Handbook

for Estimating the Socio - economic and Environmental Effects of **Disasters**

Economic Commission for Latin America and the Caribbean
E C L A C

Section Four

Economic sectors

I. AGRICULTURE SECTOR

A. INTRODUCTION

1. General comments

Each type of disaster affects the agriculture sector in its own way.[1] The sector is usually most affected by those of a hydro-meteorological nature –such as tropical storms and hurricanes, floods, frosts and droughts– whereas the impacts of disasters of a geological nature –earthquakes, volcanic eruptions and tsunamis– may only be indirect or marginal.

The extent of impact defines the scope of the work of the agricultural specialist, but agricultural issues are intimately related to all other phases of the assessment process. Cooperation and constant consultation among all sectoral specialists is therefore essential.

The agricultural specialist must first obtain a clear idea of the phenomenon's impact on the sector before asking a civil engineer to estimate damages sustained by the sector's physical infrastructure. This latter assessment should include damage to, or destruction of, livestock-raising facilities, product and input storage installations, the silting up or destruction of irrigation and drainage systems, and so forth. Therefore, close cooperation between these two specialists is essential.

As we have already suggested, agriculture is usually most affected by floods, frosts and droughts; in some instances, tropical storms and hurricanes may also affect urban areas, inflicting relatively more damage on productive sectors or infrastructure outside of agriculture. Disasters caused by earthquakes might only affect the agricultural sector by destroying or damaging such infrastructure as silos, warehouses and irrigation and drainage systems. Mudslides might affect both agricultural and urban areas.

Considering the environmental toll of most disasters, the agricultural specialist must also work in close cooperation with the environmental specialist so that the latter may include all the relevant information in his/her assessment. Such coordination assumes increasing relevance because the widening degree of degradation of natural resources prevailing in Latin America and the Caribbean is magnifying the current and future effects of natural phenomena. Losses of agricultural land through erosion and mudslides, destruction of flood control levees, changes in the course of rivers and the effects on the flora and fauna are some such factors to be considered.

1 For purposes of this Handbook, the sector comprises the subsectors of agriculture, livestock, fisheries and commercial forestry development.

It is equally important to identify the differential impact of the disaster on women. The ultimate aim is to determine damage in monetary terms, and since impact varies by sex, the design characteristics of rehabilitation and reconstruction tasks generally must be fashioned accordingly. Once again, the agricultural specialist must work in close cooperation with the gender specialist for the purposes of the assessment, providing him or her with the relevant information.

Agricultural sector products are normally processed and sold by persons or companies other than rural producers, so the agricultural specialist must also cooperate with the trade and industry sector specialists.

The preceding paragraphs make obvious the need for agricultural specialists to maintain a broad vision and define intersectoral ramifications.

In addition, she or he must analyze the post-disaster situation in connection with the immediate availability of food and whether shortages may arise. Sometimes a disaster forces farmers and pickers to abandon fields and focus on dealing with the emergency and repairing or rebuilding their dwellings. Earthquakes may curtail access to food supplies by damaging silos and warehouses. Long-duration floods –such as those caused by El Niño in Ecuador[2]– may prevent a crop from being planted, while prolonged droughts may seriously compromise the production and future availability of food.

2 The agricultural specialist must ascertain the characteristics of the phenomenon causing the disaster, because only then will he/she be able to effectively plan his/her work. Consider the case of a hurricane whose intense winds can destroy plantations and crops; the accompanying rains may lead to flooding of farmland either directly or by causing rivers to overflow their banks. Some crops that are very resistant to wind may be vulnerable to long periods of flooding, as are African palm trees. Earthquake damage, in turn, is usually limited to relatively small areas, whereas droughts frequently extend over vast regions and may even affect several adjacent countries. In other extreme cases, the natural phenomenon can give rise to widespread although temporary climate modifications, producing multiple effects on different sectors, as in the Bolivia and Peru highlands during El Niño in 1982-1983.[3] Therefore, the agriculture specialist must be well informed on the characteristics of the intensity and reach of the natural phenomenon causing the disaster, as well as its major effects and the areas affected.

2 ECLAC, *Natural Disasters in Bolivia, Ecuador and Peru,* Santiago, Chile, 1983; and Jovel, Roberto, et al., Consultants' Report for the Corporación Andina de Fomento, San Salvador, 1999.

3 ECLAC, *Natural Disasters in Bolivia, Ecuador and Peru*, Santiago, Chile, 1983.

Effects may vary significantly depending on the timing of the disaster in relation to the agricultural calendar. A tropical storm or hurricane may occur just at the time when coffee plantations are in bloom and thereby destroy or very significantly diminish the year's harvest. The situation may be different for annual crops. If a flood or a late onset of rains occurs when sowing has just begun, a new crop can be achieved by planting faster - growing varieties; however, the loss can be total if the disaster strikes when the crop is ready for harvesting and it is no longer feasible to sow a new one in the same year. Much depends on the type of crop or plantation in question. In 1979, back-to-back hurricanes David and Federico struck coffee-growing areas in the Dominican Republic. In some instances, plants were uprooted and the loss was total, whereas damage was only partial in other areas.[4] Permanent plantations generally sustain longer-lasting damage than annual crops because their recovery is slower. When part of a plantation is lost, it must be replanted, the related infrastructure –channels, drains, transportation networks, etc.– has to be rebuilt, and producers must wait several years for plants to mature and begin producing again. Such was the case of banana plantations located on the northern coast of Honduras hit by Hurricane Mitch in 1998.[5]

The agricultural specialist must also determine the destination of lost or affected production. In an area of subsistence agriculture, a disaster may have severe social repercussions. When an area is used for commercial crops, quantification of losses is essentially done in economic terms; the assessment must include an estimate of production losses, the evaluation of the national food balance and an estimation of import requirements to cover any shortfalls in foodstuffs.

An additional effect is felt when the production lost is a raw material for the functioning of an industry, such as sugarcane, sisal or vegetables for canning. Sugar refineries, which generally have quite a broad area of influence, may find it unprofitable to bring cane over long distances or to use damaged roads given the higher transport costs they imply.

When export-oriented agricultural production is damaged, the impact is felt both on the level of the local economy and in the balance of trade and the current account, potentially upsetting macroeconomic equilibriums. Production losses that are compensated through imports may create similar imbalances.

Finally, any decrease in the agricultural sector's production, as in all productive sectors, causes losses of employment and income for agricultural workers. These must be estimated in close cooperation with the employment specialist, making use of known ratios between the volume of production and the required use of labor.

4 ECLAC, *Dominican Republic: Repercussions of Hurricanes David and Federico on the Economy and Social Conditions*, Mexico City, 1979.

5 ECLAC, *Central America: Analysis of the Damage Caused by Hurricane Mitch*, Mexico City, 1999.

2. Description of damages

When carrying out the assessment and preparing the respective report, the agricultural specialist must clearly describe the type of crop or plantation that has been affected, as well as its geographic extension. The description must be accompanied by the most accurate quantification possible of the areas and production affected. Bear in mind that damage may vary in nature depending on whether annual crops or permanent plantations are affected.

The damage to plantations and permanent crops may vary from total loss to only partial damage. Remember that a single natural phenomenon –such as a tropical storm or hurricane– can completely destroy plantations in its path and unleash torrential rains and winds that rob plants of their blossoms (such as coffee) or flood lands used for plantations sensitive to excess water (such as bananas).

Hurricane Fifi's impact on Honduras at the end of 1974 is a good case in point. The storm made a landfall in the northeastern part of the Honduran Atlantic coast, moved along a river valley that runs east-west, and damaged an area of excellent and highly productive land that was home to livestock and primarily banana, African palm, maize and rice. Banana plantations were located directly in the path of the hurricane and were practically destroyed. On the other side of the river, however, oil-palm plantations endured strong winds and more than two weeks of flooding. The rice and maize in the flooded area practically disappeared, while those planted in the upper sections of the river basin survived. Smaller animals –poultry, pigs and goats– practically disappeared, along with cattle that did not manage to take shelter on higher ground.[6]

The agricultural specialist must prepare a comprehensive description of the effects on the entire environment: natural resources, physical infrastructure, working capital, damaged or destroyed machinery, livestock and so forth. Such reports should include the full range of disaster reverberations for agricultural land, such as when excessive rains and flooding cause mudslides or the silting of productive lands located on hillsides and neighboring plains whose recovery may be unfeasible or either economically or environmentally non-cost-effective. A volcanic eruption's wind-blown ash may cause temporary damage by destroying crops, but in the medium and long - term may give rise to benefits by enhancing the yields of future crops.

The destruction of terraced fields and flood-induced deposits or waste may provoke losses, but it may eventually be possible to return such land to its pre-disaster state. A detailed description of these problems makes it possible to estimate future production shortfalls on such lands, as well as the stored products or inputs that were destroyed. A tropical storm's winds and flooding may cause a drastic, months-long decrease in milk and egg production as farm animals become stressed. Although the specialist might not be able to completely quantify these future indirect effects, they must be noted when deemed significant.

6 ECLAC, *Report on the Damage and Repercussions of Hurricane Fifi on the Honduran Economy*, Mexico City, 1974.

The description of inputs or crops stored in silos is relatively easy, because it suffices to prepare a list of each one and their volume or worth, classifying damage as total or partial. This is important because sometimes damage can make a product useless for one specific end, but it can still be used for other purposes. An example of this is maize for human consumption whose presentation or attractiveness might be reduced, but which can still be used as cattle feed.

Therefore, the agricultural and the environmental specialists must carefully examine permanent or temporary damage to natural resources. In some cases, torrential rains may sweep rich hillside soils to the plains, thereby improving the fertility of alluvial soils even if they had initially been damaged by flooding. In some cases, relatively high investments may be needed to replace lost topsoil.

After volcanic eruptions, the layer of ash deposited on the soils might be quite thin and permit full production recovery. Of course, if the layer of ash deposited is too thick, the recovery cost of renewing productive agriculture could be prohibitive.

It is equally important to determine the effects on the "backyard economy" activities carried out by women for subsistence purposes or as a source of occasional and supplementary income. The backyard economy refers to relatively minor activities (producing foods or raising small animals and obtaining their by-products) common in rural and marginal urban areas. Although it does not involve high investments, backyard production is very significant for the economy and for covering the food needs of many households. Losses in this regard are usually total and make it impossible or very difficult for these women to feed their families. When such losses occur throughout large regions, obtaining food becomes difficult and costly. The situation is even worse in women-led households.

Therefore, it is very useful to identify the affected population by sex, based on prior statistical information or, when necessary, through fast sampling procedures. For example, identifying groups of affected peasant women assists in the design of programmes and projects to rebuild their backyard economy. Identifying groups of affected men is also very useful because it is they who tend to temporarily or permanently migrate to cities or even to other countries in search of jobs or income after a disaster, leaving the women in charge of plots or farms. Rehabilitation and reconstruction programmes must take these differential impacts on women into consideration.

Although impact assessments are needed fundamentally for planning medium - and long-term reconstruction, they may allow the agricultural specialist to uncover more immediate problems or possibilities that should be reported to the respective authorities.

3. Sources of information

There is very limited time available to conclude assessment work, since its results are urgently needed in order to guide reconstruction. However, the agricultural specialist and other sector specialists must collect any additional information that may allow a description of the different types of effects and damage.

The first rough assessment that officials in affected countries generally conduct when a disaster strikes provide analysts with an initial source of information that is often extremely useful when it comes to beginning the detailed assessment. These preliminary assessments define the hardest-hit areas, the geographical scope of the disaster and its effects, and potential economic repercussions. However, the time constraints implied by the urgency of such initial reports and a number of subjective factors generally mean that the initial assessments made by officials tend to be more qualitative than quantitative in nature and to overestimate effects. Therefore, the agricultural specialist must test the validity of such preliminary assessments in the field.

After dealing with the emergency stage and initially assessing the situation, governments usually undertake a more detailed study, frequently accompanied by field surveys. This information is very useful to the agricultural specialist because it is often compiled by local experts who themselves live in the affected areas and are very familiar with local crops, their yields, prices and other information needed to carry out a detailed impact assessment.

The agricultural specialist must also collect information on long-term statistical series on production and trends in the affected region; such data make it possible to estimate what production would have been had the disaster not occurred and thereby allow for comparisons between pre- and post-disaster scenarios.

During the mission, the agricultural specialist must try to get as much information as possible from different sources, even if they are apparently contradictory. This will allow him/her to verify them in due course and use the one that, in his/her opinion, best reflects the actual situation. To do this, visits to the affected region must be as wide-ranging as possible. Field visits are normally difficult to undertake because of damage to communication routes, and in such case air transport should be obtained if possible –preferably by helicopter, given the advantages of maneuverability and the ease with which visits can be made to any place of interest– so that the visit can be made in as little time as possible. If visiting the whole region affected is difficult due to a lack of facilities, the specialist must prioritize his field visits as a function of available facilities,[7] the extent of physical damage (if there is a large number of victims and infrastructure has been destroyed) and economic importance (e.g., if coffee plantations whose production is equal to half the country's foreign currency earnings are destroyed). In any case, he/she will have to be selective and choose to visit the areas that are most representative and most economically and socially significant.

7 At the time of the assessment mission, helicopters may still be in use for emergency work.

The field visits will permit interviews with local officials and people affected by the disaster, whose firsthand experiences and information can contribute to an understanding of the magnitude of the disaster and its effects. The agriculture specialist must also try to contact experts at different levels and in different activities; for example, the agriculture ministry's representative may have an overall view, whereas the extension agent may have a very specific view of the area in which he/she works. Contact must also be established with service providers, vendors of agricultural inputs and so on. who may know the structure and size of local food and raw materials demands, as produced and required by the agricultural sector. All of the above will allow the agricultural specialist to put together his/her own view of events.

Preliminary work must also be done to define in advance what information should be obtained during local interviews in the field. If there are no estimates on damaged infrastructure at the central government level, the field visit will provide an excellent opportunity to obtain such information. If, on the other hand, there are estimates but they have not been verified, interviews will allow such verification. In other words, the specialist must have a clear idea of what he/she wants or needs, and how to get it.

As has already been said, no information should be rejected, and no opportunity to talk about the disaster should be overlooked. Therefore, the agricultural specialist must also hold interviews with the national officials who prepared the preliminary damage assessment or who are connected with agriculture in various ways, such as agents from the sectoral planning office. They must also consult directors of specialized institutions or trade associations that have some kind of influence or work in the area, such as those of coffee and banana growers, cattle farmers or crop dusting pilots. The same is true of international officials having some activities in the affected area. (FAO, IFAD, WFP, IADB, World Bank, OAS development projects, etc.).

The specialist should also meet with representatives of companies involved in the transformation of agricultural products in the region, such as pasteurizers, packers, canners, fertilizer manufacturers and vendors. Their experts may provide information that will give the specialist a better idea of the impact that a lack of necessary raw materials will have on such companies, as well as additional ideas related to employment, recovery time, and so on.

Finally, in the immediate aftermath of the disaster, the printed press can provide knowledge that may assist in understanding the phenomenon, especially in the first stage, although care must be taken not to take at face value any quantitative information provided by unauthorized sources.

B. QUANTIFICATION OF DAMAGE

1. Direct damage

Direct damages to the agricultural sector refer to losses of capital assets. They may be grouped under four main headings: damage to farmland, whose recovery may take many years; damage to physical infrastructure (including irrigation and drainage systems, storage facilities, silos, etc.) and to machinery and equipment (tractors, spraying equipment, etc.); losses of crops that are ready to be harvested; and losses of stock (livestock, inputs, harvested products, etc).

A distinction must be made here between the loss of crops ready for harvest, which is considered direct damage, and the loss of future harvests, which is regarded as indirect damage or losses, as we explain in detail later in this chapter.

a) Losses of farmland

The value of farmland lost, whether through erosion or total sedimentation, is difficult to estimate. Although the soil may have been lost and there is nothing that can be done about it, a value may be assigned to that damage on the basis of what the land would have produced over ten years based on the average productivity levels of the affected area. Thus, if a hectare of bananas produced an average net annual income of 20 000 dollars, a value of 200 000 dollars per hectare can be assigned to the loss.

A rough idea of the value of damage to the land temporarily affected by flood deposits can be developed on the basis of the cost of clearing a hectare of land that has minor tree cover. These figures are always available in ministries of agriculture or may be obtained from private companies that do such work. The agricultural specialist must estimate the affected surface area and estimate the total cost of recovering the land in question together with the civil engineering specialist.

It is more difficult to estimate damage to land that has been invaded by external agents that do not necessarily have a permanent effect on resources, such as land covered by volcanic ash. In the short term, the soil stops producing and there is no rule for projecting how long it will take for vegetation to recover. The volcanic eruption that occurred in a Central American country just as the cotton harvest was being picked is a good example. The immediate result was a lowering in the quality of the fiber collected, with a corresponding fall in price. However, because the layer of ash deposited was thin enough to be plowed into the soil, agricultural activity was reinitiated the following year. In some cases, the content or composition of the ash leads to an increase in soil productivity, so it must be analyzed before it is folded into the soil by machine. When the ash deposits are too thick, the rehabilitation costs and period are greater. Of course, future harvests that will not take place because of this phenomenon must be registered as indirect losses.

b) Damage to agricultural infrastructure and equipment

Damage to the sector's physical infrastructure (irrigation and drainage channels, storage facilities, silos, machinery, laboratories, corrals, chicken sheds, aquiculture pools, fishing port installations, etc.) and equipment is estimated on the basis of physical units affected, whether totally or partially destroyed. The agricultural specialist must estimate the extent of the damage, using physical units such as kilometers of farm roads, length of channels in meters and number of tractors, and then co-operate with the civil engineering specialist to determine monetary values. Table 1 shows the type of estimate that must be carried out in the case of direct damages to infrastructure, and Table 2 describes damage to assets at the farm level.

In this regard, differences between present and replacement values of assets referred to in Section One of this Handbook –on valuation criteria– must be taken into consideration.

c) Production losses

Strictly speaking, only production ready to be harvested at the time of the disaster can be taken into account under this heading, because only then can it be considered an asset.

However, if the disaster occurs while annual crops are still growing, it is necessary to register the loss on investment in labor and inputs. If a crop is totally destroyed, the costs incurred by producers must be estimated in accordance with the stage of the crop. If destruction or damage is partial, estimates must be prorated accordingly. The costs of the forthcoming harvest cannot be considered as damage since that would imply double accounting. If imports are used to replace lost crops that could not be replanted, the value of those imports must be indicated so the macroeconomics specialist can take it into account in the analysis of post-disaster economic performance. In no case must they be added as direct damage.

Table 1
DAMAGE TO INFRASTRUCTURE

Item	Description of damage	Cost, millions US$
1. Access roads	70 km of dirt access roads in poor condition.	
	(2) 22-m long Bailey bridges, destroyed.	
2. Infrastructure	6 km main channel, water intakes 14 to 27, destroyed	
	20 postes eléctricos 1 transformador, etc.	
	7 water intakes and equipment	
	800 m of power line to operate pumps	
	20 electricity posts 1 transformer, etc.	

Estimating damage to permanent plantations is more difficult. It requires an estimation of costs incurred throughout the planting and maturing period (several years in all cases) before they production is resumed. In some cases it will also be necessary to repair or replace production infrastructure, such as networks of cables to transport bananas to the packing plants or irrigation and drainage channels. These costs must be estimated under the previous heading, using information that can be provided by the affected companies.

In the case of livestock, no losses or direct damage should be registered under the heading of production. Instead, they are considered losses of stock (which are examined under the following heading) or of future production (which is taken into account as indirect damage). As noted earlier, the volume of losses of each crop or plantation must be estimated first so that they may then be expressed in monetary terms, based on prices paid to the producer.

Table 2

DAMAGE TO CAPITAL ASSETS AT THE FARM LEVEL

Item	Description of damage	Cost
1. Land affected	35 hectares silted with sand, totally lost 150 hectares flooded with waste material, but recoverable	
2. Irrigation and drainage system	100 km of main channels 750 km of secondary channels 210 km of silted drains	
3. Machinery and equipment destroyed	10 tractors 2 seeders 3 pumps 5 tow-trucks 1 truck 7 spray pumps Sundry equipment	
4. Crops and inputs lost	21 tons of maize 5 tons of maize seed 50 bags of fertilizer 1,500 liters of gasoline 17,000 hessian bags	
5. Other production goods	16 mules 70 bales of hay, etc..	
	1 granary, 700 m 2 concrete and brick construction	
6. Buildings and installations	2 granaries, 950 m 2 adobe construction	
	1 milking parlor, adobe	

d) Losses of stock

Stocks of inputs and agricultural production that has already been harvested and stored may be totally or partially lost. In the case of total loss, damage must be estimated at farm prices and inputs at replacement value. Estimates of partial loss or damage are made on a prorated basis.

In the case of livestock, when estimating the value of losses, a distinction must be made between beef, dairy and breeding cattle, because prices and unit values are different. Production losses under this heading are estimated as indirect damage.

Previously harvested and stored pasture that may be lost as a result of the disaster must be included in the estimation of stock, based on a value determined in cooperation with experts and farmers in the affected areas.

In regions devoted to peasant agriculture, cattle raising usually provides only a supplement to the population's total income. Losses of larger animals, especially those used for agricultural work, must be taken into account at their market prices.

Losses of stock are included in Table 2.

2. Indirect losses

For this sector, indirect losses refers to any decrease in production throughout the recovery period resulting from direct damages caused by the disaster. Indirect damage also includes the cost of works required to prevent or mitigate damage by similar phenomena that may occur in the future.

Indirect damage to annual or seasonal crops occurs when there is not enough time to re-sow for a second harvest or when an extended flood or the absence of rain prevents the planting of one or more crops or reduces crop yields. In such cases, we recommend that future losses be estimated on the basis of their probable physical volume, taking into consideration the average productivity levels for the affected areas, broken down by each affected crop. In the case of plantations or permanent crops, productivity is reduced by damage to the plants themselves. Examples include coffee and fruit trees, whose future productivity may decrease due to the loss of blossoms.

Livestock production also decreases because of emotional stress on animals affected by natural phenomena. For example, after a hurricane or prolonged flood, hens stop laying eggs, and cows lose a lot of weight and their milk production falls. These indirect effects are difficult to estimate. They are frequently calculated as decreases of up to 20% of normal production, but one should consult local experts and affected producers who have faced similar experiences in the past, before deciding on the percentage to be applied. The disaster can also have a significant impact on the growth of pasture. Some pasture may be completely destroyed by floods –as in the case of Jaragua, Estrella or Taiwan types– or by drought. In such cases, the indirect damage caused by the disaster can be estimated as the cost of replanting pasturelands.

Fishing or the future production in aquiculture systems can be affected in various ways. Floods or high tides may destroy shrimp - growing reservoirs or pools used in some countries, diminishing production during the rehabilitation period. Fish capture may fall when seawater temperature and salinity change, as in the case of the El Niño phenomenon along the Pacific shores of some South American countries, or when major earthquakes occur whose epicenter is located at sea. In the recent case of El Salvador, shoals withdrew to deep sea locations that could not be reached by artisan fishing boats.[8]

Note, however, that hydro-meteorological phenomena may also have positive effects on production. The El Niño phenomenon has opened up normally arid or semi-arid lands for the temporary production of highly profitable crops, and has given fisherman access to high-value fish species that normally inhabit other latitudes. These increases in production must be subtracted from losses of traditional products to obtain a net damage result.

8 ECLAC, *The January 13, 2001, earthquake in El Salvador*, Mexico City, 2001.

The construction of defense or mitigation works against future natural phenomena is essential. In one Central American country, significant and extensive flooding occurred on coastal plains after heavy rains exceeded the capacity of watercourses to quickly discharge runoff into the sea. Moreover, the sediments brought down by the floods were deposited in river deltas, further reducing the capacity to discharge runoff. The delta had to be dredged, and protection levees were built along major sections of the rivers. The cost of such work was registered as indirect damage caused by the disaster. Other types of indirect damages might included reforestation on the upper reaches of river basins and the training of riverbeds along certain sections.

Table 3 below is an example of how to calculate indirect production losses.

3. Total damages and losses

Total damages caused by a disaster can be obtained as the sum of direct damage and indirect losses. As an example, Table 4 describes agricultural sector losses caused by hurricane Mitch in Honduras in 1999, with a detailed explanation given in Appendix X. Total damage estimates must also be broken down between that sustained by the private and public sectors, because reconstruction might be dealt with differently in each case. Steps must also be taken to determine the geographic or spatial distribution of damage in order to provide criteria for prioritizing reconstruction programmes.

Table 3

ASSESSMENT OF PHYSICAL AND ECONOMIC DAMAGE IN AGRICULTURE, BY AREA AND SECTOR

Region of the country	Area planted before the hurricane, hurricane,	Total affected area, hectares	Area with total damage, hectares	Area with partial damage, hectares	Amount of losses at the farm level, thousands of dollars 9	Percentage of total damage, %
Central	61,451	48,075	30,067	10,003	143,706	55.9
Southwest	56,621	17,826	9,355	6,471	13,994	5.4
South	46,317	12,253	5,232	7,021	15,010	6.2
East	34,169	21,325	6,926	14,399	10,334	4.2
North	117,393	37,301	14,303	22,998	43,392	16.9
Northeast	30,657	11,007	4,794	6,293	3,422	10.3
Northwest	128,984	54,292	13,600	40,692	26,360	1.3
National total	**475,502**	**202,239**	**84,357**	**117,002**	**257,127**	**100.0**

Source: Department of Agriculture.

9 Includes the cost of replacement of capital – which in the case of permanent crops will be spread over several years – but does not include losses of stock or losses due to the effect of paralysed production. That is why these figures do not necessarily coincide with those in Table 4.

Total damage and losses should not include the cost of any imports to replace lost production for internal consumption, or exports that do not take place due to lost production, as this would imply double accounting. Those figures, however, should be taken into consideration by the macroeconomics specialist in the external-sector analysis. The same applies to any loss of individual or family income due to production shortfalls, which should be added to the corresponding figures for other sectors describing the effect of the disaster on employment and income at the national level.

Table 4 below offers an example of the total cost of direct damage and indirect losses, as well as their impact on the external sector in terms of lower exports and greater imports.

Table 4

HONDURAS: LOSSES IN AGRICULTURE, LIVESTOCK, FORESTRY AND FISHERIES ARISING FROM THE EFFECTS OF HURRICANE MITCH IN 1998
(Millions of lempiras)

Sector and subsector	Total damage	Direct damage	Indirect losses	Impact on the external sector	
				Increase in imports	Decrease in exports
Total	**27,424.5**	**16,554.2**	**10,870.3**	**561.2**	**5,864.2**
Agriculture (1+2)	23,256.3	14,105.3	9,151.1	561.2	5,492.9
1. Assets (A)	11,535.2	11,535.2			
Soil	5,214.4	5,214.4			
Plantations, facilities	6,320.8	6,320.8			
2. Production: Crops	**11,721.2**	**2,570.1**	**9,151.1**		
Domestic consumption (B)	901.5	772.8	128.4		
Rice	128.4	30.9	30.9	19.3	
Beans	156.5	66.8	89.7	104.2	
Maize	611.6	609.1	2.5	383.5	
Sorghum	97.0	66.1	30.9	54.3	
Exports and Industry (C)	10,819.7	1,797.3	9,022.4		
Bananas	6,548.9	466.5	6,082.4		4,276.8
Coffee	854.9	629.2	225.7		600.3
Sugarcane	747.2	387.0	360.2		85.5
Citrus	440.2	30.0	410.2		25.0
Melon	473.6	31.7	441.9		530.2
African palm	862.9	143.8	719.1		
Pineapple	177.0	11.0	166.0	...	
Other	715.0	98.0	617.0		
Livestock (1+2) (D)	3,492.5	1,886.0	1,606.5		0.0
1. Assets	**2,755.4**	**1,763.1**	**992.3**		
Cattle	1,217.3	225.0	992.3		
Poultry	738.1	738.1			
Physical facilities	500.0	500.0			
Pasture	300.0	300.0			
2. Production	**737.1**	**122.9**	**614.3**		
Milk	737.1	122.9	614.3		
Forestry (E)	46.0	27.0	19.0		
Fisheries (1+2)	629.7	536.0	93.7		371.3
1. Assets	**119.0**	**119.0**			
Fishing	14.4	14.4			
Reservoirs	104.6	104.6			
2. Production	**510.7**	**417.0**	**93.7**		
Fishing (F)	139.4	120.0			
Shrimp in reservoirs	371.3	297.0	74.3		371.3

Source: ECLAC estimates, based on information from official sources and productive sectors.

C. OTHER ASPECTS

The agricultural specialist must take into account several additional items when assessing the impact of a disaster on his/her sector to determine the impact on other links in the production chain –trade and industry– as well as the macroeconomic impact of the disaster. These include the effects on employment and income mentioned earlier; the impact of production losses on the food and exports national balance, which has effects on the external sector; the prices of agricultural products at different points or levels in the production, transformation and commercialization chains; the differential impact of the disaster on women; and effects on the environment.

1. Employment and income

Losses of employment and income after disasters are another trans-sectoral issue because they occur in most, if not all, affected sectors. The relationship between the production of different goods and the labor required to produce them is normally used to estimate said losses; these figures are generally available from labor ministries.

How to arrive at the estimate in all the affected sectors is described in detail in the chapter on employment and income in Volume Four; what is described here is solely related to the agricultural sector. In any case, the agricultural specialist must cooperate very closely with the employment specialist to conduct these estimates.

After a disaster occurs, employment is affected for various reasons. When disasters destroy crops, field workers' income is compromised. We include under this heading losses to crops yet to be harvested, damages to major plantations, decreases in production due to floods or hurricane winds, destruction of or damage to farm roads that prevent the extraction of harvests and the like. In all these cases, the demand for labor decreases, so field workers' income drops. These costs are to be taken into account at the macroeconomic level after the corresponding totals with other sectors have been indirectly inferred.

The average amount of labor used on each crop under normal conditions serves as the basis for calculations. For example, 120 days of labor are required for the complete production of a hectare of coffee, including the harvest. If this production does not take place, around 80 workers will lose their income. The averages used in the estimates should be those for the affected area or country.

Milk and egg production will decrease, as will fish catches. In both cases the use of labor will be affected, and the workforce's income will be reduced accordingly.

An earthquake that produces widespread damage to agricultural workers' homes may impede such workers from attending to their normal duties in the fields because they have to deal with the emergency and the immediate rehabilitation of their houses, again with a corresponding drop in income.

This loss of employment and income in the agricultural sector, as in other sectors, must be broken down by sex so that the gender specialist can estimate the differential impact of the disaster on women.

Information on the loss of employment and income makes it possible to ascertain the decrease in the population's well-being and provides inputs for the design of rehabilitation and reconstruction strategies, programmes and projects employing otherwise idle labor.

2. Food and export balances

These items are included here because they have macroeconomic effects that must be quantified. A decrease in the sector's production may affect products intended for export and lead to a lack of sufficient food to meet the population's needs.

An assessment of the national food balance is essential for identifying total food requirements during the production rehabilitation period whenever the disaster has compromised domestic capacity to fulfill the food needs of the population over a relatively long period. This assessment can be of enormous value, especially in small economies, because it identifies the future need for food imports along with the subsequent macroeconomic effect on the balance of trade and payments.

Information must be collected on the availability of food before the disaster, as well as on the food assistance that is expected to arrive from countries or institutions after the disaster has occurred. In other words, the total volume of available food must be determined, regardless of its source. Later, an estimate of total demand is prepared based on the number of affected people, the estimated per capita consumption of each type of food and the expected duration of a domestic shortfall in the production of each foodstuff. The deficit for each of the food items affected by the disaster can be calculated as the difference between expected supply and demand.

The following table shows how analysts estimated the food balance in Honduras following hurricane Mitch in late 1999.

Table 5

FOOD BALANCE IN HONDURAS AFTER HURRICANE MITCH

Product	Per capita consumption, kgs	Total consumption, tons[10]	Total production after the disaster, tons	Donations received from abroad, tons	Imports required, tons
Maiz	125	875,000	670,000	200,000[10]	5,000
Frijol	30	210,000	200,000	---[11]	10,000
Sorgo	---	---	---	---[12]	---
Arroz	---	---	---	---	---
Trigo	---	---	---	---[13]	---

10 Estimated based on a population of seven million inhabitants.
11 Donation received by means of Act PL480 of the United States of America.
12 Several donations from friendly countries.
13 Cash donation made by the government of the Federal Republic of Germany for the purchase of rice.
14 Donation made by the World Food Program (WFP).

To anticipate possible decreases in exports resulting from disaster-induced production losses, the specialist must examine statistics for recent years and as forecasts for the year of the disaster. Once the volumes that can be effectively produced after the disaster are ascertained and compared with projected exports, it is possible to determine the volumes that will not be sent abroad as a result of the event. That procedure must be followed for each of the export products while estimating lost volumes in tons. The macroeconomics specialist will be responsible for determining the impact of those lost exports on the country's external sector.

3. Sectoral output

The agricultural specialist must develop a table describing the production for each product under both normal and post-disaster conditions as his/her contribution to the analysis of the effect on macroeconomic variables. All products, or at least those accounting for 85% of the sector's gross output, must be included in the analysis.

The table must include information on production volumes and on prices at the various stages of production, transformation and commercialization, as indicated above. This will allow the macroeconomics specialist to estimate the effect of production losses in the sector on national GDP, and it will provide a basis for the trade and industry specialists to undertake their respective loss estimates.

A description of the type of prices that the agricultural specialist must obtain for his/her assessment is included below.

a) Producer prices

The estimation of production losses must be based on the prices paid to the producer for each item. These unit prices can be obtained in countries' statistics offices or in the agricultural economics offices of the respective ministries, especially when a government agency guarantees the prices of certain products to farmers. International prices for a product should only be used in the case of items that are exported abroad.

b) Wholesale prices

These are prices at which industries generally sell already processed products to wholesalers. Comparing them to the prices paid to producers can provide a first estimate of the costs of transforming or processing agricultural products. Information on these costs is also usually available in national statistics offices or ministries of trade or economy.

c) Retail prices

These are the final prices paid by consumers for products acquired at shops. The difference between retail prices and wholesale prices provides a measure of the cost of commercialization. Once again, this information may be found in statistics offices and in ministries of economy and trade.

d) Government guaranteed prices

Governments sometimes guarantee prices to producers, primarily for articles deemed to be of strategic interest to the national economy. Guaranteed prices ensure farmess a minimum income at harvests.National sectoral offices and ministries of trade and economy can provide relevant information.

e) Import prices

Imports may be needed to make up for food shortages resulting from actual or foreseen production losses caused by a disaster. To estimate the value of such imports, use the food balance to ascertain the required volume, and then determine import prices –including insurance, freight and corresponding commercialization margins– with the help of representatives of commercial enterprises responsible for the imports.

Table 6 shows typical prices of certain agricultural inputs for one of the countries in the region, which might be useful for the agricultural specialist.

Table 6

PRICES OF SELECTED AGRICULTURAL INPUTS

Item and characteristics		Price in dollars a/
Tractors		
Ford 6600 77 HP		21 000
Ford 6610 84 HP (Imported)		26 500
Ford 6610 103 HP (Imported)		
TW-25 164 HP		
Certified seed (per ton) b/		
Maize		860
Beans		710
Forage sorghum		280
Grain sorghum		415
Rice		190
Soy bean		410
Wheat		325
Fertilizers (per ton)		
Urea	(loose)	88
	(in bags)	102
Ammonium nitrate	(loose)	70
	(in bags)	81
Ammonium phosphate	(loose)	197
	(in bags)	224
Ammonium sulphate	(loose)	46
	(in bags)	56
Phosphoric acid	(loose)	166
Anhydrous ammonia	(loose)	91
Triple phosphate	(loose)	109
	(in bags)	123
Simple superphosphate	(loose)	46
	(in bags)	54
Potassium chloride	(loose)	110
	(in bags)	125
Potassium sulphate	(loose)	199
	(in bags)	213
Potassium nitrate	(loose)	241
	(in bags)	254

a/ At market prices in Mexico, 9.50 pesos per dollar.
b/ Price of certified seed in the 2000 spring - summer cycle.

f) Export prices

As indicated above, the value of lost production must be expressed in terms of prices paid to producers, while that of export products should be determined by applying international prices for the lost or unproduced items. These prices are normally available in FAO Yearbooks and other publications of international organizations related to trade in agricultural products, as well as in local ministries of agriculture and foreign trade.

4. The differential impact on women

Section Five contains a thorough description of the uneven effects of disasters on men and women and how to estimate this differential impact. This is done because specific programmes and projects can, and must, be designed for implementation by women as part of rehabilitation and reconstruction programmes. The methodology required to carry out this assessment is set out in the aforementioned section, along with the requirement that each sectoral specialist work in close cooperation with the gender specialist. It is difficult to make estimates in this regard because the backyard economy is not yet included in national accounts, which is the basis for the assessments presented in this Handbook. This oversight notwithstanding, it is possible to estimate losses in this all-important productive heading.

In other productive sectors, women operate micro and small enterprises from their homes to supplement family food and income. The corresponding activities in the agricultural sector are known as the backyard economy. The agricultural specialist must carry out special estimates of losses of stock and production associated with such activities, which tend to be more heavily affected in the rural sector.

Losses of chickens, pigs and other small animals represent losses of stock in the backyard economy. Their quantification is difficult and is usually estimated indirectly for each affected area as a percentage of the family's total assets (housing, household goods and furniture). Values ranging between 10% and 40% of those assets are used, depending on whether the family belongs to subsistence or more developed agriculture. The agricultural specialist must make this estimate based on on-site interviews or on data obtained through quick surveys or samplings. The methodology must be developed in close cooperation with the gender specialist to ensure that there are no omissions or duplications. Asset losses in thebackyard economy are over and above asset losses estimated for the agricultural sector.

Any decrease in backyard-economy production also represents indirect damage that must be estimated. In the absence of detailed and reliable information on this heading, the agricultural specialist –in close cooperation with the gender specialist– must estimate this loss as a percentage of household income, taking into consideration the direct loss of stock in this same heading. In other words, indirect damage may be estimated at between 20% and 40% of the household's formal income, depending on the corresponding income level. Field visits must be made in order to directly interview the men and women affected, and surveys or samplings must be made to decide on the value to be adopted. As in the case of asset losses, these production losses are over and above those estimated by the agricultural specialist for his/her sector.

Women's employment and income in agricultural activities is another area usually affected by a disaster. The impact can be estimated based on cooperation and interaction among the agricultural, gender and labor specialists. An example of such analysis is included in the appropriate chapter in Volume Four of this Handbook.

The resulting estimates of the effects on women's assets and contribution to the backyard economy –as well as figures for damages to the environment– must not be added to the total losses for the sector because their components are not as yet included in the national accounts. Total damage figures are used to analyze the effect on macroeconomic variables, which are estimated based precisely on the use of national accounts.

Below is a list of information that the agricultural specialist must obtain, with close cooperation and support from the gender specialist, to estimate losses caused by the disaster in the agricultural sector.

In connection with direct damages, the following data or information must be estimated or determined by means of quick surveys or sampling:

- Losses of productive lands, by sex;
- Losses of subsistence agricultural production already harvested or about to be harvested, by sex;
- Losses of export agricultural production already harvested or about to be harvested, by sex;
- Losses of assets in agricultural cooperatives, by sex;
- Losses of major or minor animal stocks, by sex and producer level; and
- Losses of fishing assets (vessels, engines, nets and tackle) by sex.

In regard to indirect losses, the following information must be obtained, either through estimates or field samplings:

- Future losses of agricultural production, by sex;
- Future losses of livestock production, by sex;
- Losses of livestock production in cooperatives, by sex;
- Future losses of fish catches, by sex; and
- Losses of employment and income by women wage earners in the sector.

5. Impact on the environment

The methodology for assessing damages caused by disasters toenvironmental assets and flows of environmental goods and services is presented in the respective chapter in Volume Four of this Handbook. Agriculture, livestock and fishery are sectors based on the country's natural resource endowment. Production factors such as physical infrastructure, labor and business management, and technology are incorporated in the natural capital for obtaining environmental goods such as agricultural, forest and fish products. Agriculture and fishery sectors, in turn, are related to environmental services provided by specific ecosystems. Used in a sustainable way, forests, in addition to timber and non-timber forest products, provide environmental services such as carbon sequestration, biodiversity conservation and water flow regulation.

The same happens with agro-forestry systems such as shadow coffee production. Genetic diversity is one of the most important assets for agriculture; some production systems, mainly traditional ones, contribute to biodiversity conservation. Similarly, the productivity of fisheries in some regions is related to the health of ecosystems such as mangrove forests, coral reefs and sea-grass beds.

Therefore, a close relationship exists between damage assessment in the agriculture and fishery sectors and environmental damage assessment. In terms of quantification and valuation of damage, two situations should be distinguished (for details, please refer to the chapter on the environment):

a) Environmental damages included in the assessment of the agriculture sector

These are direct and indirect damages (loss of natural capital and changes in the flows of environmental goods and services) that are already accounted for in the agricultural sector. Examples include losses of agricultural land and timber forests, as well as decreases in agricultural and fishery production during the recovery period after the disaster. The environmental assessment seeks to identify the share of these damages that refer to the contribution of natural capital, isolated from contributions of human capital and other assets such as infrastructure, machinery and equipment. This contribution is estimated using the economic rent concept (the difference between market prices and production/extraction costs). To avoid double accounting, these estimations should not be included in the damage overview.

b) Separate quantification and valuation

This refers mainly to the valuation of assets and environmental services related to productive activities that are not accounted for in the agricultural sector assessment. Examples include changes in environmental services such as carbon sequestration, water flow regulation and fishery habitat that result from losses of forests, mangroves and agro-forestry systems. These damages should be included in the damage overview as they have not been considered in the agriculture damage assessment.

APPENDIX X

AGRICULTURAL LOSSES IN HONDURAS FOLLOWING HURRICANE MITCH

The following concepts were applied to estimate agricultural losses:

A) Loss of assets. One of the most significant effects of the hurricane, in terms of both its short - and long-term repercussions, was the loss of assets, including physical facilities, investment in plantations and the production capacity of soils that lost their top layer. Floodwaters ruined agricultural land, covering it with a diverse range of materials.

Pending a detailed survey, it was estimated that soil loss was total on approximately 10 000 hectares, located mainly on floodplains. Stone deposits were the predominant factor in these areas. In one area of roughly 750 hectares, it was decided that the high cost of eliminating sand sediment might be justified by crop profitability. However, before land covered by sand and materials can be used productively, considerable expense must be incurred in cleaning and leveling works.

Mud deposits can be beneficial because they improve soil quality, but several agricultural seasons must pass before the site can be used. Soil losses due to mudslides were detected on approximately 7 000 hectares of mountain slopes used for growing coffee; recovery will take many years.

Estimated total soil losses amounted to 5 200 million lempiras in lost net income (see Table 4). Losses in plantations and ancillary facilities amounted to 6 300 million lempiras. As a whole, they accounted for 50% of the total damage in the agricultural sector. In the case of some crops and regions, new seeds would be needed for planting.

Since agriculture in the valleys was significantly damaged, proper management of hillside agriculture became more important, not only as a source of supply and income for a sizable sector of the rural population, but also as an integral part of sustainable development for the forestry and agriculture sector.

B) Crops for domestic consumption. The hurricane coincided with the end of the harvest of certain crops and the planting of others, so availability of those products would drop the following year. The deficit would be smaller if soil humidity conditions alloweds for a second crop. The magnitude of production losses is shown in Table 4.

In the case of maize, data shows that approximately one - third of the first (and most important) harvest for the 1998-1999 farming year had already been collected, whereas in the area still to be harvested production would be reduced by 250 000 tons, worth 609 million lempiras (see Table A below). Excess water generated by the hurricane resulted in extraordinary costs by preventing the use of machinery for the harvest, which had to be done manually. That value is recorded as indirect damage. At the same time, the poor state of roads hindered transportation of the crop to collection and grain-drying centers, thereby undercutting quality.

The first harvest in the bean cycle had also been collected at the time of the disaster and the second crop, which provides 75% of national production, had already been sown. In the area planted, losses were estimated at 30%, which entails approximately 9,000 fewer tons of beans than were available in 1999. This shortfall would have to be compensated through additional imports. Replanting was possible, but not over the entire affected area. The direct damage of 67 million lempiras includes lost production in the first harvest, as well as investment in the planting of the damaged areas. Indirect damage represents the harvest that was not collected.

Table A

HONDURAS: ESTIMATE OF PRODUCTION LOSSES IN MAIN AGRICULTURAL CROPS AS A RESULT OF HURRICANE MITCH
(Thousands of tons)

Product	Production forecast before the hurricane	Production estimated after the hurricane	Lost production	Loss over expected production (%)
Basic grains				
Uncleaned rice	64.8	56.1	8.8	14
Beans	95.1	89.9	5.2	6
Maize	607.1	252.2	354.9	58
Sorghum	94.2	71.8	22.4	24
Industrial and export crops				
Bananas	872	766 a/	739 b/	85
Sugarcane	3,397	1,360	2,037	60
Coffee	153	126	27	18
Melon	203	144	59	29
African palm	576	415	161	28

Source: ECLAC estimates, based on information from official sources and productive sectors.
a/ In 1998.
b/ The last months of 1998 and the 1999 harvest.

A similar situation occurred in the case of rice, as adverse weather led to a production shortfall of 8 800 tons. Moreover, excess water hindered growth on around 700 hectares already planted that were to be harvested the following year. Direct damage of 30 million lempiras reflects lost production and investment. Indirect losses of 5.5 million lempiras represent future production that will not be obtained.

The volume of sorghum lost was greater than that of rice and beans, since barely a tenth of the harvest had been collected and almost a quarter of annual production was lost. Because a part of the planted area ready for the next cycle was damaged, supply was expected likely to fall by an estimated 10 000 tons.

Expectations of a considerable drop in the supply of basic grains led to uncertainty and a scarcity in markets that was aggravated by difficulties in the transportation of goods as a result of the deterioration of highways and access roads in production areas. To prevent price increases, the government reached an agreement with producers and wholesalers for a temporary price freeze. To meet the demands of industry and direct consumption, officials considered a zero tariff on the import of certain basic grains that are sold within a price range and with a variable tariff of approximately 35%. However, once communications were stabilized to some degree, it became obvious that available short-term stocks were sufficient and that imports (a total of 560 million lempiras) could be deferred until the following year.

Support programmes would have to be designed in line with producers' socioeconomic conditions to mitigate the harm they sustained. The priorities of a rehabilitation and reconstruction program for the whole sector should include the rehabilitation of damaged agricultural areas, the recovery and distribution of genetic material, plant and animal health surveillance, access to financial resources through preferential credits to facilitate reactivation and, more generally, the introduction of river basin management practices and infrastructure reconstruction.

Table B

HONDURAS: AREAS OF MAIN EXPORT CROPS
AFFECTED BY HURRICANE MITCH
(Hectares)

Export crops	Production area before the hurricane	Area affected by the hurricane	Percentages
Total	292,000	83,760	29
Bananas	22,000	16,000	73
Coffee	194,000	38,800	20
Sugarcane	44,300	22,000	50
African palm	32,000	8,960	28

Source: ECLAC estimates, based on information from official sources and productive.

C) Industrial and export crops. As in the rest of agriculture, industrial and export crops sustained major direct damages, which were estimated at approximately 1 800 million lempiras. Moreover, since most losses refer to permanent crops that would have to be replanted in many areas, losses not only affected production during the current cycle, but would continue throughout the time required for new plantations to reach maturity (between two and seven years, depending on the crop). Total losses thus amounted to 6 000 million lempiras, including damage to assets and indirect losses of production over several years.

Significant losses were reported for bananas, since almost all plantations are located in two of the areas most severely affected by floods. Large producers lost all or part of their plantations, as did many independent producers, particularly cooperatives. The Tela Railroad Company (Chiquita Brands) reported that between 50% and 60% of its plantations were damaged, while Standard Fruit Company (which normally hires about 10,000 workers) lost 80%. Independent producers had very high losses on some 6 000 hectares, of which only a small fraction can now be harvested to meet domestic demand and the needs of farmhands and cooperative members.

Floods affected current and future crops as many plants were destroyed. Although new plants could begin producing in one year, the time required to clean up and level fields should be taken into consideration. That year's crop losses (466 million lempiras) correspond to the November-December harvests, whereas indirect damage refers to production lost until the plantations would recover in two years' time. Infrastructure and plantation losses, totaling 3 500 million lempiras on approximately 16 000 hectares, are listed under the heading of assets.

Losses in coffee —the country's main export— amounted to 500 000 quintals, while a further 105 000 quintals of reserves were ruined when warehouses were flooded. Another 7 000 hectares were affected by landslides, as were many access roads to plantations. Over 100 coffee-processing facilities were either swept away by swollen rivers or rendered useless by flooding, which also caused significant damage to access roads and many bridges. Crop production losses were estimated at 629 million lempiras, while future production will be decreased due to the number of lost coffee plants. That loss is recorded under the heading of soils. The decrease in the next harvest and exports during the present and future cycles must also be taken into account, as the normal development of plantations was curtailed.

Sugar cane losses were high in areas rendered useless by flooding, silting, mud, sand and stones. Although sugar cane is relatively resistant to excess water, it is difficult or impossible to harvest, either mechanically or by hand, when it is covered by mud. Furthermore, the inevitable postponement of the harvest decreased sugar yield. If delays were prolonged, it would no longer be economically feasible to harvest the crop. Damage to some mills and industrial facilities (the machinery in one of them was covered by water and mud) made the delay even greater and the situation more critical. It was therefore estimated that 50 percent of the planted area had been lost and that the value of the crop that could not be harvested during the present cycle was 387 million lempiras. Extensive areas would have to be replanted to ensure the recovery of sugar cane plantations, which is why the investment lost in plantations was also taken into account. The following, year the sugar cane harvest would also be lower, and foreign exchange earnings from sugar exports in the next two years would decrease by some 85 million lempiras.

African palm losses have affected the cooperatives established following the agrarian reform, as well as independent producers and large enterprises. The most recently planted area sustained significant damage, since two to three year-old plants, which are the most vulnerable, were partially covered by mud. This affected the heart of the plants, which died as a result; adult plantations were better able to withstand the effects of the hurricane. Nurseries and other plantation-related facilities were also significantly affected. Damages sustained by plantations provide the basis to estimate present year production losses (143 million lempiras). This situation will continue over the next few years until the damaged plantations recover.

In melon production, which is concentrated in the department of Choluteca, 12 000 hectares had been set aside for planting to take advantage of market demand in the winter months. When the hurricane struck, 3 600 hectares had just been sown or were being prepared for sowing, and 80 percent were lost; the direct damage led to the loss of 32 million lempiras in investment. In contrast, indirect losses refer to the area that was not sown, resulting in lower exports in 1998 and 1999. Action was rapidly taken to recover the market, but only 7 000 hectares were set aside due to the total loss of fertile soil on farms that were covered with large amounts of sand and stones deposited by the river. These farms are included in the loss of agricultural assets, as are the substantial investments that would have to be made to recover some of the affected areas. Infrastructure was also significantly damaged, with more than 50 refrigerated transport containers destroyed; this item, however, is included in the transport section.

Citrus crops on the Atlantic coast were also seriously affected. Fortunately, grapefruit exports to Europe had concluded on October 15, so direct damage affected mainly the oranges and grapefruit for the domestic market. Production in the coming cycles would be lower because of the damage sustained by fruit trees; indirect losses were therefore estimated at 400 million lempiras. The greatest losses in assets occurred in the region of the Aguan valley, where an estimated 1 750 hectares of grapefruit were covered by sand and debris and were completely lost, and approximately 7 000 hectares of young orange groves were waterlogged for several days and would have to be replanted.

D) Livestock. The beef and dairy herd was reduced by approximately 50 000 head, valued at some 225 million lempiras. Information on livestock-raising areas was incomplete, owing to difficulties in gaining access to such areas. Although livestock raising is carried out in the highlands, losses occurred among cattle grazing in the lowlands. Adverse weather conditions resulted in animal weight decrease, causing an estimated loss of 900 million lempiras.

On the Atlantic coast, where dairy production is concentrated, the supply of raw materials to industry dropped during the first week as a result of flooding on farms and adverse transport conditions. The losses sustained on those days would cause lower milk production for several months. Direct damage was estimated at 120 million lempiras, while the subsequent impact of lower production was expected to result in higher indirect losses in view of the time required for recovery.

Damage to poultry production amounted to approximately 740 million lempiras from the loss of 60% of poultry stocks. The damage to dairy farm facilities and fences, calculated at 500 million lempiras, would have to be repaired. Flooded grasslands would eventually recover, but investments would be required to improve pasturelands. According to information provided by the unions, 70 000 hectares were affected at a loss of 300 million lempiras.

The public sector lost animal health control facilities and laboratories that produce and record genetic material. Under the prevailing conditions, the sector's response and international support in preventing diseases were very timely. Reconstruction would have to include recovery of the lost installed capacity.

E) Forestry. Timber production is an important activity in Honduras, generating export earnings of 20 million dollars. Sawmills suffered no major damage from the hurricane, although some machines were affected by water. Damage to roads was more of a problem, since it hindered access to logging camps. Lumber, however, was available for reconstruction purposes.

One of the most significant losses in the sector was timber from trees blown down by the hurricane, amounting to 100 000 cubic meters of pine. The most seriously affected areas were in the Sierra de Agalta of the eastern and western parts of Olancho and in Yoro. Losses, based on the average price per cubic meter, amounted to 27 million lempiras. If the sales price offset the cost of extraction, which was hindered by road conditions and remote locations, part of the losses could be recovered. Collecting this timber would have other benefits, such as eliminating potential sources of fire in the dry season and forest pollution.

In Atlantida, 25 000 additional cubic meters of timber from latifoliated trees were reportedly lost, and forestry plantations throughout the country were also damaged.

F) Fisheries. Fishing on the Atlantic coast and shrimp production in ponds in the Gulf of Fonseca are very profitable in Honduras. The hurricane affected these two zones, causing damage to both artisan and industrial fishing fleets. Owing to the type of shrimp-farm investments in the south, it would seem that the economic impact was more significant in that area. A total of 13,700 hectares were flooded in Choluteca and Valle, and during the first few days after the hurricane, estimates indicated an almost total destruction of infrastructure and the loss of at least two of the 2.5 annual shrimp harvests. Once the water level dropped, it became apparent that damage was considerable but clearly not as great as originally feared. Pond and packaging facilities, as well as investment in larvae for the restocking of ponds, sustained damages amounting to 100 million lempiras. In production, direct damage was estimated at 300 million lempiras —a harvest of 3,200 tons of shrimp— plus indirect costs from the partial loss of the first 1999 harvest.

Coastal fishing sustained losses of 140 million lempiras, although information on losses in the 365-vessel fish, lobster and conch fishing fleet could not be confirmed.