CHAPTER 2. ECONOMIC EFFECTS OF NATURAL DISASTERS - WITH SPECIAL REFERENCE TO GUATEMALA

1. Introduction

This chapter presents an account of some of the economic effects of natural disasters in a number of actual cases in LDCs, in particular Guatemala. Its purpose is to identify the economic problems that are common to disasters and to indicate an appropriate approach for the treatment of these problems.

The natural disasters that we shall refer to here are of the type defined by the sudden destruction of physical assets, i.e., earthquakes, hurricanes, floods, etc. Natural disasters of other types,*) e.g., drought, that are a result of gradually accumulating damages occurring during longer periods of time, will be referred to only insofar as the effects observed in their particular context are relevant to the identification and explanation of the problems discussed here.

An examination of the nature of the problems arising in the economies of stricken LDCs will help us understand the extent to which natural disasters may have more than a pure commodity shortage dimension. It will be argued that disasters result not only in the disappearance of certain physical entities but also in dislocations in institutions which lead to aggravated economic conditions for certain groups of individuals and regions (cf. Sen 1981, 1979 and spec. 1977a, pp 55-56). As we shall see, the effects of natural disasters in LDCs tend to be aggravated by factors that

*) For a definition and classification of disasters see, e.g., Russel, 1970; Krimgold, 1974; Alessi, 1975; Ritchie, 1981; Long, 1978b, pp 82-83).

are typical for these countries, such as:

- poorly integrated markets
- lack of disaster preparedness, appropriate structures of buildings, precautionary commodity stocks
- non-existence of institutional prerequisites for insurance policies or limited insurance coverage
- subsistence standard of living under pre-disaster conditions, etc.

Owing to such factors, the occurrence of a natural disaster, in the absence of appropriate relief, may lead to a worsening of the conditions of underdevelopment characterizing LDCs. Therefore, a systematic account of economic effects ("effects" hereafter) helping us to improve our understanding of the effects of natural disasters will also facilitate a proper analysis of the role of disaster relief.

Prior to our discussion of the effects of natural disasters we shall take up two aspects in brief. To begin with, we discuss the reliability and general properties of the information used and at the same time suggest an approach towards a classification of effects. Then, the different effects are presented under two main categories, namely, impact effects and indirect effects. Finally, we summarize the problems presented and point out the relevant factors which will be analyzed in later chapters.

2. Reliability of Data and Definitions of Effects

As an illustration of the economic problems of disasters, it would be desirable to present a survey of the most common ways in which economic activities are disturbed, as well as of the capabilities of different stricken countries to counteract undesirable effects.

Unfortunately, for most LDCs this type of information is very difficult to obtain. In most cases what we have found are some statistics on overall estimates of material damage and of the disaster relief provided. However, fairly extensive information on the effects of the 1976 earthquake in Guatemala and the relief given has been collected. Therefore, most of the examples presented here will refer to Guatemala.

In general, estimates of damages or effects are obtained on the basis of assumptions which differ according to the way in which problems are viewed or conceptualized. Behind each estimate will lie some degree of subjectivity which limits the validity of the values it expresses. This is certainly the case with most of the information presented below. Hence, the reader should be cautioned about the uncertain quality and relevance of the figures to be presented, in particular figures in monetary terms. Since our present purpose is primarily the identification of relevant effects, these quality problems will be less serious.

As has been pointed out, an understanding of the effects of natural disasters requires expanding our view of a catastrophe from one which comprises the physical destruction only to one which also includes the adjustments of markets, institutions, administrative procedures, etc., to the disaster. In this wider perspective we shall find it convenient to distinguish between impact effects and indirect effects. While impact effects are those that take place at the moment of the disaster, indirect effects are those arising from an adjustment to the impact effects.

Some of the indirect effects are in the nature of economic changes which will be noticed only long after the natural disaster has occurred, e.g., changes in the overall capacity for economic development. On the other

hand, the natural disasters for which information has been available and to which we shall refer here have occurred recently. That is, it is too early to identify all relevant indirect effects with long-term properties arising from these disasters. In addition, even if the adjustment period considered were long enough, the difficulties of identifying the causal factors underlying these effects are great, making an account of effects of this type a difficult task. Therefore, when referring to such indirect effects we shall focus our attention only on effects to be expected from the damage to or changes of preconditions for economic development. Since it is difficult to separate the effects of natural disasters in the statistics from those of the foreign disaster relief (discussed in chapters 4 to 7) our presentation of development inducing effects will be brief.

The nature of the disaster effects will also have to do with the type of economic agents affected, i.e. those involved in the production or consumption process. From this point of view, we shall distinguish e.g., between impact effects on production and distributional impact effects. These concepts will be defined now. A definition of the different types of indirect effects is given later (see section 5).

By impact effects on production we shall refer to the damage to or destruction of existing factors of production (physical and human) and raw materials. In general, damage to human capital refers to deaths, injuries, diseases and other disorders affecting the labor force. Damage to physical capital refers to destroyed machinery, equipment, buildings, silos, inventories, livestock, roads, bridges, railway lines, airports, ports, electrical installations, water supply systems, land, etc. The impact effects of this damage will be interpreted as reduced supply possibilities

(of physical goods or of services). An idea of the extent of the impact effects would be given by estimates of the value of the damages to physical and human capital. Most often, however, this implies complicated valuation problems, and these complications do not seem to have been properly considered (or not explicitly reported as considered) by the statistics. In principle, the value of, e.g., the physical capital destroyed would be given by the discounted net value of the services that they would have provided during their remaining life period if the disaster had not occurred. In the case of Guatemala, however, evaluations of the damages have been expressed in terms of the replacement costs of the physical units. Thus, the available figures are not necessarily the relevant ones. In particular, it is not clear - in fact, it is not likely - that these calculations have taken the degree of capital depreciation into consideration. If no allowance for capital depreciation has been made in the official estimates then the real value of the destruction would tend to be overestimated. Thus, as long as this evaluation problem has not been properly considered the figures can at best only roughly reflect the magnitude of the problems discussed.

By distributional impact effects of natural disasters we shall mean changes in the distribution of wealth (defined as all entitlements) that take place directly as a consequence of the damage affecting individuals and (or) regions differently (before markets have reacted).

3. The Guatemalan Earthquake*)

As the Guatemalan earthquake is the main case study to be discussed here, we shall first present a brief general description of it. (See also figure 1 and its fact sheet.)

*) Reproduced from UNDRO's Case Report, p. 1 (UNDRO, 1976 a).

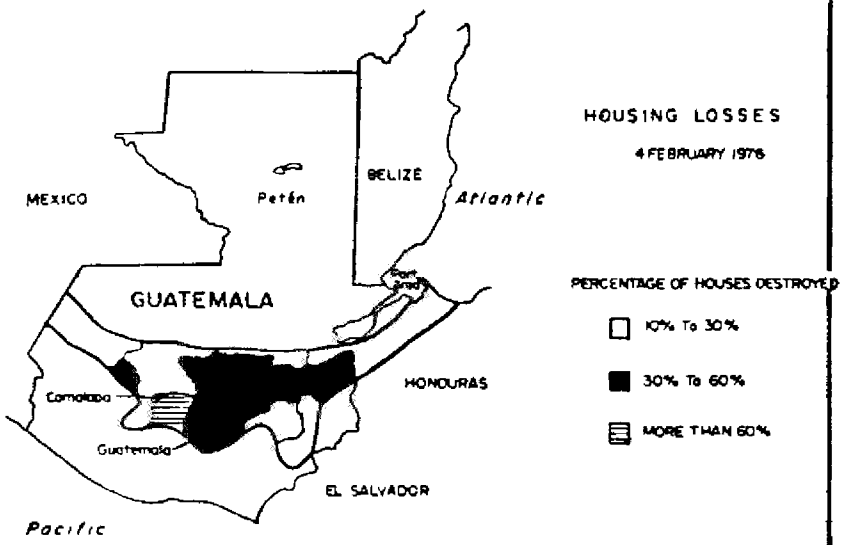
Figure 1

GUATEMALA

Population: 5.5 million.
Disaster: Earthquake7 5 on the Richter Scale.
Date. February 4 1976.
Area Affected. whole belt of highlands from west to east down to east coast. Capital city seriously affected together with many highland towns, constituting country's most populous area.
Dead: 23,000–30,000.
Injured· 74,000–77,000.
Homeless. about 1 million.
Damage: 222,000 houses lost, of which more than half in rural centres and villages; some damage to main routes, serious damage to eastern port, and to services.
Cost of Damage: Government estimate: $1 billion.

Disaster relief: about US $ 100 million*)

*) Adjusted by our estimates made in chapter 7.



Source: London Technical Group

On 4 February 1976 a severe earthquake struck a large area of southern Guatemala. The initial shock measured 7.5 on the Richter scale. The violent shaking demolished dwellings and public buildings, other than those of the most solid construction, in much of Guatemala City, particularly the northern sectors, and in towns and villages in a broad mountainous area to the north and northwest of the capital. Most of the victims were asleep in their homes when the earthquake occurred.

Landslides cut mountain roads, blocking access to the disaster area. Water and sewage mains, electric transmission lines and telephone lines were destroyed.

Because of the interruption to communications a day passed before authorities in the Capital had any real idea of the magnitude of the catastrophe in the outlying districts and it was several more days before the full extent of the devastated area became clear.

Most of the damage occurred in the region adjacent to the western section of the fault line, in the departments of Guatemala, Sacatepequez, Chimaltenango and Quiché. The hardest hit area was a triangle with the town of Joyabaj in Quiché Department at its apex in the north, and Tecpan and Guatemala City at the western and eastern extremities, respectively, of its base.

Following the major earthquake, aftershocks continued, and on 6 February, by which time emergency relief was well under way, a second intense shock measuring 5.5 on the Richter scale was felt over the disaster area. This tremor completed the destruction of some buildings weakened by the original shock and also caused new destruction and casualties. There were some casualties among patients in the hospitals, which by now were crowded with injured from the major earthquake. Some hospitals were forced to evacuate patients into the grounds or into temporary accommodation.

Minor shocks continued to be felt at the rate of hundreds per week. Particularly intense shocks were experienced on 19 February and 6 March, but although these brought down new landslides on important roads, no new casualties occurred.*)

4. Impact Effects of Natural Disasters

a) Impact effects on production. In the Guatemalan case, damage to physical capital in private sectors of production refers to destroyed machinery, equipment, inventories, buildings, livestock, etc. In terms of replacement costs these damages have been estimated to be about US $9 million as damage to rural activities, US $23 million to industry, US $6 million to commercial activities and, US $17 million to private services (mainly to the hotel industry). The total of these damages amounts to some US $55 million or nearly 1.5 per cent of the 1975 Guatemalan GNP.**)

Damage to infrastructure amounted to about US $77 million or something more than 2 per cent of the GNP. The major share of these losses resulted from damage to seaports, 26 % (of the US $77 million), roads and bridges, approximately 6 %, the agricultural infrastructure, 4 %, telecommunication systems, 4 %, and railways and electric generating systems, 3 %.

*) The reader interested in general economic information about Guatemala is referred to the brief presentation in ch. 7, section 3.

**) The statistics presented in connection with the Guatemalan earthquake, unless other references are indicated, have been taken from Bank of Guatemala, 1976. Evaluations of the damage caused have been made by the Bank of Guatemala on the basis of replacement costs where a reconstruction period of 4 years and inflation rates of 10 per cent for 1976, 1977 and of 8 per cent for 1978, 1979 respectively, have been assumed (ibid, p. 14). As already pointed out in this information it is not clear whether the estimates of replacement costs reflect real present values or not. In order to express these estimates as percentage shares of, e.g., the 1975 GNP or of any other indicator, we assume that replacement costs have not been discounted and that the economy's discount rate was approximately equal to the inflation in the respective year.

The losses to the physical capital for public services amounted to some US $220 million or 6 per cent of the GNP. These losses include damage to hospitals (40 % of the installed capacity of the whole nation), health posts (80 % of the installed capacity of the afflicted areas), school buildings (60 % of the existing school buildings in those areas) and water supply systems and other constructions dedicated to public services.

The replacement costs mentioned so far amount to US $352 million. This figure constitutes 8 per cent of Guatemala's 1975 GNP, 39 per cent of its exports of goods and services or 87.4 per cent of the production of manufactures in the country that year.

The estimate just mentioned does not include damage to housing. In Guatemala the earthquake made nearly one million people homeless (about 17 per cent of the total population). The estimate for housing reconstruction amounts to US $669 million or 19 per cent of the Guatemalan 1975 GNP. Adding to this value the estimated costs for reconstruction of the sectors of production indicated previously we obtain an estimate of the aggregate value of the damage to physical capital in the nation. This would be US $1,021 million (in 1975 prices) or nearly 30 per cent of the GNP.*) Expressed another way, for a reconstruction period of four years US $255.25 million or 7 per cent of the GNP each year had to be saved for reconstruction purposes alone. This is almost the same as 9 per cent of the Guatemalan private consumption, 56 per cent of the private net investments or 70 per cent of the total government's expenditures for the

*) This is the official government estimate. It should be noted that lower values for the total reconstruction costs, e.g., US $900 million, are presented by the U.N. Development Forum, p. 7 (cf ch. 1 section 1 above). The "air-photography" method used to assess damage on housing seems to give a 20 % degree of exaggeration. (Davis, I. 1976, p. 16). In Guatemala, however, this degree of exaggeration, it is said (idem. pp. 16 and 43) may have been neutralized by the fact that the estimates were made on the basis of the 1973 population census.

year 1975. (These estimates are based on Bank of Guatemala, 1978, Boletín Estadístico, tables 52, 53.) This reflects the efforts that the Guatemalans would have to maintain for a four-year period to restore their economy to the condition it was in prior to the misfortune in the absence of outside disaster relief.*)

Damage to human capital consists of deaths and injuries affecting the labor force. It has not been possible to find any estimates of losses from this source. However, the estimated 23,000 to 30,000 people killed and 74,000 to 77,000 injured (i.e. together nearly 2 per cent of the total population) indicate that production losses owing to reduced labor supply may have been great. This seems to have been specially serious for some stricken areas such as those of the Department of Chimaltenango where about 19 per cent of the population were killed or injured. Although predisaster unemployment among unskilled people means that part of these effects will be temporary only, the type of production - by self-employed agricultural peasants - in afflicted areas makes the duration of the adjustment period far from negligible (Bunch-Ruddell, 1977). For casualties among skilled labor and people in crucial positions, the effects on production may last longer.

b. Distributional impact effects. For a complete description of the distributional impact effects of the Guatemalan earthquake we should include all the kinds of damages presented so far. However, for purposes of illumination we find it sufficient to use information on damage to housing and other physical capital used in rural sectors. As indicated previously, the earthquake in Guatemala made one-sixth of the total popula-

*) Effects of this magnitude are not unusual. For example, the Government of the Dominican Republic indicated that losses from hurricanes in 1979 amounted to US $830 million. Although an estimate of the total damage caused by the Yungay avalanche that took place on May 1970 in Peru is not available, this disaster killed approximately 70,000 and injured 50,000 people and damaged or destroyed 80 per cent of all structures in the region. (See Smith, 1979.)

tion homeless. But damage to housing was concentrated to only one-third of the national territory. In addition, within the stricken area, the intensity of the damage differed extensively among departments. The departments most seriously affected were those of Chimaltenango (with nearly 90 per cent of damage to existing houses), El Progreso (with nearly 80 per cent), Sacatepequez (54 per cent), and Guatemala (42 per cent). According to different studies (e.g. Bank of Guatemala, 1976, p. 34) the intensity of the damage caused to housing may have depended on the low quality of houses traditionally owned by people in low-income groups, specially Indians (predominant in the stricken areas). Moreover, the areas seriously affected (see chapter 1, p. 5, above) are also areas characterized by high levels of illiteracy, lacking effective means of communication and with a high share of peasants producing for self-consumption only (Weymes & Holt, ibid).

From another point of view, considering that houses in the stricken areas are not only dwelling places but also places where people work (e.g., in handicrafts) the damage to housing had a deleterious impact on people's income generating opportunities. So, instantaneously by destroying people's means of production the damage changed the income distribution. For example, in COPEVI (1976), we find that in the whole nation 50,000 low-income households sustained by the daily incomes generated from sales of manufactures and handicrafts were affected by the partial or total destruction of their working places (houses) and equipment. Ninety per cent of the total housing stock of people in these low-income groups was destroyed. In urban areas 58,000 of the houses destroyed were owned by people with a monthly family income of US $20 to US $60 (300,000 people in this group were made homeless). For the same income group in rural areas the number of houses destroyed was 164,024 (741,000 of these people were made home-

less) (Davis, 1976, p. 17). A rough idea of the extent of this effect would be obtained by considering the fact that in the department of Chimaltenango - a major tourist area and the most severely affected by damage to housing - the major share of people's income comes from services and handicrafts in connection with the tourist industry. In the whole nation the income share from services (including trade) stands for nearly 50 per cent of the total production (GNP) and is mainly concentrated to the areas most seriously affected (Bank of Guatemala, idem).

Figures of the effects on other rural activities indicate that 50 per cent of the "minifundios" (small poor estates) in the stricken areas suffered from damage to crops and livestocks and from the total disorganization of markets for these products (COPEVI, ibid).

The damage affecting low-income groups can be contrasted with that affecting people in high-income brackets. For example, in the same source of information (COPEVI) it is indicated that 147 factory buildings were significantly damaged. This damage, however, did not lead to major losses of production (idem). About 33 per cent of the "latifundios" (large farms) suffered some losses owing, mainly, to the destruction of the transport infrastructure. Only 10 per cent of the housing stock of this group was destroyed (ibid).

As has been suggested, problems of the type described here may be alleviated by precautionary measures of different kinds. On the regional level such measures may take the form of public organizations (including representatives from the government as well as communities) designed to assist people in risky zones, to provide the building techniques necessary to prevent such events, to store of commodities etc. But in Gua-

temala, no such organizational structure existed (Bank of Guatemala, idem). The conditions required for such an organizational structure were specially weak in the areas affected. At the individual level, one relevant solution might have been the purchase of insurance. But only 10 per cent of property damage in Guatemala was covered by insurance contracts (Themptander, 1979). In addition, insurance contracts that had been purchased prior to the earthquake were owned by people in the higher income groups in the big cities of the country, specially Guatemala City. In the areas where the intensity of the damage were high there was no insurance coverage (COPEVI, ibid).

Thus, there are indications that in Guatemala the distributional impact effects of the catastrophe have been considerable. In the preliminary evaluations of the damage made by the Bank of Guatemala (idem) it is stated that the wealth losses arising have significantly aggravated the distributional problems already existing. Naturally, this situation must be at least partly a result of the conditions of being poor. The low purchasing power of the poor will not only prevent them from taking precautionary measures (e.g., purchasing insurance or investing in safe houses) but will automatically segregate them to disaster-prone areas. Most often, slums or squatter areas in the big cities are concentrated on cheap landslide-prone hillsides, ravines or river banks (UNDRO, 1979a; Davis, I. 1978, p. 11). In Guatemala City thousands living on steep slopes or in ravines died as landslides took their houses down the slopes (Davis,1978,loc cit).Similarly, communities in rural areas may tend to concentrate around disaster-prone volcanic and flood areas (usually, the most productive land) (ibid).

What happened in Guatemala need not necessarily be representative for other natural disasters or even for

earthquakes in other areas or countries. In general the size and extent of the disaster, the proportion of losses in productive sectors, etc., will differ according to the production structure in each specific case. Similarly, the distributional effects will depend on prevailing income and wealth conditions in the stricken areas (UNDRO, 1979a,"Compendium of Current Knowledge", Vol. 7). But, from the very scarce information existing on the economic effects of natural disasters one gets the idea that the distributional impact effects that are to the disadvantage of the rural and urban poor are common for most disasters occurring in LDCs, e.g., Peru 1970, see (Smith, 1979); Nicaragua 1972, see (Berg, Ferver, et.al., 1973); Honduras 1974, see (UNDRO, 1979a).

5. Indirect Effects

Indirect effects of natural disasters, as the term is used here are (see section 2, above) those changes following the impact effects. The most important indirect effects encountered in Guatemala appear to have been the result of changes in the volume and composition of the demand and income generating opportunities of people in the afflicted areas. Here we shall deal with the effects on output and prices, income distribution, sectoral and regional disparities, and the preconditions for economic development.

a) Indirect effects on output. No comprehensive statistical measure of production losses for the whole economy is available. However, according to our estimates in Chapter 5 (sections 5 and 6) production losses in Guatemala during 1976 due to the earthquake would have amounted to some US $100 million (in 1970 prices). For the entire 1976-80 period, on which our study concentrates, these losses would have been in the order of US $600 million.

In addition, we have found some data on what appear to be expected changes in the growth capacity of the total aggregate output (GDP) and of sectoral production, in the form of reformulations of the development plans existing at the time of occurrence of the earthquake. These effects, which are of the type that are noticed long after a natural disaster has occurred, are due to the overall physical destruction described previously and, in interaction, to the changes in the preconditions for economic development which will be described in the last paragraph of this section. Such an anticipated breakdown of projections is summarized in table 1, below (UNDP, 1976, p. 14).*) In this table, we can see that radically increased growth rates of sectoral production during the 1976-79 period would have been required if the projected level of GDP and its sectoral distribution (column 3) were to be achieved in 1979. (The increments needed are equal to the differences between column 1 and 2. Column 2 is constructed so as to give the same 1979 GDP as column 1.) The annual cumulative growth rate of the GDP, originally projected to be 7.5 per cent, had to be increased after the earthquake to the 9 per cent level. Government consumption, projected to grow by 8 per cent, had to be reduced somewhat to permit a radical increase in the growth of public investment (from the projected 10 per cent to the required 26.6 per cent level). In this case, the differences in sectoral growth rates (higher growth rates) required to counteract the impact of the destruction and to achieve preconceived economic goals may reflect the losses from the impact effects caused by the earthquake. Considering that historically the Guatemalan real GDP during the period prior to the earthquake grew at an average annual rate of about 5 per cent (see table 1 and figure 2, chapter 5 of this study) one may conclude

*) These estimates were elaborated by the National Planning Council in cooperation with the UNDP. They were aimed to serve as a basis for the general reconstruction plan of the nation.

that the possibilities of achieving the above described projections for 1979 would be small. Moreover, estimates such as those presented here, may in different ways fail to forecast a post-disaster development of production.

To begin with, these estimates, which were published in November 1976, probably do not take into account all relevant changes in preconditions for economic activities induced either automatically by the state of conditions following the disaster or, by the disaster relief given. Sufficiently radical changes in economic preconditions will change the capital-output coefficients of the economy (see chapter 4 section 4) and the post-disaster rates of growth of production will be different from what was forecasted. Nevertheless the Guatemalan total real output did in fact grow much faster during the post-disaster (1976-78) years than it had done during the 8 years before the earthquake. This may be an indication of the developmental role of the disaster relief given from abroad.

Table 1. Projected Growth Rates of GDP, Disaggregated (at 1975 prices)

	1	2	3
	Annual cumulative growth rate		
	Original Plan	Preliminary Global Reformulation 76-79	1979 GDP (millions)
Gross Domestic Product	7.5	9.1	5076.5
Private Consumption	6.5	8.3	3910.6
Government Consumption	8.0	7.9	342.2
Private Investment	8.4	13.6	831.8
Public Investment	10.0	26.6	284.3
Exports	7.0	7.8	1083.1
Imports	3.0	10.5	1375.5

Source: Secretariat of National Planning Council/Technical Commission on Evaluation and Planning /33).