a large number of zones and communities


MAP 2
MAPA COMBINADO DE AREAS DE INCIDENCIA
POR PELIGROS NATURALES EN
COSTA RICA
SISMICIDAD Y VULCANISMO
NICARAGUA
PANAMA
Mar
Caribe
Océano
Pacifico
Santa Cruz
Nicoya
Upala
Los Chiles
San Ramón
Puerto Viejo
Guápiles
Siquirres
Limón
Cartago
Parrita
Quepos
San Isidro
Buenos Aires
Ciudad Cortés
1916
M 7.3
1950
M 7.7
1978
M 7.0
1952
M 7.0
1904
M 7.75
1987
1975
M 6.4
1822
1935

MAP 3

MAPA COMBINADO DE AREAS DE INCIDENCIA POR PELIGROS NATURALES EN COSTA RICA

INUNDACIONES, DESLIZAMIENTOS Y SEQUIA



are subject to risks of disaster associated with more than one type of geophysical triggering mechanism.

This latter situation is a product of the diverse nature of the mechanisms affecting the country, and its reduced size (51000 square kilometers) such that for large scale phenomena no spatial isolating factor exists. Thus, for example, a hurricane or intense tropical storm entering on the Atlantic Coast will inevitably cause severe problems throughout the country; whilst an earthquake of 7.5 or above on the Richter scale will differentially affect up to or over 50% of the national territory (consider the spatial impact of the Guatemalan earthquake, for example).

These two factors, in addition to their importance as regards the impact of disasters and lower level phenomena on national development, also clearly indicate the problems faced by government in terms of the design and implementation of an adequate and spatially comprehensive disaster policy. From our perspective, only a spatially descentralized approach with active levels of local government and community participation can hope to help resolve the problems inherent in the prevention, mitigation and attention of emergencies.

The geographical zones and communities at risk identified through the reconstruction of historical data sources were then analyzed ~~in terms~~ of diverse socioeconomic, demographic and financial variables, primarily deriving from the data collected during the last population and housing census of 1984. In order to construct the data base, information available at a censal segment level (through a geographical information system available in Costa Rica), was sought for the identified communities or zones.

The information compiled for zones and communities covered the following percentage indicators: total population under five years and over fifty years old, illiterate population, unemployed and non salaried self employed persons, migrants, and population not covered by social security health systems; rental and owner occupied housing, slum dwellings and overcrowding levels; dwellings without piped water supply, electricity and radio or televisión; materials used in, and the state of construction of rooves, walls and floors. In addition, information was sought on levels of municipal finances, infrastructure and economic production. The weighted sum of these diverse variables served to postulate indices of potential social vulnerability to disasters or lesser phenomena.

The sum of the information gleaned on areas of physical risk and on potential social vulnerability, in combination with the available, but as yet inconclusive evidence on those factors (principally anthropic) which have probably increased the temporal rate and intensity of the physical triggering mechanisms, was then presented in double entry matrices for seismic activity, flooding, and landslides. A typology of zones was crossed with the information available on the causalities of

phenomena, the potential economic and human losses that could occur under disaster conditions, the socioeconomic condition of the population and local governments, and on options for prevention and mitigation of disasters.

Figure 1 provides an example of these matrices, as pertaining to flood zones in Costa Rica.

A final step in the regionalization of risk zones in the country was achieved by taking the sum of the information collected and submitting this to an analysis in terms of proposals that could be adequate for the formulation of policy and planning proceedures related to the prevention, mitigation and attention of disasters. This procedure led to the preliminary identification of six major regions, characterized as follows:

a) Central Region (including the Metropolitan Area of San Jose and communitites enclosed within a radius drawn through the towns of San Ramon, Orotina, Puriscal and Tobosi).

- Diversified physical risks (quakes, volcanic activity, flooding and landslides or avalanches),
- High levels of economic production and infrastructure.
- Good land communication system.
- High population densities (60% of the Costa Rican population) and privileged socio economic levels.

b) Southwestern Region (including the towns of San Isidro, Ciudad Cortes, Buenos Aires, Golfito and Ciudad Neilly)

- Risks due to quakes, flooding and land slides or avalanches.
- Medium levels of economic production and infrastructure, with high levels of economic dependency.
- Undiversified land communication system subject to closure due to avalanches. Access by sea.
- Low population densities.
- Low socioeconomic levels.

FIGURE 1
MATRIX OF TYPES OF FLOOD ZONE, VULNERABILITY AND OPTIONS FOR PREVENTION AND MITIGATION

Parameters	Type of flood zone	Extensive Flood Plains Rural Areas Limon	Guanacaste	Other	Extensive Flood Plains Urban Areas		Channelled Valley Metrop. Area	Channelled Valley Small Urban Area
1.	**Rivers**	Sixaola (lower basin) Estrella Sarapiquí Chanquinela Reventazón (lower basin) Pocosol (lower basin) Matina	Bebedero Tempisque	Coto Vaca Vaquita	Parrita Diria Abangares Terraba	Limoncito	Rivers Metrop. Area Barranca - Puntarenas Colorado - Turrialba	Humo Pejibaye Naranjo Urrasca Caño Seco Corredores Cañas Reventazón Reventado Paquera Pacuare
2.	**Direct or Indirect Causes of flooding**							
	Deforestation Upper Basin	2[a]	1	1	1	1	1	1
	Deforestation Lower and Middle Basin	1	1	1	1	-	-	-
	Tides	-	1	2	Parrita Terraba	2	-	-
	Sedimentation	1	1	1	Parrita Terraba	1	-	-
	Blockage by debris (forest, human, etc.)	-	-	-	-	-	1	1 (Avalanche)
	Human settlement flood zone	1	1	1	1	1	1	1
	Economic occupation flood zone	1	2	1	Parrita	-	-	-
3.	**Type of flooding**	x	x	x	-	-	-	-
	Slow	-	-	-	x	x	x	x
	Rapid/violent							
4.	**Potential Economic Losses[b]**	x	-	x	-	-	-	-
	High	-	-	-	Parrita	-	-	-
	Medium	-	x	-	x	x	x	x
	Low							
5.	**Potential loss of dwellings and/or human life[b]**	-	-	-	-	x	-	-
	High	-	-	-	x	-	x	x
	Medium	x	x	x	-	-	-	-
	Low							
6.	**Socio-economic status of population and municipality[c]**	-	-	-	-	-	x	x
	High	-	x	-	-	-	-	x
	Medium	x	-	x	x	x	-	x
	Low							
7.	**Options for prevention and mitigation**	x	-	x	x	x	Barranca	-
	Dykes	-	-	-	-	-	-	x
	Dams	-	-	x	x	x	River clean-up	-
	Dragging of river	-	-	x	x	x	-	x
	Straightening river	x	x	x	x	-	x	x
	Control of river basin	-	x	x	x	x	x	x
	Control location housing	-	-	-	-	-	-	x
	Control river flow							

a) 1, 2 indicate principle and secondary factors
b) High, medium, low used with reference to the overall context of Costa Rica
c) High, medium, low used with reference to population of country located in flood risk areas.

c) Guanacaste Peninsula (Liberia, Cañas, Nicoya, Paquera, Cobano)

- Risk from seismic activity, drought and flooding.
- High levels of agricultural production with low levels of diversification. Importance of tourism.
- Undiversified and poorly articulated terrestrial communications, especially in the south of the Peninsula.
- Low population density, rural dispersion and small towns.
- Medium socioeconomic levels.

d) Central Pacific Region (Coastal zone from Abangares to Quepos)

- Seismic risk and flooding.
- Medium levels of production and in density of stategic infrastructure.
- Adequate, if undiversified terrestrial communication system; access by sea.
- Low to medium socioeconomic levels.

e) Atlantic North and South (Cariari-Limon-Sixaola)

- Historic risk from hurricanes and flooding. Seismic risk recently appreciated.
- High levels of rural production primarily with a dependency on bananas.
- Undiversified land transport system.
- Low population densities; dispersion with the exception of Limon City.
- Strategic infrastructure in terms of petroleum refining and exports.
- Low socioeconomic levels of the population.

f) Atlantic North Central (Puerto Viejo de Sarapiqui to Upala)

- Flooding and volcanic activity.

- Low but increasing levels of economic production concentrated between Ciudad Quesada and Nicaraguan frontier.

- Low and high socioeconomic levels of the population in different segments.

In sum, the research undertaken in Costa Rica and the rest of Central America sought to provide a broad macroview of existing risk zones and regions, systematizing or ordering disperse information and providing a framework for more intensive and precise risk zoning procedures at a regional and local level.

III. THE INADEQUACIES OF DISASTER POLICY AND PLANNING IN CENTRAL AMERICA

The high physical risk and the social vulnerability of Central America to disaster events is obvious. However, this context is hardly at all reflected in terms of schemes or policies for prevention and mitigation; whilst the institutional and human resources framework for emergency preparedness and attention is fraught with numerous difficulties. Needed innovations and changes and new emphases in orientation will not be easy to implement due to the social, economic, governmental and overall attitudinal context which prevails throughout the isthmus.

In this third section of our paper, we will very succintly present some specific conclusions that emanated from the analysis undertaken in the CSUCA study of Central America, pertaining to the institutional, administrative, policy and planning frameworks and the legal, economic, and structural instruments existing for prevention, mitigation and attention of disasters in the isthmus. The analysis undertaken on the six Central American nations (excluding Belice) reveals a high level of coincidence in terms of the existing situation, accepting some notable differences which we will attempt to point out as we go along.

a) Prevention and Mitigation: A pending task

No Central American country can profess to have an integral policy and global strategy for the prevention and mitigation of potential disaster situations, neither in terms of reducing the probability or impact or these nor in terms of adequate preparation for confronting these should they occur.

Despite this fact, numerous guidelines, clear indications and precepts exist in the profuse legislation existing in the different countries which are of direct relevance in terms of responses to determined situations of social vulnerability. Land use zoning is a prerequisite in national urban development or planning laws and risk maps exist for numerous communitites; seismic and building codes are common;

regulations and laws as regards environmental management, deforestation and control of river basin management are prevalent; numerous schemes for the construction of dykes and dams and dragging rivers have been implemented in various zones; a limited number of pilot projects have been institutionalized in terms of the education of populations in risk zones; and, all of the countries have a semblance of early warning systems related to flooding, landslides, wave action and volcanic activity, in particular.

However, the existence of legislative norms and controls, or semblances of structural or nonstructural activities is no guarantee of their application, applicability or efficacy.

In Central America, as in many developing areas, inadequate administrative structures, duplicity of functions, lack of, or inadequately prepared personnel, corruption in the private and public sectors, lack of sufficient budgetary assignations for maintenance of public works, amongst other factors, signify that a tremendous gap exists between the normative content of measures directed towards prevention and mitigation and the real capacity for their implementation.

A further dominant aspect relates to the fact that the measures promulgated are many times out of tune with more pervading social processes and, consequently, operate in a social vacuum.

Thus, for example, the lack of real options in terms of access to secure, habitable land for large numbers of the poorer sectors in urban and rural areas makes "invasions" of marginal lands a dominant process which defies attempts at land use zoning, unless this is accompanied by repressive eviction techniques leading to social unrest and probably violence. Moreover, in many cases of land invasion, the state, at a local or national level, finally "supports" such movements, legitimizing and consolidating them by providing the new colonies with basic services (water, electricity, etc.). Risk and vulnerability are thereby institutionalized.

As regards building and seismic codes, the fact that a good part of the population falls outside the formal land and housing markets (credit financed), recurring to artisan and primitive construction techniques, without possibilities of recourse to structural engineers or architects, signifies a necessarily wide inapplicability of these codes. This is compounded by the lack of any real way of controlling inadequate construction, due to the size of the problem and the lack of human resources available. Moreover, the impact of recent earthquakes in Central America (Cobano, Alajuela and Limon in Costa Rica 1990-91; and San Salvador, 1986) suggests that even a relatively large number of modern private and public sector buildings do not come up to seismic code standards (see Santana, 1990).