LIMA DISASTER PREPAREDNESS REPORT

VOLUME XV

SUMMARY VOLUME

by

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FOREWORD

This is the summary volume of a fifteen volume report whose individual sections are listed on the following page, concerning disaster preparedness in Lima, Peru. It was researched in Lima by a team of disaster specialists during the period July - November, 1981, for the Agency for International Development's Office of U. S. Foreign Disaster Assistance and USAID Mission in Peru. The report is supplemented by a considerable number of maps, charts and resource documents which are located in the USAID/Peru Disaster Preparedness Resource Library in Lima.

November 1982

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The Lima Disaster Preparedness Report has 15 sections:

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Volume II	Port of Callao Infrastructure Security and Emergency Evacuation Needs
Volume III	Electricity
Volume IV	Water and Sewerage
Volume V	Heavy Equipment Rehabilitation and Maintenance
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SUMMARY VOLUME

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INTRODUCTION

This summary volume of the Lima Disaster Preparedness Report is a collection of the executive summaries of the other fourteen volumes of the report, comprising among them about 2,400 pages. Its purpose is to describe the contents and distill the essence of the individual volumes in a form more accessible to the reader who seeks a general introduction to them and who may later wish to look at individual volumes in more depth.

Contents of Each Volume

Each individual volume of the report contains an executive summary, a detailed description of the respective sector, and an assessment of its vulnerabilities in a severe (8.4+ Richter) earthquake. It presents recommendations for action to save lives and reduce serious injuries by mitigating earthquake hazards; to accelerate re-establishment of vital services after an earthquake through advance preparedness measures; and to conduct disaster relief policies activities themselves. Many volumes contain numerous maps, charts and illustrations. But some information, too lengthy or too large for inclusion in the report, has been placed in the USAID/Peru Disaster Preparedness Resource Library. Their custodian is Ing. Edilberto Alarcón, the Mission's Chief Engineer, Disaster Preparedness and Relief Officer, and Project Officer in Peru for this study. Some of these materials are also available through Mr. Oliver Davidson, the Project Officer for the study in AID's Office of U. S. Foreign Disaster Assistance, Washington, D. C.

Methodology

The report adheres to the National Civil Defense System's placement of primary operational responsibility for disaster operations on the national agencies normally responsible for the management of each sector. Coordinated under the umbrella of National Civil Defense, these individual organizations actually comprise the National Civil Defense System itself.

The methodology volume of this report explains the approach used by the OFDA Disaster Preparedness Team responsible for this study, the amount and type of professional manpower involved, and the approach used to gather data (including questionnaire formats). It includes a one-hundred volume bibliography, a list of 430 individuals interviewed in connection with the study, and numerous references and acknowledgements to individuals and organizations who played critical roles in its development. With apologies to these individuals and organizations, the summary of that volume has not been included here in the interest of brevity.

In Peru, the idea of this study was welcomed and supported by the National Civil Defense System's General Secretary, Admiral Edmundo Masias Scheelje, who graciously assisted in substantive technical and procedural matters too numerous to mention but in the absence of which only a fraction of this work could have been achieved. In implementing this support, Ing. Jose Kamiya Teruya and Mr. Alfredo Trujillo of Civil

Defense's Operations Division helped assure that the work was realistically and securely launched by generously sharing their organization's plans, research findings and documentation, and adding to these their time, patience and personal insights.

Purpose of Report

The intention of this report is to open up for discussion some concrete suggested approaches to disaster mitigation and preparedness in Lima. In addition, it assesses alternative disaster relief strategies which could be employed by the Government of Peru after an earthquake and provides specific suggestions for international donors on the appropriateness of alternative disaster relief resources they might provide. Almost all of the report's recommendations have been drawn from the suggestions of the line managers of the respective sectors which comprise the National Civil Defense network, and from lessons which can be drawn from the literature and experience of previous similar disasters. However, no consensus of all professionals in any sector around any particular recommendation was usually attempted.

Next Steps

The submission of these recommendations to each sector's principal decision-makers, discussion of them with such officials, and the development of specific plans and proposals for their implementation (or implementation of alternative ideas which emerge in such a dialogue) are the next logical steps in this process. In cases where because of the severe fiscal constraints facing the Government of Peru, the National

Civil Defense System and its component agencies cannot finance the costs of such actions, it is hoped that donors such as the World Bank, Canadian Embassy, Pan-American Health Organization and U. S. Agency for International Development which expressed interest in this study during the conduct of its fieldwork, can provide loan or grant financing, or technical assistance manpower. The study's recommendations are fairly low in cost and many could be integrated into on-going agency operations or internationally-financed development efforts.

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Fieldwork for this study was undertaken during and immediately after the period when Lima was most concerned about the earthquake predictions of Dr. Brian T. Brady. Response to the goals of the study from national agencies was substantial and enthusiastic. In part, this was because the predictions made the earthquake which many in Lima believe to be possible or even inevitable at some time in the future appear much more imminent.

But the consciousness of Lima's population to earthquake hazards and to the catastrophic damage which earthquakes can produce, is always high. In October, also during the fieldwork for this study, on three separate days about one million people of many classes, races and backgrounds in Lima joined in the annual religious processions celebrating the miraculous Señor de los Milagros. In doing so, they bessech that Lima be spared from the kinds of catastrophic earthquakes which occurred in its history on those three dates.

It is hoped that such a disaster will never occur again. If it were to recur, however, it is hoped that the continuing actions of Peru's disaster preparedness system and measures undertaken as a result of this study will help to minimize to the extent possible the fatalities and suffering which such an earthquake would surely occasion.

LIMA DISASTER PREPAREDNESS REPORT

COLLECTED EXECUTIVE SUMMARIES

EXECUTIVE SUMMARY: ELECTRICITY

This report describes Lima's electrical system, managed by a public power authority, ELECTRO-LIMA; and aspects of the City's fire-fighting system, which is managed by a volunteer fire department called the BOMBEROS (FIREMEN). It also discusses the availability and usefulness of portable energy-generating equipment after a possible disaster.

ELECTRO-LIMA, formerly a privately-held corporation, was acquired by the Government of Peru in 1968, and is now part of the national ELECTRO-PERU system, falling under the Ministry of Energy and Mines. Lima's power is drawn from six hydroelectric plants (part of an inter-connected national network) and a small thermal plant. Energy is transmitted to Lima principally through 220,000 volt overhead lines. The current is processed through five transformation centers where power is stepped down to 60,000 volts; then through 27 primary substations, where power is again stepped down to 30,000 or 10,000 volts; and finally through 5,300 secondary substations, where power is stepped down to 220 volts. In the entire system, about 70% of the cables -- especially low-tension wires -- are underground; about 30% are overhead.

ELECTRO-LIMA serves about 700,000 customers. But the main energy consumer in Lima is industry, whose 6,500 customers consume 50% of all power. Another 25% is consumed by a larger number (75,000) of commercial customers. The overwhelming majority (88%) of ELECTRO-LIMA's clients -- domestic consumers -- use only about 20% of the energy. About three-quarters of all domestic households have direct electrical service.

Within the category of "industrial consumers", industries highly vulnerable to fires -- textiles, chemicals and fuels, and wood and paper -- account for 42% of industry's daily consumption.

Although maximum consumption of electricity occurs between 8AM and Midnight, there is strong demand from industrial and other consumers 24-hours a day.

In previous earthquakes in the region, particularly in Managua (1972), concern was expressed about fires raging out of control in industrial zones. Some fires originated from short circuits; some others may have originated from arson. But these fires, which consumed industrial areas, and housing areas with both wood and adobe construction, engaged the energies of rescue and relief workers for up to a week after the earthquake.

A study by a Peruvian disaster specialist from the National Engineering University suggests that short circuits, leakages of chemicals, escape of flammable gas, and faulty electrical equipment would be major sources of fires after an earthquake. Short-circuit fires occur frequently in Lima even without earthquakes, resulting in substantial economic loss and suspension of employment for a population already suffering from severe unemployment.

Peruvian experts consulted in connection with the report expressed concern about Lima's vulnerability to short-circuit origin fires after an earthquake. In normal times, about 40% of the City's fires are caused by short circuits, and some believe the number and magnitude would increase considerably after an earthquake in both industrial and low-income residential neighborhoods, and possibly even in schools and hospitals. Electrocutions may likely occur where relatives and rescuers rush in to save victims buried in the rubble and make contact with electrical wires or metal or water conducting current.

The ability of the volunteer fire department -- the BOMBEROS -- to combat fires after an earthquake would be limited, as streets will be choked with traffic, rubble, flooding, and other obstacles; the water pressure -- a chronic problem for firefighters in Lima -- would likely be too low to permit efficient activity; and many fire stations would collapse before firefighting equipment could be removed from them.

Thus, reducing the risk of fires after earthquakes is a top priority of ELECTRO-LIMA, the BOMBEROS, Port and other industrial officials, and engineers and professionals concerned with this danger throughout the City.

At the moment, ELECTRO-LIMA has a modern, adequate security system. When massive short-circuits are produced, and when current surpasses the maximum tolerance for which its wire conductor was designed, relays open at the nearest substation, cutting off the power supply. But this system requires a degree of maintenance and control which ELECTRO-LIMA cannot always implement. Also this system requires that individual factories and homes have their own electrical security systems, but most do not. The shut down follows the massive short circuits -- it does not precede them. Thus, there are some vulnerabilities in the system.

One area for potential improvement is in timing of the automatic shut-down of the system in the event of an earthquake. This strategy would strengthen the security system and would be redundant or partially redundant with the existing system. In essence, it would provide for the automatic shut-down of the electrical distribution system from the moment an earthquake reached a pre-determined magnitude. Thus, the shut-down would precede the massive short-circuits, resultant fires and electrocutions which could otherwise occur.

One system for implementing this suggestion would be the connection of accelerographs to the five major transformation centers through which all current for the City must flow. These accelerographs would be mounted and calibrated to automatically interrupt the flow of current from the transformation centers when an earthquake passed the equivalent, for example, of a 6.0 Richter level. This type of system would be harmonious with the principles currently followed by ELECTRO-LIMA and national Civil Defense policy. This report examines the possible disadvantages of such a system, but finds that they are considerably outweighed by its safety and security advantages.

Another recommendation focuses on the potential for preparing a strategy, in advance of an earthquake, for post-disaster operations. Specifically, it is recommended that a list of critical facilities, by priority, for each sector (health, water production, etc.) be developed and shared with ELECTRO-LIMA. These lists would allow ELECTRO-LIMA to plan in advance for the rational, prioritized use of their resources after an earthquake; and would permit its technicians to respond more rapidly in the event of a disaster, even if advance contingency plans had not been made.

There are approximately 150 generators with a capacity of under 100KVA, and about 11 with a capacity of over 100KVA, available for emergency operations. While the 100KVA+ category is limited, the report recommends caution in the provision of generating equipment from international sources. However, if necessary, a small number of generators could be provided for key facilities _if_ generators which match the technical specifications required in Lima can be airlifted.

Because of the degree of professional skill of ELECTRO-LIMA's own staff of technicians and managers, it is not recommended that technical assistance in the electrical area be provided after a disaster. Similarly, ELECTRO-LIMA reports that it has adequate supplies of wiring and other emergency supplies. But if technical assistance or special equipment is required, ELECTRO-LIMA would not hesitate to request them. For this, and for on-going preparedness operations, a list of contacts in ELECTRO-LIMA, the BOMBEROS, and other related public and private sector institutions is provided at the conclusion of the report.

EXECUTIVE SUMMARY: WATER AND SEWERAGE

Lima's water supply and sewerage systems are its most vital lifelines. As water is relatively scarce in Lima in the best of times, it is of great concern to disaster preparedness planners in the City. This report describes the two systems, which are managed by a State-owned and managed public utility known by its acronym, ESAL. It provides a glimpse of post-disaster experiences after earthquakes in Peru (1970), Managua (1972) and Guatemala (1976). Some of the system's principal vulnerabilities in an earthquake are presented, and proposed disaster preparedness and response actions are recommended. Lima's post-disaster water requirements are estimated at about 50,000 cubic meters per day — 10 liters per person.

Nearly 60% of Lima's water is drawn from the surface of the Rimac River. Before it reaches the captation point, the river has served as a depository for three other sewerage systems and considerable industrial waste. About 40% of Lima's water is produced by a series of approximately 200 ESAL-managed water wells in Lima.

Rimac River water is processed at the La Atarjea Water Treatment Plant located within the City, designed to purify water coming in with a rate of up to 3,500 parts per million impurities (PPM) down to about two PPM. But during landslide periods, the intake level sometimes reaches up to 90,000 PPM. The plant's gravity-flow system relies principally on natural sedimentation for purification, but also uses coagulants and chlorine. The plant relies principally on the power authority, ELECTRO-LIMA, for its energy and has its own secondary substation nearby. It has an 80 horsepower generator, which is inadequate to efficiently substitute for normal power.

Nearly 30% of all water well-production is generated by only 24 of the City's 229 active wells. These 24 produce 130,000 cubic meters of water per day, about 9% of the City's daily consumption. All wells are powered by ELECTRO-LIMA high-tension wires, which are stepped down at each well by transformers to appropriate levels. In the past, before ELECTRO-LIMA's service was completely reliable, many wells had generators or gear head drives as auxiliary power sources; today, none have standby power.

ESAL's distribution network (4,800 kilometers of water piping; 4,000 kilometers of sewerage piping), serve about 400,000 homes; about 3,400,000 people; about 75% of the City's population. In the water pipe distribution network, new major trunklines — steel-reinforced concrete pipes — are considered highly seismic resistant; while some of the newer but somewhat smaller trunk lines are not as reliable. A considerable proportion of the distribution lines are asbestos cement with rubber joints between them. The sewerage network tends to rely almost entirely on concrete joints between pipes and is considerably more vulnerable.

For the parts of the City without pipe distribution, a group of about 180 private tanktrucks (2,000 gallon capacity per truck) distribute water. Tanktrucks are filled by ESAL at very low prices and distribute directly from truck to individual family. It is reported that there are 100 additional trucks being used for other purposes which can be rapidly refitted to carrying water in an emergency; and the municipal authorities have about 50 trucks used for watering parks.

For emergency fire-fighting, there is a network of 4,500 hydrants. But water pressure is erratic.

In addition to the ESAL water system, there is an underground irrigation system which consumes about five cubic meters per second from the Rimac River and without decontamination is used for some agriculture but mostly for watering parks.

In the Chillón Valley north of Lima, there are numerous wells used for irrigating agricultural lands. Five of these provide 25,000 cubic meters of water per day in normal times; they are powered by diesel generators and are completely independent of the ELECTRO-LIMA system.

Finally, there are about fifteen substantial privately-operated wells in Lima, many of which have their own generators. There are also some shallow wells where water can be tapped at a depth of only six to eight meters, permitting their operation with small [10KVA] generators.

Sewerage tends to be conducted through the piping system by gravity, with the exception of about ten critical spots around the city where power — supplied by ELECTRO-LIMA — is required for operation. About 65% of the City's waste is pumped into the Pacific at the northern side of the City, in El Callao; the balance is discharged in the south.

The vulnerabilities of the water and sewerage systems in Lima are multiple: the Atarjea water treatment plant has poor standby power resources; its 500,000 cubic meter storage reservoir broke down because of structural collapse in 1970 without earthquake provocation, flooding downtown Lima — at that time the reservoir was only about 30% full.

Hydrogeologists do not anticipate substantial permanent change in the underground water table. But the water wells are completely dependent on ELECTRO-LIMA's power. Thus, even though the majority of wells would structurally survive an earthquake, they could not function. The water pipe distribution system would be expected to fare erratically: the main new trunk lines may survive; the secondary trunk lines cannot be relied upon; and much of the asbestos-cement distribution piping would fracture. The sewerage system is more vulnerable than the water system, because more than 90% of it has unreinforced cement joints. Because the sewerage system is generally constructed under the water pipes; and because there is a layer of about 30 meters of earth between the sewerage lines and the underground water supply, contamination of the underground water supply is not anticipated. But if sewerage waste rose to the surface in some places, it could flow into water wells. ESAL does not have the magnitude of equipment or trained staff to conduct emergency water quality tests on a large scale.

The City's valve control system for water is not in reliable working order. Thus, manipulation of available water pressure would be difficult after an earthquake, as it is in daily emergencies (for example, for firefighting).

Lima could upgrade its level of preparedness for a major earthquake if some of the following suggestions were considered:

- Raising the priority for the purchase of a 300 KVA generator for the Atarjea water plant;

- Identification, in advance, of water wells to which ELECTRO-LIMA should give immediate priority after an earthquake;

- Placement now of available gear-head drives on the 24 key water producing wells;

- Fitting the 24 principal wells with dispenser units, permitting their use in conjunction with tanktrunks or water bladders;

- Considering revisions in the construction specifications for some types of water storage tanks;

- Planning for post-disaster operations with increased specificity and including the potential use for back-up purposes of the Chillon Valley wells, the underground irrigation system, the industrial and "shallow" wells; and, as a worst-case back-up, the use of Chillon or Lurin surface river water.

- Increasing ESAL's capacity to monitor water quality after a disaster, through provision now of emergency testing equipment and staff training;

- Equipping major new wells to be constructed with both standby power (gear head drives) and dispenser units, features which can be incorporated from design stage at costs considerably lower than those of retrofitting the units;

- Finalizing contingency plans for providing water to hospitals.

In the event of a disaster, AID/Peru through its Office of Engineering should establish contact with ESAL. In addition, USAID could consider:

- Provision of experienced water engineers for liaison and technical purposes;

- Provision of full-circle clamp couplings via emergency airshipment. These couplings, which require no special equipment for use, could greatly accelerate immediate, permanent repair of fractures in the pipe system.

- Emergency provision of gear-head drives, available from a local producer in Lima;

- Provision of water purification units after the disaster. However, a warning: OFDA's seven units can provide only 600 cubic meters per day, about 1% of the City's minimum need. Still, in a worst-case emergency, these units could be used at selected critical facilities, perhaps drawing on the underground irrigation system.

- Provision of rubberized canvas water bladders, with about 2,000 gallon capacity, to permit decentralized tanktruck distribution of emergency water supplies, and permitting tanktrucks to be used for delivery (not storage or distribution) of water;

- Provision of emergency sanitation expertise and resources.

The provision of enough generators to provide significant standby power for water wells would be impossible. One large standby generator for La Atarjea, if provisions have not been made before then, might be useful only in the unlikely case that ELECTRO-LIMA is unable to provide emergency power.

ESAL currently possesses two mobile electronic leak detectors, recently acquired from the HYDROTRONICS/Miami group, and trained operators for them.

A list of contacts in the water/sewerage public and private sectors appears at the conclusion of the report.

EXECUTIVE SUMMARY: PORT OF CALLAO INFRASTRUCTURE SECURITY AND EMERGENCY EVACUATION NEEDS

Although it is administratively a separate unit from the rest of the City of Lima, El Callao is an integral and vital part of Metropolitan Lima. It is also, on balance, the area of the city perhaps most vulnerable to disasters. More than most others in Lima, its soils tend to magnify seismic waves, thus provoking in the same event greater proportinate damage in comparison with other city areas. El Callao's vulnerability includes substantial risk to life and property from Tsunamis. The area contains the city's highest risk industrial complex — the Port of Callao. Many of the area's buildings -- including structures intended as provisional housing for the population after the 1940 earthquake -- are serious fire risks. The new expansion areas of the city -- called pueblos jóvenes -- in El Callao seem to be the most vulnerable to fires which, in some cases, destroy 50% of some settlements more than once each year.

Because of its importance to the national economy, and because of its vulnerability to many kinds of inter-related disasters -- earthquakes, Tsunamis, widespread fires, port explosions, etc. — El Callao's problems are the special focus of this section.

The Port of Callao

One of 25 national ports, the Port of Callao handles more than 55% of national imports, and a total of 20% of tonnage handled by all ports. As 75% of Peru's industry is based in Lima, port operations are key to the national economy. The port contains numerous grain silos; gas and chemical storage areas; warehouses sheltering flammable raw materials; and a two-kilometer 14" - 16" propane line containing at all times a load of 1,350 barrels of LPG. Port officials expressed two areas of need in which, they assert, disaster mitigation activities are possible:

(a) The need for automatic electrical cutoff of all port facilities when seismic movement passes the equivalent of 3.0 Richter. Especially because of multiple risks of fires and explosions caused by risky electrical installations, and the consequent risk of major disaster, the officials endorse the installation of an accelerograph at ELECTRO-LIMA's La Marina sub-station.

(b) The need for objective security assessments by an outside expert. For example, there is some disagreement among security officials about the type of equipment needed to remove hazardous accumulations of fuel-sludge inside the port's wave-breakers. In another case, a number of the port officials believe that propane installations are inadequately protected and represent a danger for the entire port; an objective outside assessment is suggested to establish the facts to assist security officials in persuading other authorities of this danger.

In case of an actual earthquake, it is recommended that USAID/Peru include among its immediate priority activities an assessment of the impact of the disaster on the port, and a draft checklist is provided for this purpose. Assistance to the port in establishing operations is recommended as a priority within the post-disaster assistance options, especially if the SEABEES or Army Corps of Engineers are available.

La Punta and Port of Callao Evacuation Needs

El Callao, at present, does not have a plan for life-saving evacuation of the civilian population in the event of Tsunami. Primary responsibility for these functions rests with the National Civil Defense System, although the Peruvian Navy has many key installations in the zone. Tsunamis could be generated by earthquakes immediately off-shore in which case the maximum warning period before landfall of a Tsunami would be 20 to

30 minutes; or they could be generated elsewhere in the Pacific, in which case up to 12 hours or more of alert could be expected.

Such events have occurred before in Peru's history. In 1746, for example, two Tsunami waves destroyed much of El Callao about ninety minutes after an off-shore earthquake. Of the area's 5,000 inhabitants, only 200 reportedly survived. Nineteen vessels were destroyed, and one was carried 1½ kilometers inland.

In recent times, there have been false warnings leading to panic, evacuation and looting (1980); failed attempts at evacuation after an actual earthquake (1974); and one actual warning by the Hawaii Tsunami Control Center which was not acted upon as late as three hours before predicted landfall (1979). While Tsunamis did not occur in any of these events, they demonstrated the need for some type of alert system and evacuation plan.

One vertical evacuation plan suggested by a recent study, and a second "seven point" evacuation plan suggested by local officials, are discussed in this study. At present, the "seven point" proposal seems more desirable. The main purpose of the discussion is to suggest some of the proposed alternatives for further consideration and development. It is recommended that USAID remain involved in this area under further phases of Disaster Preparedness Program.

EXECUTIVE SUMMARY: HEAVY EQUIPMENT REHABILITATION AND MAINTENANCE

After an earthquake of magnitude, the City of Lima could find its main roads, to the north, south and east, are blocked by landslides and mass failures; that its streets are filled with rubble; that critical city infrastructure has suffered breakdowns. Buildings which threaten life and safety will require demolition, adding to the rubble and to the demand for the heavy equipment needed to carry out these jobs. Clearing land for new resettlement areas will further tax Government and private sector tractors, bulldozers, front-end loaders, and dumptrucks.

This report describes the organization and resources of the Government of Peru's fleet of such equipment; reviews the post-disaster experience of Guatemala (1976) in this sector; and proposes some post-disaster options for international donors in the event of a major earthquake.

Management of the Government's US$100 million equipment fleet, including its 2,000 pieces of heavy equipment distributed in 25 departments, and the 2,400 employees who are machine operators and mechanics, was, until recently, conducted by the Ministry of Transport and Communication's "SEM" office. From September, 1981, operation and maintenance of the fleet was transferred to the Dirección General de Caminos within the Ministry. Major overhaul, purchase of spare parts, and technical inspection remain with SEM.

Only about 40% of the fleet is operational at any time. The balance is either under repair or inoperable. A significant part of the fleet is concentrated in only a few manufacturers' brands, and usually concentrated again in specific production years.

After the 1976 earthquake, the Government of Guatemala, faced with an incalculable amount of earth and rubble moving work, but a finite amount of operational equipment, adopted a program which might be useful in Peru should a similar disaster occur. In short, under a USAID grant, private sector firms were contracted to conduct emergency rehabilitation of heavy equipment which was in the repair shop or which had been considered inoperable because of lack of spare parts. Another private sector contract provided for regular weekly maintenance in the field of the equipment, to insure its continued service. Finally, a small amount was set aside for procurement of U.S. Government surplus equipment at extremely reduced prices.

Improvement of on-going maintenance programs for the Government fleet does not fall within the purview of this report. However, as a post-disaster option, a crash maintenance and rehabilitation program, such as that conducted in Guatemala, is suggested. The resumés of two potential liaison/technical resource experts are provided.

The report contains numerous charts illustrating the composition of the Government equipment fleet by manufacturers' brand, age and location. These charts were developed by the disaster preparedness team from lengthy inventory documents, which are available in the USAID disaster preparedness resource library in Lima. At the report's conclusion, a list of contacts current at the time of the field research is provided; because of the recent organizational changes, the list may well have changed substantially in the interim.

Rubble-removal in low-income and other housing areas must be approached with sensitivity to the salvage, psychological, land-demarcation and other needs of occupants. Policies governing such activity are discussed elsewhere.

EXECUTIVE SUMMARY: AIRPORT AND AIRCRAFT RESOURCES

Lima's three airports, and its considerable Armed Forces aircraft and helicopter capacities, would be vital resources in the event of a major earthquake in Lima. This report discusses these resources and provides some suggestions for disaster preparedness and response activities which international donors may wish to consider supporting. It also includes a review of literature relevant in a general way to the subject.

Lima is served by three airports: Jorge Chavez International Airport, with a capacity for about twelve C-141's if civilian traffic is cleared for emergency operations and a capability for night-time operations; the Peruvian Air Force LAS PALMAS Airport, which can support small numbers of C-141 and C-130 aircraft; and COLLIQUE airstrip, whose night-time operations would depend on flares and which has modest aircraft capacity. Detailed technical profiles for each airport are provided in appendices to the report.

Because of Lima's dependence on Jorge Chavez airport, it would be wise to review and strengthen emergency runway and airport repair and rehabilitation plans and to develop an inventory of locally available resources for this purpose. Some technology and experts developed as part of the U.S. Air Force "Rapid Runway Repair" program at Tyndall Air Force Base, Florida, might be able to provide some technical guidance or support for such an activity.

USAID/Peru should be prepared to assess damage and operating capacity of the three airports as part of its early post-disaster assessment response.

For this purpose, a brief checklist is provided.

After a disaster, a staff member should be assigned fulltime to observe and report on airport operations, and to act as a liaison and coordinator with the Government of Peru and other donors. But U.S. operations at the airport, where possible, should be segregated from general operations, and a .. fulltime labor force -- available when needed at odd hours -- should be arranged to support U.S. operations, if they will be substantial.

The Peruvian Armed Forces have 43 heavy transport aircraft (including 15 Canadian BUFFALO's and 15 AN-26's) and about 100 helicopters, 80 of which are generally located in Lima. The helicopters have a combined passenger carrying capacity of about 1,800, and a cargo capacity of about 250 tons. A statistical breakdown of the fleet is provided in charts which are part of this report. Unless circumstances change considerably, provision of U.S. aircraft for in-country operations for an earthquake in Lima does not seem necessary.

A short list of Government of Peru and U.S. technicians contacted in connection with this report is provided at the conclusion of the report.

EXECUTIVE SUMMARY: LOW-INCOME HOUSING

This report describes the nature of principally low-income housing in Lima, focusing on the inner-city slum areas, called tugurios, and the relatively newer settlements which grew up on the outskirts of Lima during the late 1960's and 1970's, called pueblos jovenes. It includes a general assessment of the vulnerability and dangers in these areas in the event of a severe (8.4+ Richter) earthquake; the magnitude of shelter needs and options which such a disaster could generate and their policy implications; and some recommended disaster mitigation and preparedness actions.

Tugurios

Lima's inner-city tugurios are characterized by poor, overcrowded living conditions, principally large buildings originally designed to accommodate two or three families which have been converted into an average of 20 - 25 individual one-room dwellings. Each one-room dwelling is occupied by up to ten family members. About 175,000 such single-room dwellings exist in central Lima and other nearby tugurio areas in El Callao. Monthly rent for such a room is typically about US $5.00 to $10.00 and includes use of a communal water tap or two shared by all building residents; a common toilet area, which may or may not permit privacy to the user; and electricity services, some connected clandestinely by area residents without security precautions. The adobe and quincha (cane and mud) structures are generally in an advanced state of deterioration which has been accelerated by recent relatively mild earthquakes (1970, 1974) and the almost absolute lack of maintenance services by building owners. The small number of such buildings which renters have managed to collectively purchase contrasts starkly in quality of services and structural maintenance.

During the 1960's and 1970's, when there was significant migration of rural Peruvians to Lima, many came first to the tugurios and, after a period, went to the newer pueblo joven settlements. Tugurio dwellers did not do so for a variety of reasons: proximity of their dwellings to their source of employment; cost and availability of transport from the newer areas to factory areas; cultural identification with central Lima; availability of running water, waste removal and electricity services -- however marginal -- in tugurio buildings, versus the certain knowledge that such services would be long delayed in coming to pueblos jovenes; and relatively negligible cost of rent in tugurios versus the cost of house construction and services in pueblos jovenes. Despite tugurio residents' sense of cultural and class identity with their central Lima environments, tugurios are notably bereft of social organizations and activities.

Milder earthquakes in 1970 and 1974 in Lima weakened tugurio buildings but did not destroy them, leaving local residents with a sense that their buildings are "earthquake resistant". Civil Defense authorities project, however, that most of the 60,000 deaths and 700,000 * injuries which can be anticipated for Lima in an 8.4+ Richter earthquake

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* These are Civil Defense estimates, the only ones available to the study. The ratio of deaths:injuries is different from some previous earthquake experiences.

would occur in these areas. Not only are the building structures inadequate, but they tend to have only one, narrow and precarious "escapeway" in each building -- and these "escapeways" may be more dangerous than the buildings themselves.

Perhaps the largest owner of tugurio property is the 440-year old Sociedad de Beneficencia Publica de Lima (SBPL), which operates orphanages, shelters for the homeless, services for the elderly, training of nurses, and other social services. The operation of these services depends on the SBPL's income principally from its tugurio holdings; it estimates that it owns or manages 20% of all tugurio properties.

SBPL obtained these properties through bequests from wealthy citizens of Lima who desired that the income from these properties support its social activities. Yet as the buildings have deteriorated and rent control has frozen rent rates, its income has diminished to the point where it has been forced to abandon its operation of many hospitals and faces termination of other social services as well. At the same time, SBPL is uncomfortable with its role of slum landlord and realizes that in a severe earthquake large numbers of fatalities and serious injuries will be attributable to its properties. As a prestigious private institution, whose President is appointed by the President of Peru and whose Board is appointed by the Minister of Health, SBPL desires to alter this situation -- a desire which may be shared by many other individual institutional owners -- religious orders, universities, and insurance companies. But many tugurio buildings are owned by 30 - 50 different individual heirs who may not even know each other; in these cases, the already minimal income is further fragmented so that active interest in the property is negligible, and actions requiring legal sanction are difficult to implement.

Based on Civil Defense and other expert assessments, it can be anticipated that 30% - 50% of tugurio buildings would collapse in an 8.4+ Richter earthquake; that 20% would be so severely damaged as to be uninhabitable and require demolition; and 30% - 50% would remain damaged but inhabitable. For purposes of discussion, this report suggests that of those residents who remain homeless, about 50% will probably remain in some type of temporary shelter on or very close to their building; 30% would move in with friends, neighbors and relatives in inhabitable buildings in the same tugurio area or elsewhere around the city; and about 20% would seek to erect temporary shelters in parks, streets, and in public buildings. Negligible proportions would spontaneously move to pueblos jovenes on the outskirts of Lima or return to their (now distant rural) places of origin.

The statistical implication of the foregoing assumptions would be that 50,000/70,000 tugurio families would remain homeless. Of these, perhaps 23,000/33,000 would erect temporary shelters at their buildings sites; 15,000/21,000 would move into inhabitable buildings around Lima; and 10,000/14,000 would move into parks, streets and public buildings. Each of these solutions will present particular problems to the Government of Peru.

For those who erect temporary shelters at their building sites, it is likely that a type of slum housing worse than current conditions will emerge and become permanent. As non-owners of the land, they may be hesitant to improve their shelters. In any case, a political confrontation over rights to that land between property owners and the former renters (who will then be called "squatters") is inevitable, especially as many of the buildings are located in areas with considerable commercial potential (some property owners may see the earthquake as the solution to their desire to empty the slums to redevelop their properties).

The ideal temporary solution from the Government's viewpoint will be that adopted by those who move in with friends, neighbors and relatives in inhabitable buildings around Lima. But the hosts will tolerate their homeless relations for temporary periods, not permanently. Thus, while this category is not as visible as the foregoing one, it will eventually require access to permanent housing.

Homeless families who settle in public parks (a policy currently encouraged by preparedness plans in Lima), streets and public buildings will have serious disruptive effects on the city; compete with emergency medical and other services for use of such property; and frequently expect the Government to resolve their permanent housing needs at little or no cost to themselves. The current plan to move the homeless in an organized program to tent cities in the public parks may aggravate rather than alleviate many problems.

Pueblos Jovenes

Pueblos jovenes are newer settlements generally located in the expansion zones on the outskirts of Lima, where about one million people currently reside. Such settlements begin in their initial stages with precarious temporary housing (wooden poles wrapped with plastic sheets or cane/estera mats), with water delivery by tanktruck and absence of other services. The settlers make enormous sacrifices to acquire and accumulate building materials, and gradually build steel-reinforced brick houses around their temporary homes. Later, they erect a 200-300 gallon concrete water tank in front of the house. If the community can get organized and obtain financing, it can eventually have household connections for water, waste removal and electricity installed. This evolutionary process may take ten to twenty years to complete.

Building specialists believe that 60% of the brick houses in pueblos jovenes are suitably reinforced for earthquake resistance; 20% are over-reinforced, adding to their weight but probably safe; and 20% are inadequately reinforced. Yet, in comparison with the much more densely populated tugurios, relatively few deaths and injuries are expected here.

The exception to this assumption would be newer settlements on extremely steep hillsides in the pueblos jovenes and even in central Lima. The proximity of each house to the next, the steepness of the hillsides, and the possible inadequacy of siting and foundations, could contribute to a large number of fatalities in such areas. In addition, houses built along the edge of the Rimac River are subject -- even in the absence of earthquakes -- to fatalities due to mass failures along the cliffs on each side of the River.

Recommendations for Action

Disaster Mitigation

The main opportunity for saving lives and severe injuries in the shelter sector would appear to be in mitigating these risks in the *tugurios*, where the majority of Civil Defense's projected 60,000 deaths and 700,000 injuries would occur. But the mitigation of these risks is only a small part of the overall need to develop a comprehensive policy for dealing with the problems of the *tugurios*. This need is being increasingly focused upon by the Government of Peru. There are a number of discrete actions which would be of value in serving disaster mitigation and housing policy ends:

1. *A detailed assessment of land tenure* in the *tugurios* should be made, expanding on Map B introduced in this report. In a first stage, a district-by-district analysis of SBPL, religious order, university and insurance company holdings should be initiated, focusing first on the *Cercado de Lima*, Rimac and Victoria districts, and then expanding the geographical scope incrementally.

2. *Options for development of tugurio properties* need to be studied, especially in connection with SBPL. Removal of illegal occupants, consolidation of renters into better quality buildings, and demolition of the most dangerous structures should be considered.

SBPL property locations often have considerable commercial value; in such cases, some of their proceeds could be used to finance an incentive system for current occupants to encourage them to evacuate these buildings. Concessional financing for alternative inner-city low-income units has been suggested by SBPL. Integration of the currently planned World Bank-financed 30,000 sites and services program -- especially for Canto Grande development -- should be considered. Legislation enabling social welfare organizations to manage their properties more efficiently should be drafted. Finally, schemes which offer the possibility of collective building ownership by current residents should be evaluated.

For properties which can be evacuated, SBPL has suggested it could retain title, build and manage new buildings, and use rental income to support its social services. SBPL could also sell such properties, invest the proceeds, and use cash revenues to support such services. One experimental program integrating many of the foregoing features was the El Porvenir project from whose successes and failures many relevant lessons can be drawn.

Disaster Preparedness

In terms of disaster preparedness, two steps are recommended:

1. Advance preparation of inspection/demolition plans for buildings which have not collapsed but after an earthquake which may represent dangers to life.

2. Advance development of contingency plans and options for a post-disaster shelter policy. Current plans should be examined, up-dated and revised, where appropriate; and senior Government officials should have an opportunity to wrestle with the serious (and politically explosive) substantive issues before such a possible event.

A review of field assessments of housing programs after the 1970 Peru earthquake and similar assessments for Managua (1972) and Guatemala (1976) appear in Volume XII of this series and are too extensive to summarize in this volume. They offer valuable and relevant lessons concerning shelter, especially in the failure of tents and other temporary housing.

A list of selected public and private sector experts in low-income housing in Lima appears at the end of the report.

The reader should be warned that the nature of this review of the low-income housing sector is limited; it is not intended to be a thorough study of all facets of such housing in Lima, but mainly to suggest initial directions toward which disaster mitigation and preparedness efforts can be directed.

EXECUTIVE SUMMARY: EMERGENCY MEDICAL CARE

Peru's Civil Defense authorities have projected that a severe (8.4+ Richter) earthquake in Lima would cause approximately 60,000 deaths and 700,000 serious injuries. The overwhelming majority of these casualties would occur in the extremely crowded central city slums, called _tugurios_, whose buildings are two to three storeys high and constructed of adobe or a combination of adobe and _quincha_ (cane and mud). Many of the buildings have been structurally weakened through deterioration over time, lack of inspection and maintenance, and previous relatively milder earthquakes. _Tugurio_ residents are in danger of being struck by collapsing adobe walls inside their buildings and in the streets, and by injuries sustained from collapsing interior hallways and staircases, by trampling and panic, and by other structural failures. About 20% of primary schools -- especially in _tugurios_ -- are projected to collapse in such an earthquake.

A second principal cause of casualties would be the relatively newer settlements on precarious sites such as steep hillsides and the edges of cliffs over river banks. Electrocution from falling wires during and after an earthquake, as survivors plunge into building rubble to rescue the victims; and burns suffered in fires provoked by an earthquake could also be considerable.

In all, this study suggests for illustrative purposes that between 37,500 and 62,500 dwelling units would collapse in an earthquake. If an average of one to two persons perished in each case, Civil Defense's projection of 60,000 fatalities (equal to 1.2% of Lima's population) would be realized. The worst case would occur if the event took place during normal night-time sleeping hours, when the tugurio buildings are full.

There would probably be serious differences among specialists concerning the number of serious injuries which would be generated if 60,000 persons were killed. Most would suggest a ratio of 1:2 or 1:3 for deaths:serious injuries. The 700,000 projection (equal to 14% of Lima's population) yields a ratio of 1:12.

Local residents of tugurios and other vulnerable areas indicate in their overwhelming majority that they would bring injured victims directly to major hospitals, and not to local health posts or health centers. This would be especially true in the tugurios. Depending on the time of day of the earthquake, hospital staff behavior would vary: in daytime, many staff would rush home to verify the condition of their families, become caught for hours in paralyzing traffic jams, but would later return to their hospitals to handle emergency cases. In the evening, most hospital staff would be at home with their families, could promptly verify their condition and proceed to the hospital with relatively few traffic jams, subject to transitibility of the roads.

There are 25 hospitals in Lima which have more than one-hundred beds each, and three key hospitals with less than one-hundred beds each, as follows:

are extremely low. This study has initiated the development by some members of the Peruvian medical community of a list of essential medicines and supplies which would be required after a severe disaster. It is recommended that this list be completed and widely distributed, and that external donors should be encouraged to provide considerable quantities of the listed supplies, properly marked and packaged, as emergency relief resources after an earthquake.

Striking differences of opinion emerged among medical experts concerning the necessity, feasibility and desirability of the external provision of non-Peruvian -- especially U. S. -- medical personnel to Lima after a severe earthquake. After detailed review of the arguments on both sides of this issue, this study concludes that small numbers of experienced para-medics and rescue squad workers could be useful, if the number of casualties is reasonably estimated to exceed 140,000. Such personnel must be accustomed to handling milder burns and injuries and immobilizing fractures under difficult emergency conditions and should focus on decentralized out-patient care only; or on relieving Peruvian personnel to permit rest periods. Such personnel must have Spanish speaking capability and bring its own supplies and support system; and could include X-Ray technicians with Polaroid equipment and supplies to support medical operations by Peruvian staff. Uninvited foreign doctors who arrive can be directed to evacuation sites in unaffected areas outside Lima whose hospital staff may require supplementation. Externally provided technical assistance experts, if they are mobilized and operational immediately after the event, have been used successfully

Ministry of Health	17 hospitals	7,574 beds	60% of all beds
Social Security Inst.	4	2,342	19%
Armed Forces	4	2,145	17%
Private Sector	3	539	4%
Total	28 hospitals	12,600 beds	100% of all beds

The Ministry has designated seven of its hospitals as primary emergency facilities, though two of them have been judged by some experts to be vulnerable to collapse or severe damage requiring their immediate evacuation. In order to begin to develop a plan for provision after an earthquake of emergency services by the 28 hospitals, a hospital questionnaire was developed and completed for eight hospitals. The questionnaire solicits data on power, water, waste removal, personnel, services, emergency plans, and other key elements.

This study recommends that the remaining questionnaires be completed and that based on their analysis the city power, water and other authorities develop prioritized plans for provision of emergency services to the hospitals. Contingency plans should be made for evacuation and alternate siting of principal hospitals which may themselves be severely affected. A plan for decentralizing emergency out-patient care outside of the major hospitals is vital, as is a strategy for evacuation of serious cases to the large number of hospitals outside Lima in areas unaffected by an earthquake.

Because of a continuing national fiscal crisis, Ministry and individual hospital inventory levels for medicines and related supplies in the fields of epidemiology (especially the Center for Disease Control, Atlanta); bacteriological decontamination (U. S. military have such standby resources); and veterinary medicine. They could probably be most useful in Lima if they are promptly mobilized and deployed there after an earthquake.

Distribution of blankets to most affected disaster victims would be useful for their health and minimal comfort as the night-time climate in Lima is cold.

But the dispatch of field hospitals -- even though they will undoubtedly be requested -- is probably the least useful way in which external resources can be employed in Lima. They will arrive after the real need for them has diminished if not disappeared; cost great sums of money to transport; and detract from higher priority national operations. With the number of major hospitals in Lima; two Peruvian field hospitals permanently stored in Lima; and considerable hospital resources throughout the country which can provide backup support, external field hospitals would be poor uses of resources.

A brief overview of the health delivery system of Peru is included as an annex to this report, as are three articles concerning lessons learned in epidemiology and emergency medical care operations in Peru after the 1970 earthquake and in Guatemala after the 1976 earthquake.

A good contact point for disaster preparedness discussions and activities in Lima is Dr. Miguel Gueri, PAHO/Lima's Disaster Preparedness

Specialist, and on whom this study relied for technical guidance.

The USAID/Peru Family Health Office, and particularly Helene Kaufman, its Chief during the time of this study, provided substantial and invaluable assistance in the conduct of the work described herein.

EXECUTIVE SUMMARY: Food Supply and Consumption

This report describes the principal foods consumed by the population of Lima, and the sources of supply, critical transport routes, storage facilities, distribution networks and other key parts of the food supply chain for this city of approximately five million persons. As part of a disaster preparedness plan, it can assist in determining whether food per seas a relief resource may be required as a result of a disaster which could occur in Lima or elsewhere -- nearer the sources of supply -- in Peru. It can help to identify the actual causes of possible shortages; to design appropriate disaster responses to alleviate such causes (whether or not directly food-related); and to quantify the need, if any, for alternate national or external foods. By providing detailed monthly supply data by department, the document can assist in pinpointing the cyclical food shortages and needs which various kinds of disasters could provoke.

The study which forms the main part of this report was conducted by SECOMAN [Servicios Comerciales Andinos, S.R.L.], a private sector professional consulting firm, under the direction of Ing. Alfredo Gordillo Uribe, its Executive Director. The terms of reference of the study were developed, and the work itself was supervised, by a team of disaster specialists working in association with the USAID/Peru Office of Rural Development, and in particular with AID's Statistical and Marketing Specialist, David Flood.

Separate data was developed for the following commodities: wheat, rice, potatoes, sugar, cooking oil and selected meat, dairy products, vegetables and fruits. and kerosene. The information includes:

1. Departmental production sources for principal foods consumed in Lima, also presented by regions (north, east/central, south, and from external sources). For example, Sample Maps A and B describe the proportion of potatoes and rice, respectively, produced by each rural department, expressed as a percentage of all Lima's consumption. (The ship on Map B represents the imported percentage.)

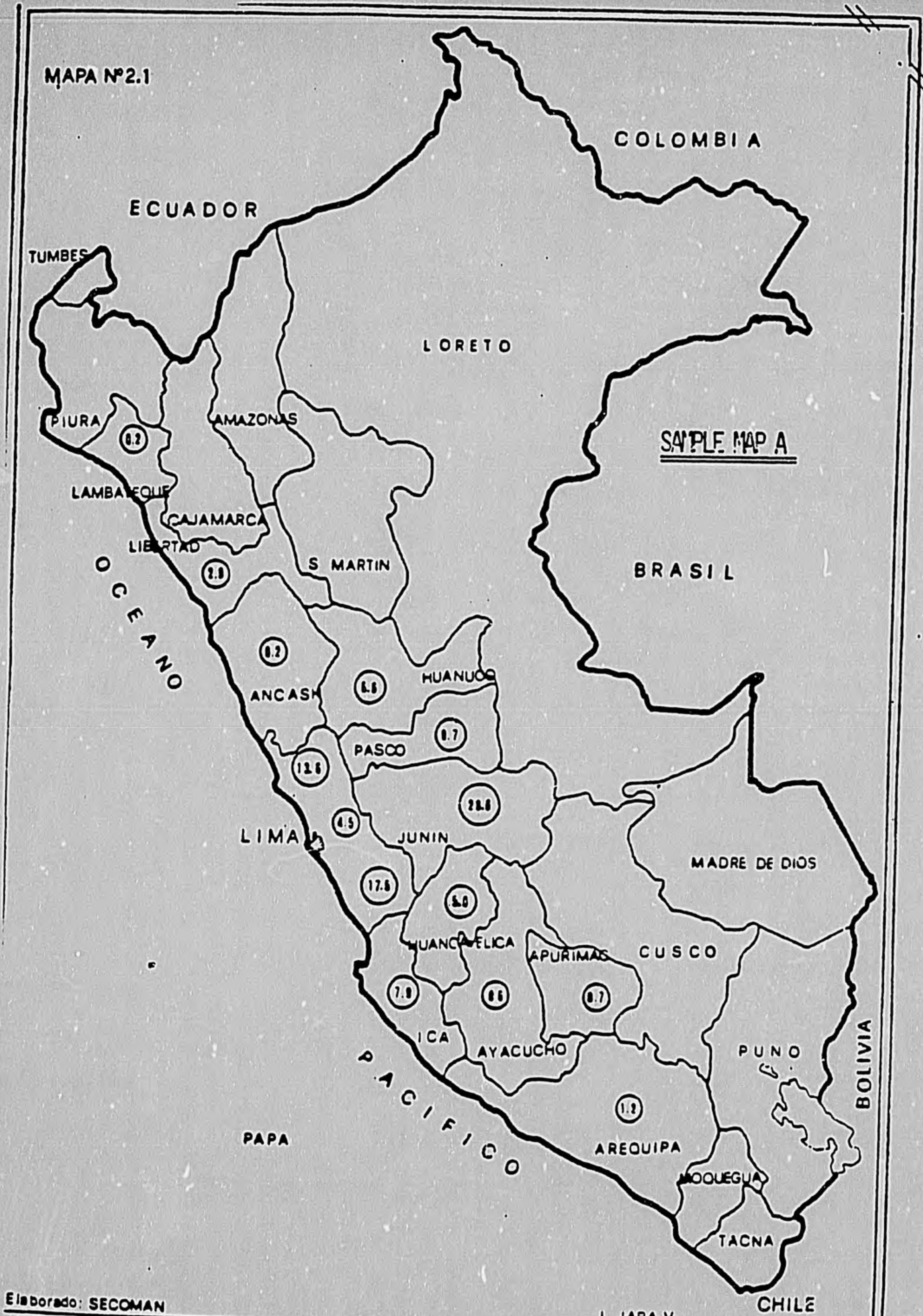
2. Monthly supply patterns and historical import patterns, by commodity. Sample Charts A and B illustrate this data for potatoes and tomatoes.

3. Principal in-country transport routes for food conveyed to Lima, and seaport facilities. For example, see Sample Map C, principal road and rail routes.

4. Storage facilities for principal products, and flour-mills. Sample Map D, for example, illustrates the location of major sugar, flour and kerosene storage facilities in Peru.

5. Marketing/distribution networks in Lima, as, for example, illustrated in Chart C, depicting the sugar distribution network in Lima.

6. Consumption patterns for principal foods by economic class (See Sample Chart D, detailing per capita consumption by economic class of principal items in the diet); frequency of purchase by product by class; and relative cost of food to each class.



MAPA Nº2.1
COLOMBIA
ECUADOR
TUMBES
LORETO
PIURA
AMAZONAS
SAMPLE MAP A
CAJAMARCA
LIBERTAD
S MARTIN
BRASIL
OCEANO
ANCASH
HUANUCO
PASCO
LIMA
JUNIN
MADRE DE DIOS
HUANCAVELICA
APURIMAC
CUSCO
ICA
AYACUCHO
PUNO
BOLIVIA
PACIFICO
PAPA
AREQUIPA
MOQUEGUA
TACNA
0.7
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Elaborado: SECOMAN
L. JARA V.
CHILE

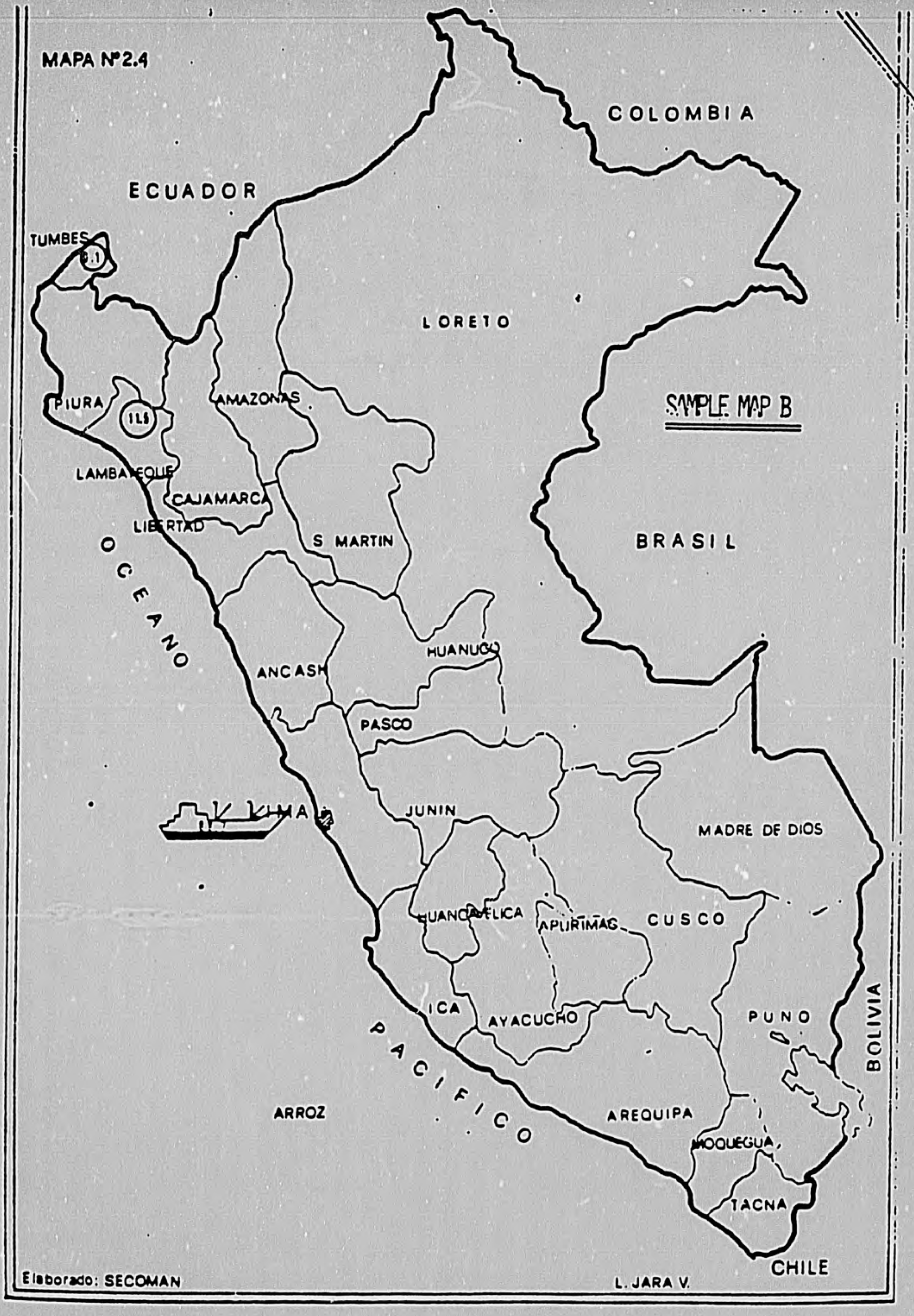
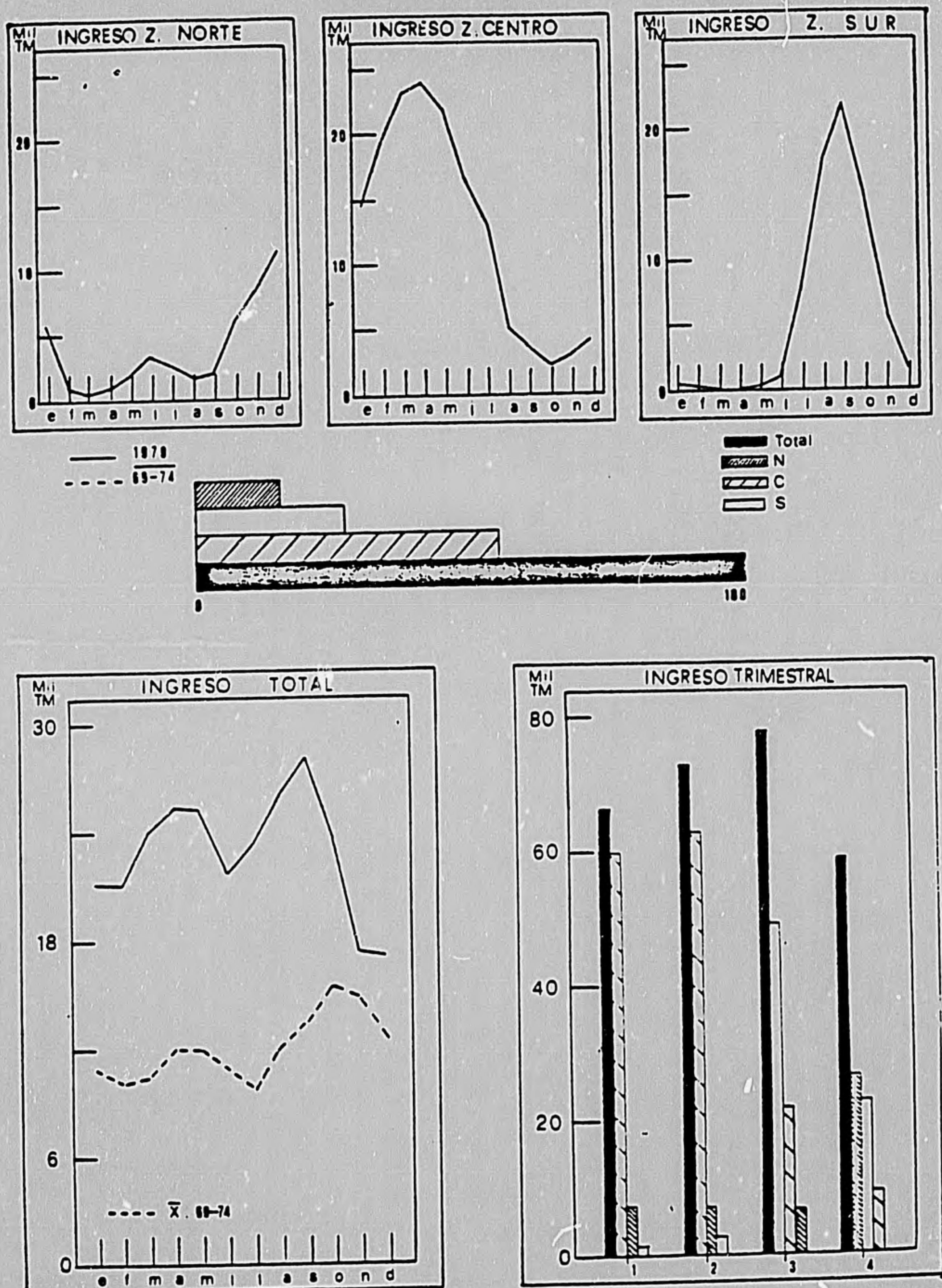

MAPA N°2.4
ECUADOR
COLOMBIA
TUMBES
LORETO
PIURA
AMAZONAS
SAMPLE MAP B
LAMBAYEQUE
CAJAMARCA
LIBERTAD
S MARTIN
BRASIL
OCEANO
HUANUCO
ANCASH
PASCO
LIMA
JUNIN
MADRE DE DIOS
HUANCAVELICA
APURIMAC
CUSCO
ICA
AYACUCHO
PUNO
PACIFICO
BOLIVIA
ARROZ
AREQUIPA
MOQUEGUA
TACNA
CHILE
Elaborado: SECOMAN
L. JARA V.

GRAFICO Nº 2.1

INGRESOS CALENDARIZADOS A LIMA METROPOLITANA

PRODUCTO: PAPA SAMPLE CHART A

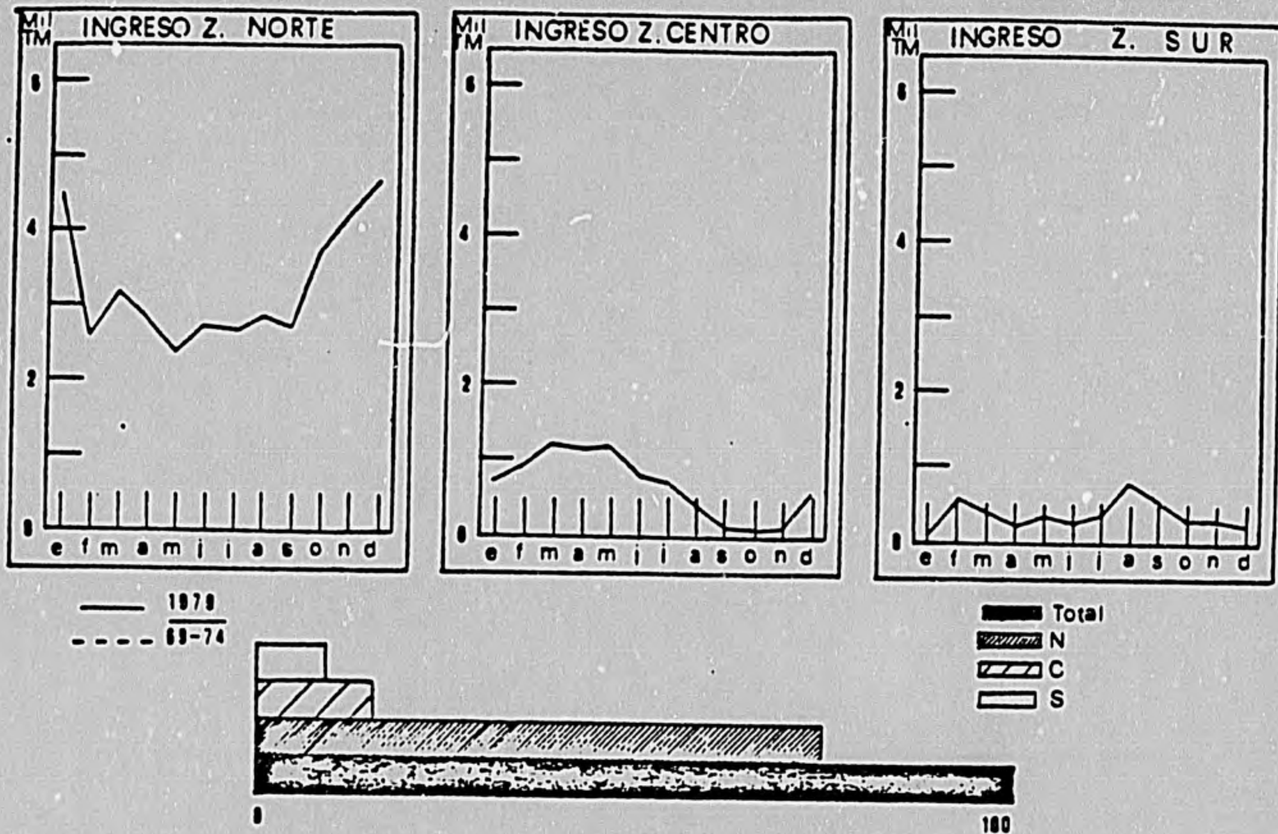


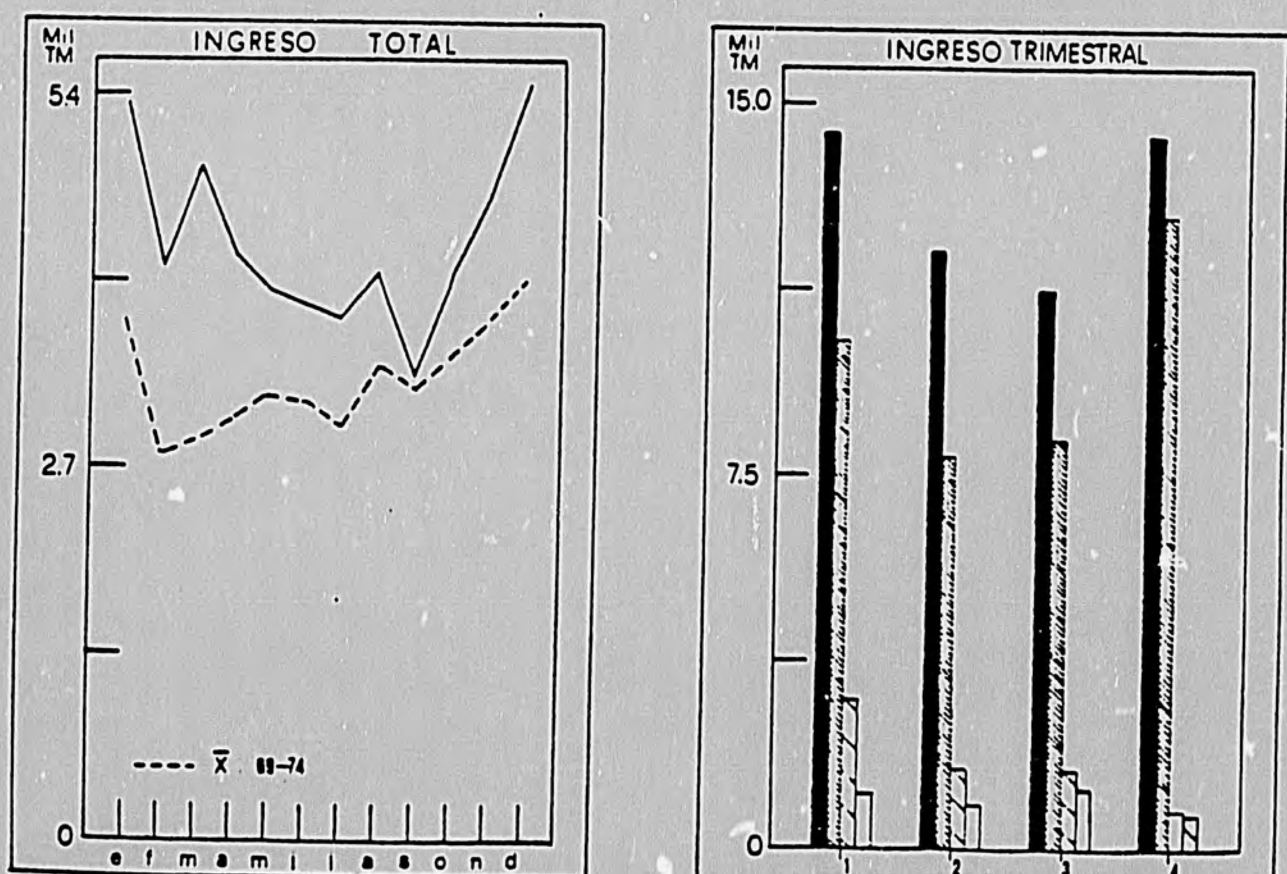
Elaborado: SECOMAN

L. JARA V

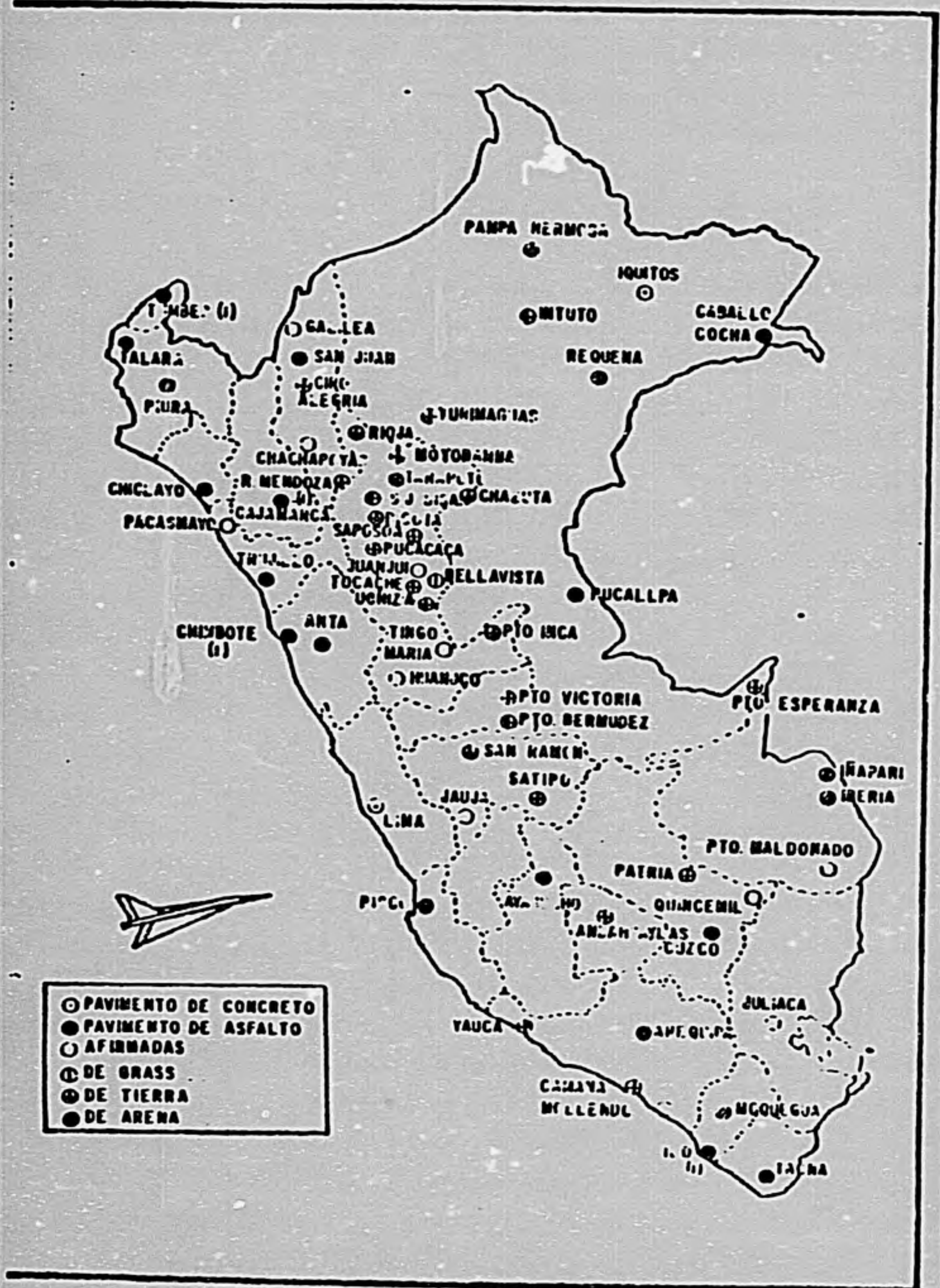
INGRESOS CALENDARIZADOS A LIMA METROPOLITANA

PRODUCTO: TOMATE SAMPLE CHART B

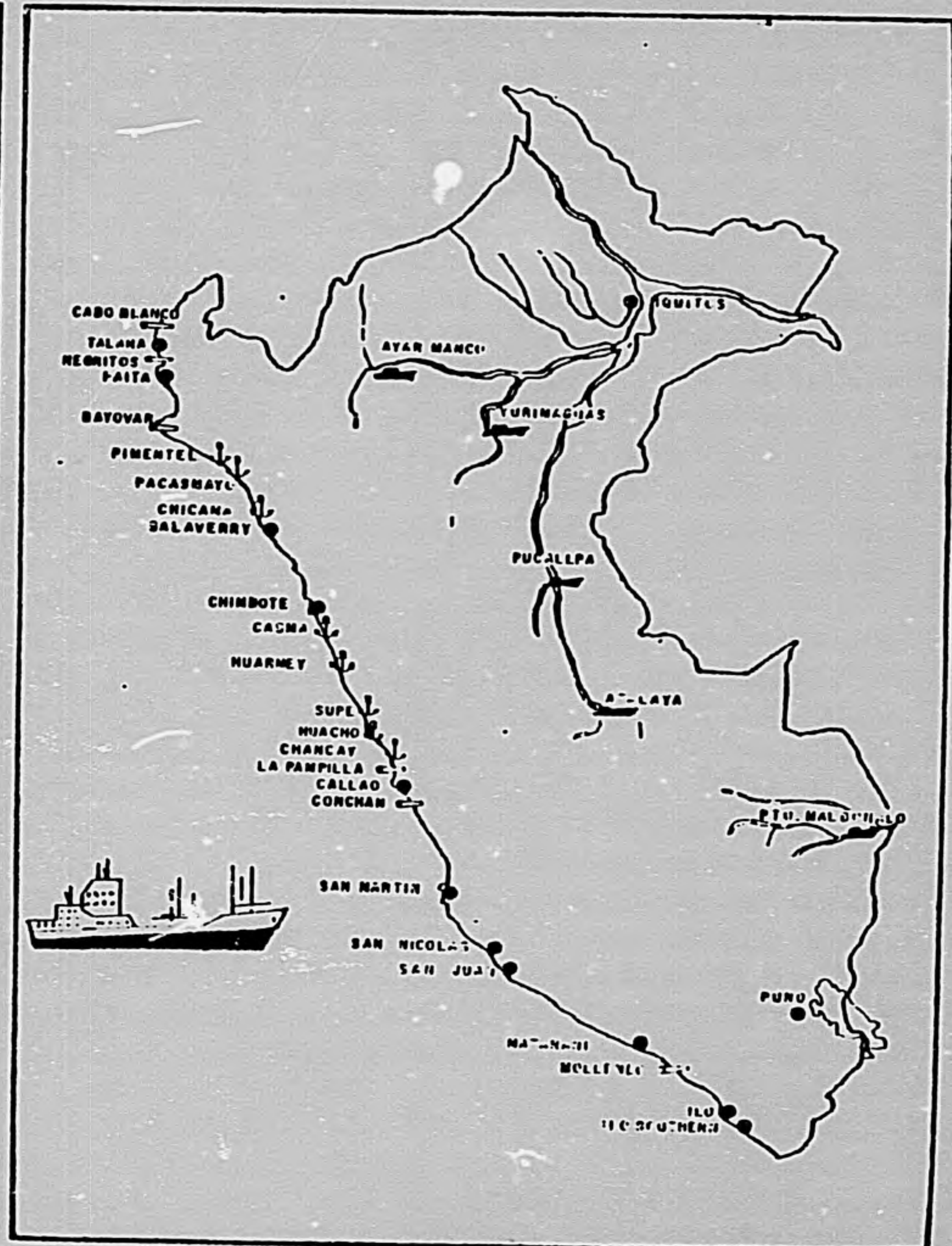




MAPA N° 3.2



SAMPLE MAP C



Fte MTC


MAPA Nº 4.2
ECUADOR
COLOMBIA
TUMBES
LORETO
PIURA
AMAZONAS
LAMBAYEQUE
CAJAMARCA
LIBERTAD
S MARTIN
BRASIL
SAMPLE MAP D
OCEANO
ANCASH
HUANUCO
PASCO
LIMA
JUNIN
MADRE DE DIOS
HUANCAVELICA
APURIMAC
CUSCO
PUNO
ICA
AYACUCHO
BOLIVIA
PACIFICO
AREQUIPA
MOQUEGUA
TACNA
CHILE
ALMACENES
Azucar
Harina
Kerosene
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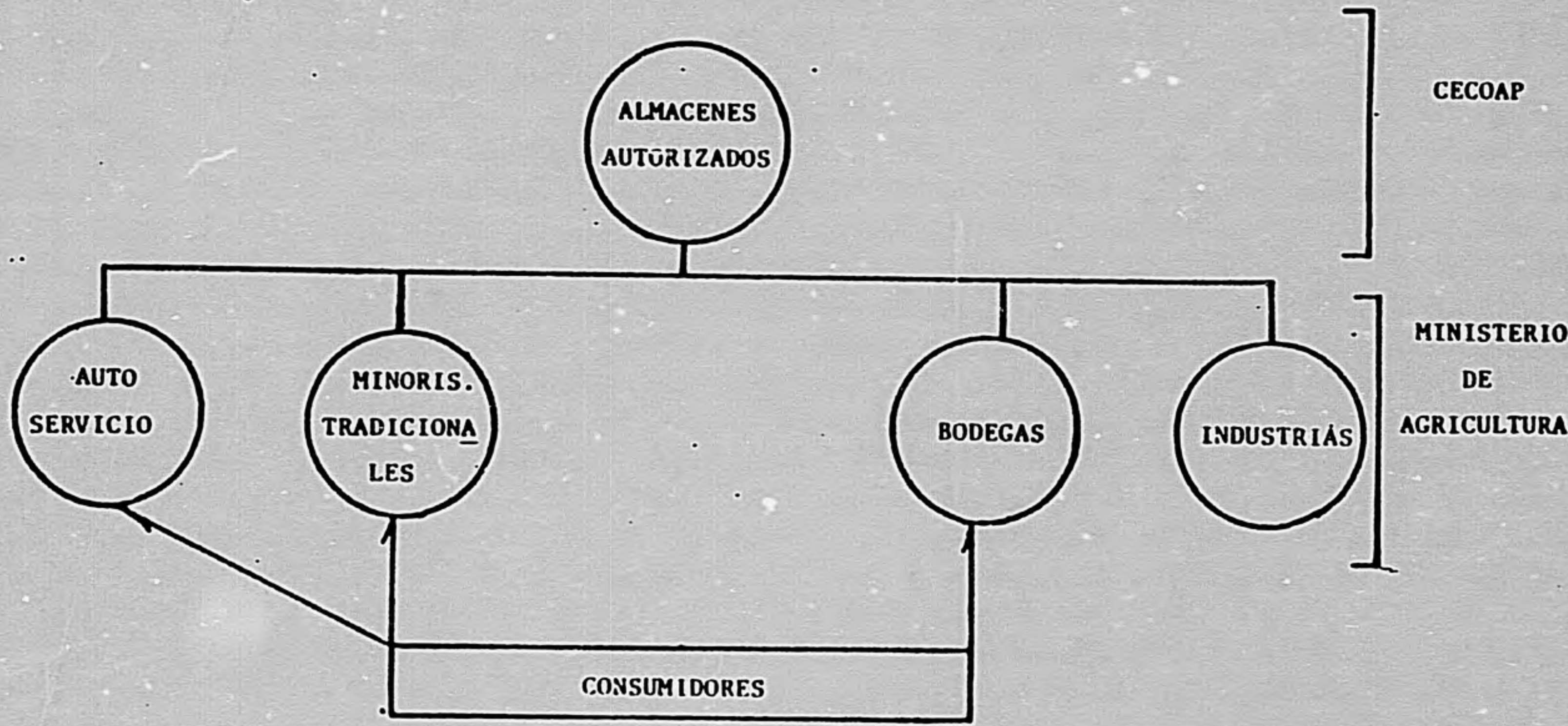
5.4-5 AZUCAR

SAMPLE CHART C



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Telex 25424 CP ISIDR

CUADRO N° 6.2-1

SAMPLE CHART D

CONSUMO PER-CAPITA/AÑO
LIMA METROPOLITANA
(Kg.)

	ESTRATO I (Bajo)	ESTRATO II (Medio)	ESTRATO III(Alto)
	Consumo por Per/cápita	Consumo por Per/cápita	Consumo por Per/cápita
Aceite cocina	6,777	7.480	7.137
Arveja	4.111	3.979	4.440
Arroz (1)	31.252	34.666	27.775
Azúcar (2)	19.236	19.467	16.929
Camote	6.587	6.956	4.610
Carne Pollo	7.602	12.870	14.212
Carne Vacuno	9.945	18.745	27.872
Cebolla	12.057	14,751	14.791
Fideos	13.231	10.463	7.128
Frijol (3)	0.533	0,231	0.304
Leche Evaporada	15.701	18.953	16.242
Leche Fresca	2.141	59.643	87.670
Lechuga	1,114	2.063	3.326
Limón	2.321	4.047	4.432
Manzana	2,188	5.180	6.426
Naranja	6.706	11.589	11.836
Pan	5.376	5.353	5.205
Papa (4)	46.870	45.416	36.929
Plátano (5)	9,281	14,867	11.472
Tomate	7.742	10.735	12.621
Trigo	1.486	1.145	1.714
Yuca (6)	2.913	3.432	2.578

(1) Involucra arroz corriente y arroz extra
(2) Azúcar Blanca
(3) Panamito
(4) Papa amarilla, y papa blanca
(5) Seda e Isla
(6) Blanca

FUENTE: Consumo Familiar y Per/cápita de 54 productos alimenticios seleccionados por areas, regiones y zonas del Perú. 1971 - 1972 MEF-DGIE

7. Government of Peru food-stamp and subsidy programs.

This report was developed during the period September 29 - November 16, 1981, about seven weeks. It was required to draw on existing published and unpublished data, upon whose quality, detail and timeliness it is largely dependent. The task required the SECOMAN staff to gain access to and to process data which, up to that point, had not been processed. In this and in other tasks associated with the study, the Ministry of Agriculture's Statistical Division, under the direction of Dr. Romulo Grados, provided assistance with great effectiveness.

Should a disaster occur, it will be important for the USAID Mission and others who might choose to do so to use analytical instruments such as this report to determine whether post-disaster food assistance is required. A severe earthquake in Lima may disrupt transport, seaport, storage and distribution networks around the city; it seems unlikely that food supplies *per se*, will be affected. Alleviating infrastructure bottlenecks which interfere with resumption of normal food distribution would be effective means of dealing with the problem. Local inner-city networks for distribution are likely to re-establish themselves, if only in *ad hoc* form, very quickly.

In the meantime, relatively small supplies of PL480/Title II food commodities already in-country, may well be called upon for emergency relief purposes during the first weeks after such a disaster. The Mission must insure that these are directed to the areas of the city which have suffered the greatest damage -- probably the *tugurio* slum areas --

and not necessarily to the pueblo joven areas where the Title II program is currently active. The tugurios would be a new geographical target area for the Title II program, and its residents a different type of target group. Even emergency food must be carefully planned to insure effectiveness in these new programmatic environments. The AID/OFDA Disaster Team found the advice of the Seventh Day Adventist/OFASA field workers especially useful in connection with various phases of fieldwork conducted in the tugurio areas.

The distribution of all relief supplies should be closely coordinated with the Government of Peru's overall strategy, which may be to provide incentives for more permanent types of shelter and other solutions and to avoid temporary solutions. In addition, consideration of the provision of additional relief food, after the emergency period, should be considered only if food itself is absolutely necessary. It should be subject to close scrutiny, taking into account programmatic pitfalls, possible negative social outcomes, potential disincentives to Peru's program to increase production and achieve self-sufficiency in some principal foods, and other potentially negative features of protracted post-earthquake food aid.

EXECUTIVE SUMMARY: EDUCATION

This report focuses on two disaster-related aspects of educational activities: the addition of a new, disaster preparedness feature to the regular primary and secondary school curricula of the Ministry of Education; and some modest steps which can be taken in disaster preparedness and post-disaster operations concerning school infrastructure.

Encouraged by the Brady prediction that a severe earthquake could strike Lima in the Summer of 1981, the Ministry of Education committed itself to a program of curriculum development for disaster preparedness. A four-teacher team worked for about six months using such disaster preparedness literature as it could identify. Technical assistance in this effort was sought from USAID, and supported by both the local AID Mission and OFDA/Washington. However, a qualified expert could not be identified or was not available during the desired time-frame. Thus, the team of teachers carried on as best it could in writing teachers' guides, texts for slide presentations, and illustrated texts. Because these materials had not been approved by the Ministry, they could not be made available for review as part of this study and may not have been completed and published because of time and resource constraints.

The private sector has published a 32-page booklet. "Los Sismos: Que Hacer Antes, Durante y Después" which is quite suitable for youngsters. This clearly illustrated low-cost pamphlet was designed especially for Lima and could be used to initiate some efforts. In the meantime, materials which are more elaborate or less elaborate, depending on the need, could continue to be developed.

A program of education in the schools is worth pursuing. USAID could add additional vigor and momentum to the Ministry's initiative by providing resources to assess the work completed by the Ministry's team and the applicability of the "Los Sismos" booklet; make funds available for procurement of the booklet, if appropriate; provide for the production, under contract, of other materials desired by the Ministry; and provide management assistance in the organization and initiation of this effort. For this purpose, specialists in the substance of earthquakes and earthquake-preparedness; and in management and organization, would be most appropriate. Specialists in curriculum development could be identified in Lima.

In addition to this major program, the Ministry of Education could assist in Tsunami evacuation education efforts in El Callao; and could consider on a trial basis the integration of Red Cross demonstration training sessions in first aid in their classes throughout Lima.

Infrastructure

A 1977 study by the National Engineering University's Ing. Julio Kuroiwa suggests that in a severe earthquake 20% of the primary schools in Lima would collapse and 30% would be irreparably damaged. The low-income tugurio areas contain the most vulnerable schools. If the earthquake were to occur during the 25% of the week when the schools are occupied, there would be considerable death and severe injury to children. Paul J. Flores, a Civil Defense consultant from California who worked in cooperation with Peruvian Civil Defense, reached similar conclusions.

This study recommends to USAID/Peru two disaster preparedness actions with respect to the schools:

(a) Conduct of a quick, "mini-research" survey of the schools, in cooperation with the Ministry of Education. This survey would provide an inventory and maps showing location of schools, student population, type of construction, and a quick assessment of their vulnerability. This study would be helpful in disaster mitigation efforts, but would also be important in relief and reconstruction efforts after a severe earthquake. According to the Ministry's disaster preparedness officer, there are no systematic maps or inventories of the schools at present.

(b) Encouragement of AID itself and other funding agencies to provide relatively modest amounts of money to reinforce the most vital evacuation and escape routes from the most vulnerable schools. The purpose of this activity would be to provide school children with a minimum amount of time to escape death or severe injury and to reach safety. It is recognized that it is not within the financial means of the Government of Peru or the donors to demolish current schools and rebuild seismic resistant ones.

Post-Disaster Operations

Re-establishment of the educational system after an earthquake would be a high priority. Parents would be anxious for their childrens' education to continue and for their children to be productively occupied while parents attend to pressing reconstruction needs. The Ministry of Education would be anxious to re-establish its services and to enable its teachers to resume their teaching duties.

For assessment, planning and implementation the availability of an inventory and map showing the location of the schools and whose development is recommended above as a preparedness measure — would be most helpful.

USAID helped to provide for the prompt re-establishment of the schools after the Guatemala (1976) earthquake through the provision of 300 pre-fabricated BUTLER building units. After considering the advantages and disadvantages of the use of pre-fabricated buildings, the report provides the narrative recollections of the manager of the Guatemala effort, Dr. Howard D. Lusk, and such background documentation as could be located at this time.

A list of contacts in the Ministry of Education appears at the conclusion of the report.

EXECUTIVE SUMMARY: INTERNATIONAL DONOR COORDINATION

Coordination among the major international donors, both before and after disasters, should have among its principal objectives:

1. To share information about disaster plans, or about damage and needs assessments after disasters. Each donor has its own well-placed contacts or long-term interest and expertise in a particular geographical area from which all donors can benefit.

2. To avoid duplication of effort, insuring the most efficient use of all resources available to the disaster victims and the Government of Peru.

3. To anticipate and avoid potential policy conflicts which can usually be rapidly resolved through effective coordination.

This section presents brief profiles of the other major international donors. Each profile identifies an appropriate contact person for each donor; describes the nature and magnitude of disaster resources and the procedures for activating them; and provides other background information.

Profiles for the following donors are included:

Britain	Canada
Holland	Germany
Japan	Brazil
United Nations	World Bank

Efforts should be continued to meet with representatives of the Governments of Mexico and Venezuela to complete this process.

One international donor requested of the National Civil Defense System a list of resources likely to be required after a major disaster in Lima. The list which appears as an Appendix to this volume was provided. The document from which the list was drawn ("Calculo de Recursos, etc." is summarized and analyzed elsewhere.

This report recommends the following actions to USAID/Peru:

(a) Disaster Preparedness A thorough briefing on the results of the Mission's first phase of its Disaster Preparedness Program should be provided individually to each major donor. Each of these groups provided suggestions and contacts during the conduct of the activity and expressed interest in receiving a briefing on its conclusions.

Thereafter, the contact persons for the donors should meet each six months to keep each other apprised of their disaster preparedness activities and to provide an opportunity for newly appointed contact-persons to become integrated in the coordination process.

(b) Post-Disaster Operations The coordination process should be pursued with greater vigor after a disaster. A USAID official should conduct daily, informal coordination with each active major donor and should assist in the organization of meetings of the donors, as required.

EXECUTIVE SUMMARY: CRITICAL ABSTRACTS FROM THE LITERATURE - A FIELD PERSPECTIVE ON MAJOR EARTHQUAKES

In this volume, notes and summaries of thirty-two reports and books have been collected. The summaries and extracts concern previous earthquake disasters in the Americas. Nineteen of the documents concern Peru, and most of these discuss the 1970 earthquake there. The others were developed after the Managua (1972) and Guatemala (1976) earthquakes. A few of the documents address more than one of these disasters.

This collection is not based on an exhaustive or systematic search of all available literature on these subjects. Rather, it addresses some of the literature reviewed by an OFDA field team in Peru in 1981. The summaries and extracts sometimes reflect only one part or some sections of the document reviewed, especially including items of special interest to the team.

However, it was felt that this set of field notes would be valuable to persons involved in future disaster operations or in disaster preparedness activities in Peru, or perhaps elsewhere.

Most of the literature reviewed in this volume can be found in the resource files of the Mission Disaster Relief Officer, at the USAID Mission in Lima. Some can also be found in the Disaster Preparedness Office for Latin America and the Caribbean within the Office of Foreign Disaster Assistance, AID, Washington, D. C.

A list of documents reviewed in this volume appears at the following pages.

Critical Abstracts from the Literature:

Documents Reviewed

I. PERU

Emergency Phase

USSOUTHCOM Disaster and Assistance Survey Team (DAST)(sic) After-Action Report - 1970 Peru Earthquake

MAAG - U. S. Military Advisory and Assistance Group, U. S. Embassy, Lima, Peru - After Action Report, July 21, 1970

PERU EARTHQUAKE - May 31, 1970, USAID After Action Report (Crocker), August, 1970

Review of U. S. Assistance Activities Related to the Earthquake Disaster in Peru, Committee on Foreign Affairs, U. S. House of Representatives, December 3, 1970

Reconstruction Phase

Completion Report of $7.4 Million Grant Agreement for Earthquake Rehabilitation and Reconstruction Program, Jacob Willebeek-Le Mair, USAID Engineer, September, 1974

Report of Audit - Earthquake Reconstruction and Rehabilitation Grant, USAID/Peru, AID Auditor General Report No. 71-3, September, 1971

Preliminary Report on Post-Disaster Housing in Peru, Paul and Charlotte Thompson, INTERTECT, 1976

Evaluación de Resultados al 31 Diciembre 1978 del Convenio Unico ORDENORCENTRO-EMADIPERU, Ing. Carlos Torrejon I., EMADI-PERU Document evaluating credit collection of Post-1970-Earthquake Housing Programs

El Terremoto de Lima del 3 de Octubre de 1974, CERESIS, Dr. Alberto A. Giesecke, published under a UNESCO Grant, 1974 - A historical overview of seismic and Tsunami events in Lima

Disaster Preparedness and General Background

Report of the Disaster Preparedness Evaluation Mission to Peru, January 30, 1981

Cálculo de Recursos Alimenticios y Recursos Materiales para Los Sectores Críticos y a Nivel de Lima Metropolitana ante la Ocurrencia de un Sismo de Grado 8.4, National Civil Defense System, June, 1971

People and Housing in Third World Cities - Perspective on the Problem of Spontaneous Human Settlements (Lima Section), D. J. Dwyer, 1975

Espacio Vital, Catholic University film about the history of a land invasion leading to the settlement of a pueblo joven in Canto Grande, Lima

Analysis for the Potential for Housing Improvement in High Risk, Vulnerable Areas of Peru, Frederick C. Cuny, INTERTECT, April, 1979

Latin America: Housing Survey for Disaster Relief and Preparedness, Office of Foreign Disaster Assistance (OFDA), 1981 (Peru Section Only)

Estudio Sísmico de las Viviendas en el Distrito de La Victoria, (Ing.) Jose L. Medina Avila, Universidad Nacional de Ingeniería, 1977 (Thesis Submitted in Support of Candidacy for Degree in Civil Engineering)

Mensaje al Congreso (State of the Economy), Prime Minister Manual Ulloa, August 27, 1980

Protección de Lima Metropolitana Ante Sismos Destructivos, Ing. Julio Kuroiwa H., Universidad

Plan de Operaciones de Emergencia, Lima Metropolitana, Comité Nacional de Defensa Civil, 1981

Audit Report: PL480 Title II Programs, USAID/Peru, Report No. 1-527-81-2, AID Auditor General, October, 1980

La Industria en el Perú - Principales Indicadores 1970 - 1980

II. MANAGUA

Emergency Phase

USSOUTHCOM After-Action Report: Managua, Nicaragua Earthquake Disaster, March, 1973

After-Action Summary: Disaster Relief Operations - Nicaraguan Earthquake, DAST Commander, Undated

Efectos del Terremoto en el Sistema de Agua Potable de Managua, Ing. Normando Porras, October, 1974

Emergency Shelter and Natural Disasters: Some Observations in Skopje and Managua, Ian R. Davis, October, 1975

III. GUATEMALA

Emergency Phase

Guatemala Disaster Relief Operations: After-Action Report, USSOUTHCOM, April, 1976

DISASTERS: Volume 1, No. 2, 1977, Special Guatemala Edition - Three Extracts:

Housing and Shelter Provision Following the Earthquakes of February 4th and 6th, 1976, Ian R. Davis

Rural Centre and City Slum after the Guatemala Earthquake, Hazel Weymes and Julius Holt

Considerations on Health Relief, Guatemala Earthquake, 1976, Michel Lechat

Audit Report: Guatemala Earthquake Disaster Relief Program, Project No. 520-1[illegible]-0241 USAID/ Guatemala, Audit Report No. 1-520-81-10, March, 1981

Manual del II Seminario Sobre Ingeniería Sanitaria en Situación de Catastrophe
University of San Carlos, Guatemala, Otober, 1976

IV. LESSONS LEARNED FROM RECENT DISASTERS

Issues and Problems in the Provision of Shelter and Housing - A Review of Experiences and Lessons from Recent Disasters, Cuny/Davis/ Krimgold, INTERTECT Reprint, January, 1978

The Disaster Area Survey Team in Latin America, (USSOUTHCOM? 1976/1977?)

North Field: Meeting the Triple-R Challenge, Tyndall Air Force Base Research Engineering Division, Summer, 1981

EXECUTIVE SUMMARY: SELECTED AVAILABLE DOCUMENTATION - THE BRADY EARTHQUAKE PREDICTIONS

In 1976, Dr. Brian T. Brady, a theoretical physicist with the U. S. Bureau of Mines who specializes in rock mechanics, applied his deterministic model for predicting rock bursts in silver mines to the prediction of earthquakes. According to Dr. Brady, this model can be used to predict the location of an earthquake, its magnitude and period of occurrence. The Brady model provoked considerable consternation and controversy among the scientific community.

Dr. Brady applied his earthquake prediction model to Peru. He predicted that during mid-1981, a series of earthquakes of unprecedented magnitude -- an event with a recurrence level interval of about 800,000 years -- would occur off the Peruvian coast near Lima. Such earthquakes and accompanying Tsunamis would cause catastrophic damage, probably destroying many of the populated areas of the West Coast of South America, including Lima and its population of about five million.

When the first major predicted event did not occur, Dr. Brady re-evaluated his data and, on July 9, 1981, withdrew his prediction.

In addition to the debate it sparked off in the scientific community, the Brady prediction had considerable impact in Peru itself, where it was sensationalized in the press. Some Peruvians attributed a sharp decline in tourism and a decline in real estate values in some areas to the prediction. Others reported that the prediction has motivated businessmen to renew and increase insurance coverage against such a contingency. Moreover, the prediction undoubtedly stimulated considerable public sector activity in disaster preparedness (although once the prediction was withdrawn much of it abated).

During the period July - November, 1981, when an OFDA team researched this disaster preparedness report in Lima, one could not help but become interested in the prediction, the process of its consideration, and its public impact. It is clear that these will be of interest to public policy managers, scientists, social psychologists, economists, and professional researchers in the future. Already several studies and activities in this connection have been initiated.

In the context of the foregoing events, it appeared prudent to assure that available documentation concerning the prediction not be lost to the professional public, and the OFDA team determined to include such documentation in its final report. Thus, the purpose of this volume of the Lima Disaster Preparedness Report is a simple one: to present, in chronological order, the documentation available from AID's Office of Foreign Disaster Assistance (OFDA) in Washington, D. C., and from the U. S. Embassy and U. S. AID Mission in Peru, the documentation available in its files concerning the Brady prediction. This information is to be shared with the serious public policy managers and professional researchers who will seek to evaluate the management and impact of the prediction in the future.

This volume (No. XIII) of the report consists of four books:

BOOKS A & B — Reports, Memoranda, Correspondence and Other Communication 1977 - 1980 and 1981 - 1982, respectively.

Each document in these two volumes has an individual sequential identification number on its first page. The series runs from No. 001 to No. 158.

BOOK C	Press Clippings and Media Reports - 1979 - 1981
	The media reports include transcripts of television presentations, where available.
BOOK D	Published and Unpublished Technical Papers
	These papers, relatively small in number, are presented in loose chronological order.

Devoting as much time to this task as possible, I have been able to collect and sort all of the materials, but not to provide a more elaborate cataloguing, indexing or more complete set of materials than those available at the sources which are described later. There remains much which can be done to improve and complete this effort; again, its purpose is simply to insure that in the meantime the documentation available from these sources is not lost.

Mr. Oliver Davidson, OFDA's Project Officer for this activity, assisted in coordination of the collection effort. Dr. Martin D. Howell, OFDA's Director, recognized the need to preserve these documents and graciously welcomed a review of the pertinent OFDA files. Much of the material in this book was gathered by Mr. Alford Cooley, Economics Officer of the U. S. Embassy in Peru. Mr. Cooley acted as official contact point in Peru for matters related to the prediction and played a vital and constructive role related to the prediction.

The majority of materials in this volume were drawn from the working files of Dr. Paul Krumpe, Science Advisor in OFDA. Dr. Krumpe meticulously collected all kinds of documents related to the prediction and played a central role in its consideration as well.

I am interested in receiving any additional documentation concerning the Brady prediction and will continue to attempt to make such information generally available.