# THE INTERNATIONAL DECADE FOR NATURAL DISASTER REDUCTION IN JAPAN

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## 1. What has been done.

The international Decade for Natural Disaster Reduction (IDNDR)was proposed by Dr. Frank Press in his keynote address to the 8th World Conference on Earthquake Engineering held in San Francisco in July 1984. The International Association of Earthquake Engineering which organized the Conference immediately acted to endorse the IDNDR. The concept of an IDNDR was given in the last half of Dr. Press's address delivered under the title, "The Role of Science and Engineering in Mitigating Natural Hazards".

His proposal dealt neither with actual policy nor with concrete projects; Dr. Press discussed the concept of reducing the natural hazards from the world. Thus, IDNDR is a proposal to stimulate paying efforts by which the final goal of mitigation can be reached by all persons, organizations and nations who agree to the undertaking of an IDNDR. The ways of reaching the goal will take various forms, depending on the type of disaster to be mitigated, the regional characteristics of a hazard, and the political and economic situation in each nation.

By the end of 1985, 25 organizations in 20 nations had endorsed, or were considering, the IDNDR. At that time in Japan, only a few scientists in the field of earthquake engineering had been considering the possibility of spreading the idea of the IDNDR throughout the country. Then in January 1986, the National Committee for Disaster Science of the Science Council of Japan gave its support to the IDNDR. In addition, the Japanese Group for Natural Disaster Research, an organization of about 1500 scientists engaged in research on natural disasters, recognized the importance of the proposed IDNDR and organized an ad hoc committee to promote it and to act jointly with the National Committee for Disaster Science.
Present members of this committee are

Abe, Katsumasa: University of Tokyo, Seismology
Asai, Tomio: University of Tokyo, Meteorology
Ishizaki, Hatsuo: Professor Emeritus, Kyoto University, Wind Engineering
Iwasa, Yosiaki: Kyoto University, Flooding
Mizuno, Kinji: Ministry of Tokyo, Earthquake Engineering
Hakuno, Motohiko: University of Tokyo, Earthquake Engineering
Mizutani,Shinjiro: Nagoya University, Geology
Osawa, Yutaka: University of Tokyo, Earthquake Engineering
Kamo, Kosuke: Kyoto University Volcanoes
Sato, Ryosuke: University of Tokyo, Seismology
Shibata Akenori: Tohoku University, Earthquake Engineering
Shiraishi, Naruhito: Kyoto University, Wind Engineering
Shuto, Nobuo: Tohoku University, Tsunami
Takahasi, Yutaka: University of Tokyo, Flooding
Toki, Kenzo: Kyoto University, Earthquake Engineering

This committee met several times to discuss possible approaches for developing an awareness of and an interest in the IDNDR, and some members established and maintained contact with government officials in order to push forward the concept of the IDNDR in Japan. Plans were made to invite Dr. Frank

Press to Campaign for the IDNDR in Japan; in particular, among those most concerned with disaster mitigation at a time when there could be widespread, in depth discussions. Dr. Press's visit became a reality, and three symposia were held during October 1987. The programs of these symposia were

Oct. 20, 1987, Tokyo: "Natural Disasters and the International Decade for Natural Hazard Reduction "held by the Science Council of Japan.

1. Frank Press: President, the National Academy of Sciences, U.S.A.
2. Juji Suehiro: Former President, the Meteorology Agency, Japan
3. Yosiaki Iwasa: Chairman, the National Committee for Disaster Science, Japan
4. Katsuhiko Miki: Director, the Bureau of Disaster Prevention, the National Land Agency, Japan

Oct. 21, 1987, Nagoya: "Seminar on Regional Disaster Prevention".Held by the United Nations Center for Regional Development

1. Frank Press: President, the National Academy of Sciences, U.S.A.
2. Keiji Higuchi: Professor, Nagoya University, Japan

Oct. 23, 1987, Osaka: "Symposium for the 60th Anniversary of the Western Chapter of the Japan Society of Civil Engineers".

1. Frank Press: President, the National Academy of Sciences, U.S.A.
2. Michio Okamoto: the Japanese Council of Sciences, Japan
3. Hidenobu Takahide: President, the Water Resources Corporation

The symposia held in Tokyo and Osaka were particularly successful in attracting audiences of more than 300 to each one. Those attending included those working on disaster mitigation in both government and nongovernment organizations, as well as scientists and engineers. During his stay, Dr. Press also met with many officials, including two ministers and several directors of bureaus of various ministries, with whom he discussed the promotion of the IDNDR.

The National Land Agency's committee for the IDNDR was composed of representatives from most government ministries and from several prefectural governments, as well as the Group for Natural Disaster Research's Committee for the IDNDR and the United Nations Center for Regional Development. This joint Committee met every two months and information on the IDNDR was distributed through its membership. The member organizations of this committee sponsored the symposium held in Tokyo that was described previously. In short, the two committees that were organized to promote the IDNDR in Japan are the Ad hoc Committee composed of members from academic fields and the Working Group for IDNDR composed mainly of personnel from government agencies. This latter committee has been dissolved, but will be re-formed as a national committee by April 1988.

2. What should be done now.

The resolution for an IDNDR having been adopted by the United Nations, its promotion will, hereafter, be accelerated throughout the world by all those engaged in natural disaster mitigation. The urgent task now is to organize a nationwide committee for the IDNDR. A National Committee will be organized in early 1989, which will be chaired by the Prime Minister in accord with the usual procedure taken for past International Years. Members of this committee will include the deputy ministers of all the ministries of the Japanese government and

representatives of nongovernment organizations. The committee will deal only with administrative affairs and final decisions: therefore, we must establish another committee to initiate substantive plans and concrete activities before and after the start of the International Decade in 1990. For this purpose, a Preparatory Committee will be organized by the National Land Agency before the end of April 1988.

The long term goal of the IDNDR is to prevent different types of natural disasters from taking place on our earth. It is impossible, however, to attain this ideal goal within as short time as a single decade. We must therefore impose a realistic secondary goal that is reachable within the coming decade of the 1990s. To obtain positive results, we need to keep in mind that

* the standpoint is global and international,
* the goal must be concrete and distinct,
* the persons who implement that goal must have a deep understanding of and interest in disaster mitigation,
* the essential financial support must be provided, and
* the organization that executes the plans must be firmly established.

As yet, there is no international cooperative program which satisfies the above conditions. We must establish new components and organizations which will extensively and strongly promote the IDNDR.

The occurrence, frequency, magnitude, etc. of natural disasters depend markedly on regional characteristics. Some natural disasters that are common to one region may be unknown in another area. The principles that govern hazards are, however, common ones, and the same concepts for mitigating hazards can be adopted even when the features or characteristics of disasters differ in different areas. Through cooperation and the operation of joint programs, effective exchanges of information among nations will become possible, and the usefulness of such information will be greater in international terms. Therefore, exchanges of people, knowledge, or both, related to the mitigation of natural disasters is an important feature of the IDNDR.

Among developing countries, many have urgent problems other than those presented by natural hazards; consequently, programs for the mitigation of natural hazards have not been well developed in those countries. This means that very large numbers of lives are lost and much property is damaged every year owing to unpreparedness for natural hazards and the disasters they spawn. By contrast, some industrialized countries, even though their experiences of and knowledge about disaster mitigation needs advancement, are well developed in comparison to some developing countries. Therefore current knowledge and methods for mitigating natural hazards must be adapted for use in developing countries if we are to have global disaster prevention. This signifies the importance of technical assistance to developing countries for the improvement of natural disaster mitigation efforts.

Moreover, the fundamental methods that will be used to mitigate or prevent natural disaster in the 21st century will be based on the state of science and engineering at the end of this century. If we are to achieve further development in the mitigation and prevention of natural hazards and disasters during the next century, we must begin fundamental research now, looking at the century to come is an important subsidiary aim of the IDNDR.

On the basis of the above, the main features of the IDNDR should be
1. an international exchange of people and knowledge
2. the promotion of fundamental research on natural hazards
3. technical support to developing in detail in the next section.

The first two items are discussed in detail in the next section.

## 3. International Cooperation during the IDNDR

### 3.1 Education and Training

One of the most important features of the IDNDR is the program in which people and knowledge are to exchanged in order to achieve global mitigation of natural disasters. As knowledge flows only with communication among people, international cooperation requires the exchange of people. And, as developing countries have many more problems related to natural disasters than do developed countries, and must use their resources for immediate, fundamental problems that are social and economic. These latter problems are given high priority so that countermeasures against disasters advance very little, particularly as natural disasters are not daily problems.

Attention first must be directed to the shortage of trained engineers and leaders of disaster mitigation programs. Even though the education of future engineers is most urgent, it will take a long time before most developing countries can assemble a core group. Therefore, the most effective way to educate engineers is to do it in those countries where disaster mitigation studies and programs are relatively well developed. The education of engineers and leaders concerned with mitigation programs should be carried out in universities, government and non-government institutions, wherever fundamental research is being done on disaster prevention. The education of foreign students in such Japanese institutions has a long history--almost 20 years in the field of earthquake engineering. However, this education of foreign students has to be expanded beyond the current limited fields to include all areas relevant to disaster prevention and mitigation. In addition, already established educational practices must be intensified.

It also is essential that effective countermeasures for securing the lives and property of the citizens of nations and regions be taken in order that basic research and the related engineering and technology that evolve from it can be effective. Setting up these types of countermeasures is the task of government or nongovernment technocrats, and it is well developed in Japan as compared with developing countries. Consequently, strategies and information on how to secure lives and property must also be exchanged with the technocrats of foreign countries. Also, the training of engineers and technocrats from developing countries needs to be carried out in various Japanese institutions. In conclusion, the education and training of personnel to staff and administer disaster mitigation programs in developing countries are two of the most important features of the IDNDR program.

### 3.2 Investigations of Natural Hazards

As recently as 1985, we saw what grievous devastation can be caused by natural hazards such as the Mexico earthquake and the eruption of the Nevada del Ruiz volcano. Immediately after these disasters, several countries dispatched relief teams and teams to investigate the sources of the various disasters triggered by these events. Japan also sent relief and investigative teams after these two catastrophes. These types of emergency measures are needed to minimize the effects of such disasters and to restore the normal order as soon as possible. To implement such measures, Japan enacted an International Emergency Relief Act in 1987.

By investigating disaster sites soon after the events, it is possible to gain important information as to the origins of a given disaster and to use that knowledge to produce preventive measures against such devastation occurring a second time; therefore, we must make detailed investigations of the extent of

damage and what was done to restore normalcy. Although many investigations have been made after past disasters, individual countries usually have conducted separate investigations--seldom have been as effective as they might have been because much effort and information have been duplicated, thereby not making the most efficient use of time, money and personnel. One way to overcome such ineffectiveness is to form joint teams of specialists from several countries willing to send teams to a devasted area or country. This would make possible a more effective sharing of information and work and so broaden the range of the investigation.

Also, in the past, although research teams have been dispatched by a number of countries, joint research with the country in which the disaster took place has been very rare. Research teams from foreign countries usually have asked only for logistical aid. If, however, joint research includes the country where the disaster took place, more information can be gained by the investigation team to help determine the cause(s) of the disaster and this, in turn, will lead to the establishment of better countermeasures against the reoccurrence of such events. Furthermore, when it is a developing country that experiences devastation, it may be difficult, or impossible, for it to conduct an extensive investigation on its own or to formulate preventive measures because of lack of funds and trained personnel. If developed countries that have well developed basic and applied disaster mitigation programs are able to support the engineers and technocrats of the effected country, who are engaged in disaster mitigation, in carrying out their investigations it will benefit both the effected country and those foreign nations that have dispatched relief and investigative teams.

3.3 Establishment of a Database on Natural Disasters

The study of natural disasters must begin with the study of past disasters. There are many examples of disasters for which the causal mechanisms are unknown even though physical phenomena related to the disaster have recorded, and are known. A typical example is the liquefaction induced by the 1964 Niigata, Japan earthquake. During this earthquake, many structures and houses slumped or collapsed because of liquefaction of the supporting ground. Long before this earthquake took place the phenomenon of liquefaction was known, but no one imagined that liquefaction could produce such devastating damage. This is a typical example of learning what causes damage after-the-fact. Since that earthquake, a number of studies have been done to determine the mechanism of liquefaction, and countermeasures have been suggested and put into practice by researchers and engineers from various parts of the world. To better understand why natural disasters occur, we need to share all the information and data obtained on hazards among all the nations of the world. The establishment of a data base on natural disasters ins, therefore, one of the primary goals of the IDNDR. This data base would provide information not only to enterprises and administrations engaged in disaster mitigation, it would make it available to any interested person anywhere in the world. The rapid development of computer and communication networks makes the establishment of such a data base possible in the near future. To monitor its set up and use, an appropriate international organization must be formed.

3.4 International Joint Observation Programs

Many natural disasters are caused by natural phenomena that are global in scale. Earthquakes, typhoons and tsunami are products of dynamic processes in which several hundreds or thousands of kilometers of the earth's crust, air, or both, are involved. For a better understanding of these natural physical processes and in order to develop effective countermeasures, a global observation network for monitoring all natural phenomena occurring on the earth is essential. In the case of meteorology, monitoring has been done by LANDSAT, but historically observations have been made on the earth itself, and theses still play an important role in

weather forecasting. It is most important that we be able to share and exchange the observed data that is being collected world wide as it provides useful information and data for long-range prediction of weather and of meteorological fluctuations.

The POSEIDON plan, a large-scale observation network extending several thousands of kilometers over the earth, enables us to monitor deformation of the earth's crust and to probe the inside of the earth with greater accuracy. Similar observation systems should be considered in other areas, but any system planned must be on a gigantic scale; a network that ranges from ocean to ocean, from continent to continent, or both.

3.5 Seminars on the IDNDR

The significance of holding international seminars is that the exchange of information from the most recent research and the newest techniques for disaster mitigation is made possible through through discussions among attendees at international conferences. Because of the large scale of the IDNDR, frequent co-ordination among the participating countries is necessary. For this reason, seminars or symposia must be held every few years. Comparisons of each nation's program with the programs of other participating nations will provide early detection of problems and expert held in solving them. Conferences should not be limited sole 1 to seminars prepared for, or by, IDNDR participants; a greater exchange of information will become possible if IDNDR sessions are scheduled at regular international seminars and symposia held by fields related to natural disaster study.

Bilateral and trilateral seminars have already been held in various fields that deal with natural hazards or their effects, but most have been single events that provide no continuity for information exchange. Considering the importance of promoting the widespread understanding of the IDNDR, it is necessary to have adequate budgets for such seminars in each participating country in order to assure the success of the IDNDR.

4. Fundamental Studies Related to Natural Hazards

If we are to mitigate and prevent natural disasters,it is imperative that the relation(s) between natural hazards and the disasters that follow them be established and that fundamental studies to determine the mechanisms that operate to produce natural disasters be done. These fundamental studies must be completed by the end of this century, so that new types of natural disaster research and new mitigation programs can be addressed in the 21st century.

4.1 Development of Numerical Simulations

The role of computers in the development of science and technology in the last half of the 20th century has been unprecedented. This also holds true in studies concerned with natural disasters. Structures have been designed so as to be resistant to natural disasters, the designs being based on numerical simulations that are the products of research on the natural phenomena that cause disasters. Because fundamental studies must deal with a wide range of natural phenomena that occur on the earth, any analytical system used must be broad enough to encompass research that ranges from studies of the earth's core and mantle to studies of the atmosphere and the space beyond.

Simulation enables us to predict whether phenomena will occur in the near future, allowing us to represent complex physical processes by a realistic model. To do this we need much more sophisticated computers. But, whatever advant garde computers are developed, it will still be impossible to simulate actual three-dimensional space with a finite degree of freedom model; therefore, we need to develop new methods of analyzing physical processes that have a high degree of

accuracy. Considering the potential of the computer, it will have a greater and greater role in analyzing the spatial phenomena related to natural disasters--providing the governing equations are known. The 21st century promises computers with capabilities ten times greater than the best now in operation. Consequently, analyze the dynamic processes of nature.

4.2 Studies of Historical Disasters

The frequency of natural disasters being inversely proportional to the their magnitudes, the number of events decrease with increasing magnitude. We must, however, assess the magnitudes of disasters that may happen only once in a lifetime or at even greater intervals. At present, data on and records of such rare events are few as to the regions effected and the degree of intensity. For this reason we need to collect as much information as possible from throughout the world and to make case studies of past disasters. Frequent, well done case studies have been made in countries in which the study of disasters is developed, but there has been scant collection of information on the history of natural disasters and the associated data in countries that have few research activities on disasters, even though they have experienced frequent disasters in the past.

As time elapses, the quality and reliability of information on disasters decrease; therefore, it is important to collect data as soon as possible after disasters occur. The collection of information on past disasters that have taken place throughout the world requires the establishment of a flexible methodology. We need to create data bases for both written and oral data because these types of information differ. Consequently, piecing together records of old disasters that have occurred throughout the world is an important feature of the IDNDR.

4.3 Controlling Natural Phenomena Related to Disasters

In the 20th century, in particular in its latter half, human society has benefitted inestimably from the development of technology. But the number of disasters prevented because of advanced science and technology are few when assessed globally. This is mainly because efforts devoted to mitigating natural disasters do not usually have a high profile or produce monetary profit, their nature is defensive and low key. There has been negligible investment in disaster mitigation research which requires large amounts of capital to be successful. Nevertheless, remarkable progress has been made in the acquisition of information on natural disasters and much greater progress is expected in the next century, when we foresee the control of some of the natural phenomena responsible for disasters. For example, in the future the strain accumulated in a particular portion of the earth's crust may be released gradually by a series of small, controlled earthquakes, thereby averting potential secondary disasters. But, in the case of typhoons, even if we could change their direction of travel, the chances are that diverted typhoons would hit other areas and change the total or annual balance of water resources, thereby causing other problems. It is obvious that we should pay attention not only to the technological aspects of mitigation but to possible secondary effects as well. Efforts to solve problems related to both the technology necessary to control natural processes and related secondary disasters must be begun within the next decade.

4.4 Development of Experimental Studies and Advanced Technology

To determine which natural phenomena cause disasters, studies should be directed to the behavior of the earth's water and air, as well as to its crust. If the governing equations for those phenomena are known, the actual behavior of the water, air and crust can be determined regardless of the scale of the phenomena. Many problems, however, have yet to be solved because the governing equations are not yet known for the behavior of media and for the complex interactions between media and man-made structures. The observation of phenomena should be the basis for research, and experimental studies should be directed to obtaining facts related

to disasters, past and present. This requires experimental facilities that have high capabilities. Also, we must develop experimental technology that gives highly accurate and reliable results. Because such experimental facilities are costly, they should be developed and operated jointly under international aegis.

The main cause of natural disasters being that structures and facilities lose strength under stress from natural forces, if we are to mitigate natural disasters, the behavior of structures under stress from natural forces must be investigated and understood. In all probability, most structures and facilities are being constructed without their behavior under stress being known. And, as laws governing this behavior are still unknown, we cannot predict how structures will behave only by making analytical and numerical simulations of stress phenomena. Experimental facilities must be established that can determine these laws by utilizing the latest in advanced technology.

The IDNDR offers us an unprecedented chance to greatly advance our knowledge of and measures for mitigating natural disasters that follow natural hazards. To be successful the International Decade must be global in scope and in cooperation. Programs for the exchange of information and personnel engaged in disaster mitigation programs and studies, the education and training of personnel to staff and direct such programs and studies in developing countries, the establishment of data bases for written and oral information on past disasters and worldwide networks that link together facilities equipped with the latest devices and technology for probing the behavior of the earth's crust, air and water and the behavior of man-made structures exposed to natural hazards, as well as adequate funding and joint, international operation of all the proposed programs are the essentials not only for a successful IDNDR but for progress in disaster mitigation and control in the 21st century.