

# CONTENTS

The Problem.....	1
The Workshop.....	4
Narrative Account.....	7
Conclusions and Recommendations .....	15
Appendix 1: Participants.....	31
Appendix 2: Workshop Agenda.....	39
Appendix 3: The Indochina Global Change Network.....	45
Appendix 4: Summary Papers.....	49



## THE PROBLEM

Over the past two decades, the term El Niño has become associated with social, economic and environmental crises in many parts of the globe. El Niño events signal major departures from normal seasonal climate patterns, particularly over tropical regions. For some countries, an El Niño event is typically associated with abnormal heat and drought, for others it is persistent rain and devastating flooding.

El Niño, the Christ Child, was originally the name given by local fishermen to the annual appearance of a warm southward flowing current in the surface waters off coastal Ecuador and northern Peru during the Southern Hemisphere summer (December-February). The coastal communities also recognized that in some years the offshore waters were warmer than usual and cold nutrient-rich waters failed to return during the following year, giving a poor fish harvest with disastrous consequences on local food stocks and community welfare. Flood rains that caused loss of life and severe damage often accompanied the periods of abnormally warm coastal waters.

Now, it is the period of prolonged abnormal warming and consequent climate disruption that is referred to as an El Niño event. The related disturbance of the atmospheric circulation, that eventually creates climate extremes throughout much of the tropics and subtropics, is known as the Southern Oscillation. The overall process of Pacific warming and cooling, atmospheric disturbance and climate disruption is sometimes referred to as the El Niño-Southern Oscillation phenomenon or simply as El Niño.

In recent decades, the importance of the opposite phase of El Niño - his sister La Niña - has become more widely recognized. The cooling of the tropical Pacific also brings disruption of weather and climate to many tropical and subtropical regions. In some areas, the disruption may have even greater impacts than in the case of El Niño.

Both El Niño and La Niña events have severe impacts on the Indochina region, affecting patterns of temperature, rainfall and other weather variables such as the frequency of tropical storms. While some consequences may be beneficial, adverse effects on agricultural production, water supplies, flood and storm occurrence and other determinants of human well-being and economic health frequently occur.

*For development of sectoral strategies to mitigate the impacts and to take advantage of any favourable opportunities during El Niño events, it is essential for each country to have access to global, regional and national climate monitoring products.*

William Kininmonth

At this time, the capacity of the nations of Indochina to protect local peoples, natural ecosystems and national economies against the impact of El Niño and La Niña is limited. Historic means of coping with natural hazards, developed over centuries and millennia, are severely stretched as climate extremes coincide with societal developments that increase the vulnerability of regional populations and economies.

The needs of the region are many and diverse - to ensure access to adequate human, technical and financial resources, to develop the scientific and decision-making infrastructure, to put in place the necessary communication channels between relevant governmental agencies and other stakeholders, including local communities, to promote awareness amongst stakeholders and the general public, to strengthen response strategies at the regional, national and community levels...

The Indochina Global Change Network was formed to strengthen the scientific capacity of the focal nations of Cambodia, Laos and Vietnam to respond to the multiple threats posed by global environmental change and related hazards. The Network is dedicated to the ideal of sustainable development, meeting present-day needs while ensuring environmental security across both space and time.

The workshop *The Impact of El Niño and La Niña on Southeast Asia* was organized by the Indochina Global Change Network to assist the scientific communities of the nations of Cambodia, Laos and Vietnam, and the other nations of Southeast Asia, to play their part in strengthening the capacity of the region to respond effectively to the impact of El Niño and La Niña.

While the focus of the workshop discussion was the response to the impact of the short-term, interannual phenomena of El Niño and La Niña, strengthening the capacity to respond to present-day hazards also represents an effective precautionary response to the longer-term threat of global environmental change, specifically the global warming and related climate change and sea-level rise induced by human activity. If we can cope with present-day climate impacts more effectively then

we will be better equipped to manage the long-term threat of climate change and the many other adverse effects of human activity.

The workshop was organized by Nguyen Huu Ninh, Mick Kelly and Sarah Granich on behalf of the Indochina Global Change Network in order to address these critical issues and, thereby, support efforts to promote sustainable patterns of development.

## THE WORKSHOP

The workshop *The Impact of El Niño and La Niña on Southeast Asia* considered the implications of El Niño and La Niña events for Southeast Asia. Participants drew particular conclusions regarding capacity strengthening needs for the nations of Cambodia, Laos and Vietnam, the focal nations of the Indochina Global Change Network, in order that these nations are able to respond more effectively to adverse impacts and take greater advantage of beneficial effects. They also gave serious consideration to the position of the other nations of Southeast Asia. Other aspects of short-term climate variability also affect the area and these, too, were discussed at the meeting.

The workshop took place against a backdrop of changing conditions in the key El Niño indicator regions of the Pacific Ocean and this provided a strong focus for discussion of the role of the scientific community in promoting and supporting the wider national and regional response.

The specific question the workshop addressed was - How can the nations of Indochina, and the other nations of Southeast Asia, improve their understanding of the El Niño and La Niña phenomenon so they can predict and anticipate impacts and respond more effectively, thus protecting human life and economic health?

The meeting brought together invited representatives of the scientific and decision-making communities from the focal Indochina Global Change Network nations of Cambodia, Laos and Vietnam and other countries in Southeast Asia with experts from outside the region to assess current understanding and to consider how the scientists of this region, in particular, might promote effective responses. There was strong representation at the meeting from the Southeast Asian meteorological and climatological communities and experts in sectoral concerns, such as agriculture and water supplies, as well as policy analysts and policy makers also attended. The full participants list is given in Appendix 1.

The agenda for the meeting drew on previous discussions with policy makers in the focal nations regarding their views on capacity strengthening priorities and on experience of the most recent El Niño and La Niña events.

*We underscore the need for wider use of training resources, development of training and public awareness programmes.*

Laos delegation

The meeting considered three specific themes:

- *Impact assessment* - How is the climate of the region affected, including the monsoon circulations? What are the sensitive sectors (agriculture, water supply, coastal protection, natural disasters and so on)? Are there positive as well as negative impacts?
- *Prospects for prediction* - What seasonal climate forecasts are available internationally and how reliable are they? Are these forecasts used in the region? What monitoring and prediction schemes have been developed within the region? How can forecasting capacity be improved? Can forecasts be effectively used?
- *Responding to El Niño and La Niña* - What needs to be done to promote effective response strategies in the region? What can participants at this meeting do to promote an effective, precautionary response to the latest predictions of the likely breakdown of the prevailing La Niña event.

Invited papers identified key conclusions, issues, trends, resources and capacity strengths and weaknesses, providing a sound basis for discussion during the working group sessions. During intensive working group sessions, conclusions and recommendations, including specific action points for the participants, were developed. The agenda for the meeting is presented in Appendix 2.

The workshop took full account of the various initiatives established by national and international organizations and programmes and focused on action that the participants themselves could undertake or promote in the near future.

By sharing experience both within the Southeast Asia region and further afield, by providing a forum for discussion, by providing access to resources available from the international community, and through specific recommendations for action, it is hoped that the workshop has taken a modest step towards enhancing the region's capacity to respond effectively to El Niño and La Niña and, in the longer-term, global environmental change.

*Policy makers and the public must be educated and informed on the seriousness of the potential impacts of El Niño and La Niña.*

Cambodia delegation

The meeting was an activity of the Indochina Global Change Network, funded by the Asia-Pacific Network for Global Change Research and sponsored by the Vietnam Union of Science and Technology Associations. It was organized by the Center for Environment Research Education and Development, Hanoi, Vietnam, with the assistance of the University of East Anglia, Norwich, United Kingdom, and was held at the Fortuna Hotel, Hanoi, Vietnam, from February 21st-23rd 2000.

Alongside this workshop report, two briefing documents for scientists and policy makers will be made available by mid-2000 as a result of the meeting.



## **NARRATIVE ACCOUNT**

The workshop consisted of two half-day sessions of invited papers covering the three themes of the meeting: impact assessment, prospects for prediction; and responding to El Niño and La Niña. The remaining three half-day sessions were devoted to working group discussions on these three themes (participants were split into two parallel working groups for each discussion) and plenary report-back. In this section, brief accounts are given of the invited papers. Summary papers are given in an appendix to this report. Complete papers or related publications can be obtained from the authors. The workshop conclusions and recommendations are presented in the following section.

Dr. Nguyen Huu Ninh (Center for Environment Research Education and Development) opened the workshop on behalf of the Indochina Global Change Network and welcoming speeches were then delivered by Professor Academician Vu Tuyen Hoang (Chairman of Vietnam Union of Science and Technology Associations), Dr. Vu Minh Mao MP, (Vice-Chairman, Committee on Science, Technology and Environment, National Assembly of Vietnam), Dr. Mick Kelly (University of East Anglia, UK) on behalf of the workshop organizers (Dr. Nguyen Huu Ninh, Dr. Mick Kelly and Ms. Sarah Granich) and Dr. Gerhard Breulmann (Asia-Pacific Network for Global Change Research)

Dr. William Kininmonth (Australasian Climate Research , Australia) presented a global overview of the El Niño-Southern Oscillation phenomenon, describing the physical basis of the process and its impacts world-wide. Understanding of the mechanisms underlying the phenomenon is well-advanced and extensive monitoring and prediction is now undertaken to provide early warning of developments. The impacts of El Niño and La Niña occur throughout the tropical and subtropical belts though the effect on climate varies from region to region. He emphasized the need for each country in Southeast Asia to have access to global, regional and national monitoring products and the need for cooperation at the regional level.

Mr. Sidup Bin HJ Sirabaha (Brunei Meteorological Service, Brunei) discussed the impact of El Niño and La Niña on Southeast Asia. The climate effects are diverse and widespread but more needs to be done to define the precise response of the Southeast Asian climate, particularly at the national and local level. The losses due to the 1997/98 El Niño amounted to more than US\$1.38 billion and considerable human suffering occurred as a result of food shortages, landslides and persistent smog. He advanced various areas in which regional capacity needed to be strengthened.

*There are major requirements needed in capacity building before an effective systems approach to climate forecasting can be realized.*

Roger Stone

Dr. Hoang Minh Hien (Hydro-Meteorological Service of Vietnam) reported on recent work on the effect of El Niño and La Niña on the occurrence and characteristics of tropical cyclones in the Western North Pacific, Bien Dong Sea and the coast of Vietnam. The impact of La Niña on the typhoons which make landfall on the Vietnamese coast is more serious and more complicated than the effect of El Niño. In La Niña years, the number of storms making landfall is higher, affecting the south of the country in particular during the latter months of the typhoon season.

Mr. Sengdeuane Phomavongsa (National Disaster Management Office, Laos) presented a report on El Niño impacts on Laos on behalf of his nation's delegation. He noted that floods and droughts are a regular occurrence in his country but observed that particular droughts do seem to be associated with El Niño, causing low river flow and water supply shortages, especially for rice production during the dry season. He underscored the need for regional cooperation, stronger regional information systems, including warning systems, a wider use of training resources and public awareness information and the sharing of experts.

Mr. Mak Sideth (Ministry of Environment, Cambodia) discussed the situation of Cambodia with regard to El Niño and La Niña impacts on behalf of his country's delegation. He observed that there had been very little work undertaken on this topic in Cambodia but noted that related concerns include forest loss, flooding, less predictability in the weather, atmospheric pollution and climate change. Dependence on rice production makes Cambodia particularly vulnerable to any change in climate conditions, whether seasonal or long-term, and it is very important to strengthen the ability to respond to climate variability.

Mr. U Tun Lwin (Department of Meteorology and Hydrology of Myanmar) described the impact of El Niño and La Niña on Myanmar. The effect of El Niño is apparent in temperature, rainfall and drought indices and affects monsoon climatology. As an agricultural nation, any change in monsoon rainfall is also of great importance to this country. During major La Niña events, the monsoon is weakened and minimum temperatures fall far below normal. He called for better understanding of

*We need to develop education and training of scientists and decision makers skilled in the use and interpretation of new forecast capabilities and analysis techniques.*

Nguyen Van Thang

the impact of El Niño and La Niña on Myanmar and for further research globally on this phenomenon.

Dr. Simon Mason (University of California at San Diego, USA) discussed forecasts of the El Niño-Southern Oscillation phenomenon, describing their production and assessing their accuracy. There are two main means of predicting El Niño and La Niña: statistical methods and dynamical, model-based, techniques. Both approaches have strengths and weaknesses, related to the level of physical understanding on which they are based, technological and financial requirements, and the nature of the forecast product. He observed that both types of forecasting method perform about equally well but each one is appropriate for different circumstances. For Southeast Asia, statistical forecasting represents a good starting point but access to, and skill in interpreting, the products of model-based forecasts is also essential.

Dr. Roger Stone (Queensland Centre for Climate Applications, Australia) described two prediction methods in use in Australia. He proposed an efficient and practical approach using observed values of the Southern Oscillation Index or sea surface temperatures to predict future temperature and rainfall and, hence, secondary impact variables such as crop yields. This method might be particularly appropriate at this time for many of the meteorological services in Southeast Asia experimenting with seasonal climate prediction. He stressed the need for an overall systems approach, staff trained in relevant statistical and analytic techniques and the engagement of forecast users in all stages of the forecast process.

Professor Wang Shaowu (Peking University, PR China) described the historical development of the seasonal forecasting techniques that have been applied in China since the late 1950s. Statistical methods, informed by physical understanding of the processes that are involved, are now employed to predict a range of seasonal variables. There have been notable successes. The severe flood on the Changjiang River in the summer of 1998, for example, was successfully predicted. But, he concluded, knowledge is far from complete and the variable skill of the statistical forecasts, which may be the result of the varying influences on seasonal climate, must be understood. There is hope

*There is an urgent need to strengthen capabilities at national and regional levels for effective emergency preparedness, prevention, mitigation, response, and recovery.*

Sanny Jegillos

that the ongoing development of dynamical models, used to accurately predict summer rainfall in recent years, may prove a significant advance.

Dr. Nguyen Van Thang (Climate Research Center, Vietnam) discussed the development of a seasonal climate forecasting capability in Vietnam. Dynamical-statistical methods of prediction are used to forecast parameters such as winter season temperature, Hanoi rainfall, summer rainfall and the onset of severe cold in the winter. Medium-range (10-day) forecasting is also being developed. There is no specific dynamic climate prediction model available in Vietnam. At this time, climate prediction is considered experimental, rather than operational, but considerable efforts are being made to improve databases, identify physically-plausible predictors and evaluate skill levels so that forecast capacity can be strengthened.

Ms. Louise Bohn (University of East Anglia, UK) described research undertaken in Swaziland in southern Africa which has attempted to define user needs and the value of climate forecasts. She stressed the importance of considering user needs throughout forecast development. Timelines, charting month-by-month user operations, decisions and sensitivity to climate conditions can act as an effective guide in the assessment of requirements. Finally, she emphasized the various physical and human constraints that determine, in the real world, whether a forecast will be taken seriously and, indeed, whether it has any value at all.

Professor Tran Thanh Xuan (Institute of Meteorology and Hydrology, Vietnam) discussed the experience of the two big floods that occurred in central Vietnam towards the end of 1999. In some rivers, the flood levels were the highest seen in the past 70-100 years. Serious damage occurred for people and properties in the coastal provinces of central Vietnam. According to preliminary estimates, there were 700 killed and missing people and total economic losses reached 4.7 billion VND (US\$ = 14,000 Vietnamese Dong). The floods also changed the natural environment, eroding mountains and riverbanks, filling cultivable land with sediment and creating new estuaries. The events of November and December 1999 may or may not have been generated by La Niña (which

*The World Meteorological Organization has recommended to all nations that any accurate forecasts for tropical storms would become meaningless if the necessary steps for protection were not taken.*

Duong Lien Chau

generally brings increased rainfall to central Vietnam) but most certainly highlight the need for strengthened disaster management, here and in other nations.

Dr. Duong Lien Chau (National Center for HydroMeteorological Forecasting, Vietnam) described the impact of a previous disaster affecting southern Vietnam: Tropical Storm Linda in November 1997, the most disastrous tropical storm this century in Vietnam. While the progress of Linda was forecast accurately and warning issued promptly, the unusual nature of this storm (such a strong storm rarely occurs in the affected region and it struck at high tide), communication problems (particularly with fishermen at sea) and lack of awareness amongst the local communities and of experience in relief and rescue activities heightened its impact with thousands of lives lost, livelihoods destroyed and considerable economic damage. She noted that lessons had been learnt from the experience of Tropical Storm Linda and that the Government of Vietnam has carried out a series of activities aimed at the reduction of damage and minimizing the loss of human life.

Mr. Sanny Jegillos (Asia Pacific Disaster Management Centre, Philippines) described the priorities in managing risks associated with El Niño and La Niña. Natural and human-induced disasters have had a devastating effect on the people of Asia and on national economies. In Southeast Asia, disaster-related issues are increasingly linked to growing environmental degradation, population growth, poverty and unplanned rapid industrialization, compounded by economic slowdown and shrinking public budgets. Responding to El Niño and La Niña impacts is still largely reactive, hampered by poor cooperation between neighbouring nations as well as heavy reliance on international humanitarian assistance. There is now, though, a shift towards a more proactive response, towards a development approach that incorporates hazard mitigation and vulnerability reduction. He outlined the key aspects of this ‘disaster risk management approach’ and stressed the need for regional cooperation.

During the course of the working group sessions, short presentations were made by Dr. Ooi See Hai (Malaysian Meteorological Service), Dr. Aida Jose (Climatology and Agrometeorology Branch, Philippines) and Dr. Patipat Patvivatsiri (Meteorological Department, Thailand) on the impact of El

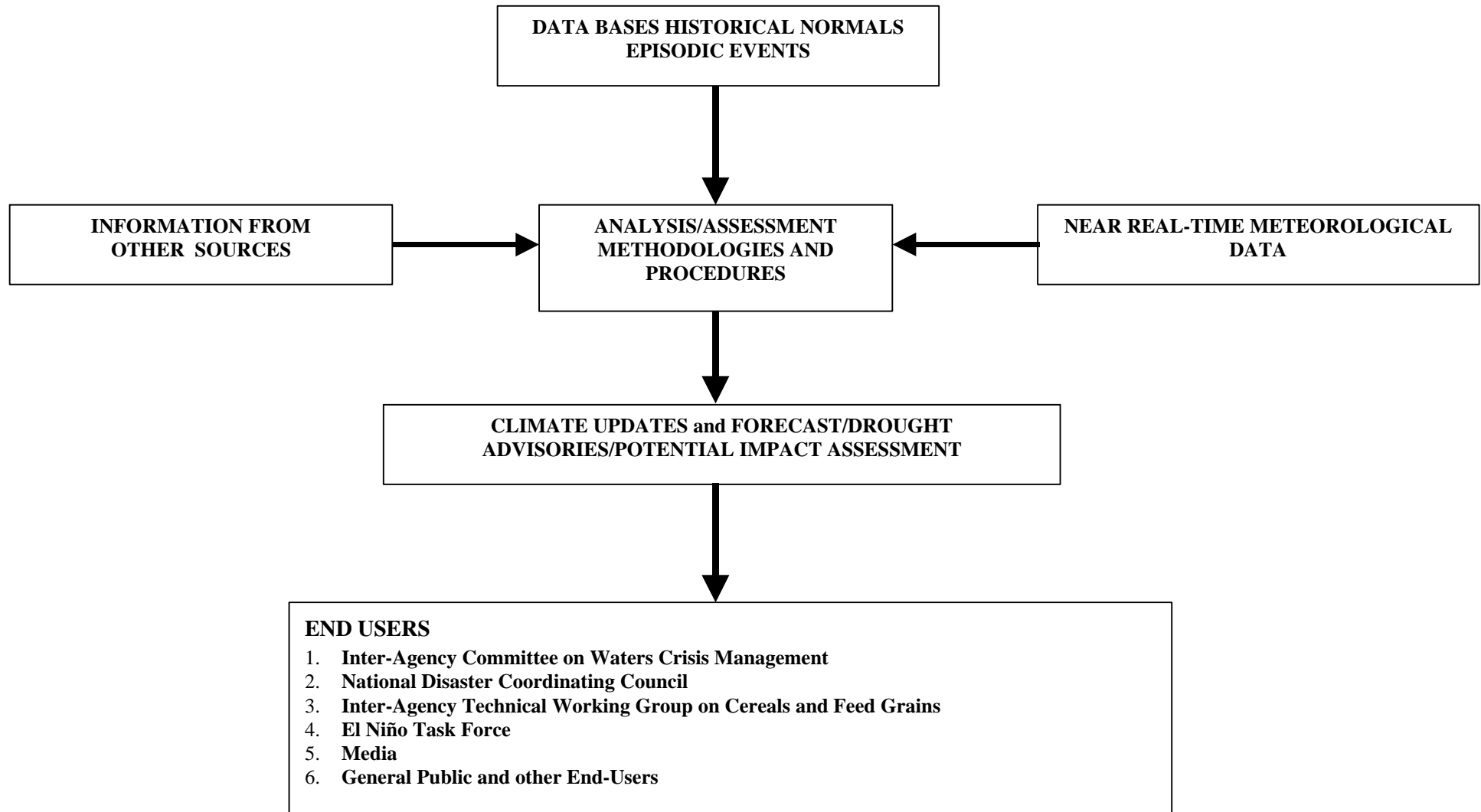
*Disasters are truly cross border issues, and their management is a matter of concern for all countries situated in vulnerable areas and beyond.*

Sanny Jegillos

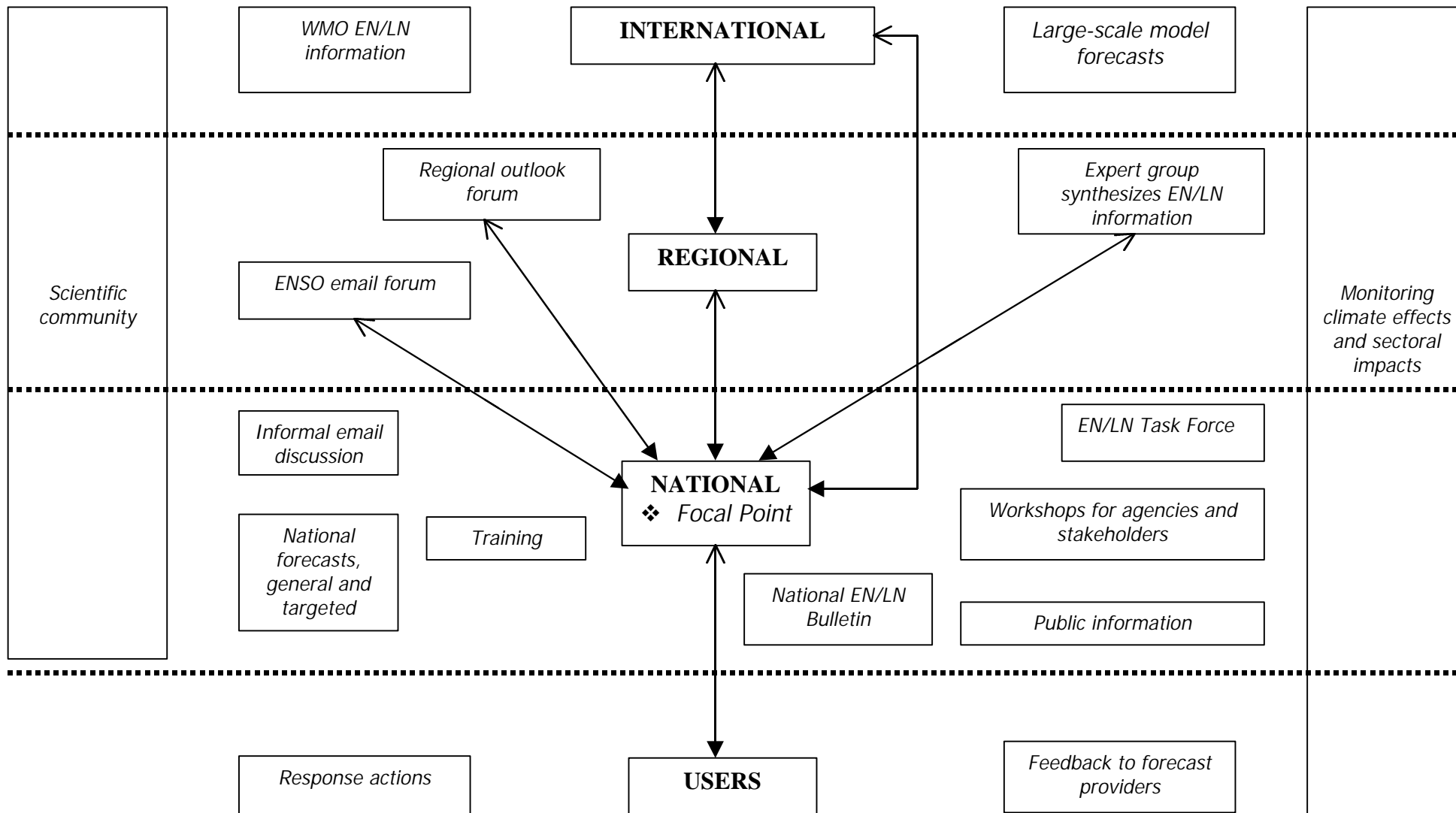
Niño and La Niña and associated research in their respective countries. Dr. Nguyen Van Viet (Institute of Meteorology and Hydrology, Vietnam) described the significant impact of El Niño and La Niña on rice production in Vietnam. Dr. Aida Jose discussed work on monitoring and early warning in the Philippines and Dr. Le Van Sanh (Vietnam Committee for the International Hydrological Program) presented an account of the recommendations of the Vietnam Committee for the International Hydrological Program with respect to the El Niño-Southern Oscillation phenomenon.

During the closing session of the workshop, Dr. Nguyen Huu Ninh and Dr. Mick Kelly summarized the development of the Indochina Global Change Network and plans for the next phase of activities, which will focus on training workshops covering climate prediction, impact assessment and land-use and land-cover change, were endorsed by the workshop participants. The aims and principles of the Indochina Global Change Network are presented in Appendix 3. Finally, after a vote of thanks from Dr. William Kininmonth on behalf of the workshop participants, expressing gratitude to the staff on the workshop registration desk, the staff of the Fortuna Hotel and the workshop organizers, Dr. Nguyen Huu Ninh closed the meeting, thanking the Asia-Pacific Network for Global Change Research for their support and the participants for their very active involvement.

In recognition of the significance of the workshop, a formal reception was held on the first evening at the Office of the National Assembly of Vietnam, hosted by the Vice-Chairman of the Committee on Science, Technology and Environment of National Assembly of Vietnam, during which the issues before the meeting were discussed. The reception was followed by dinner at the Hilton Hanoi Opera Hotel. On subsequent evenings, dinner was held at the Cha Ca La Vong and Lau Tu Xuyen restaurants. Dr. Nguyen Cong Thanh, Director-General of the Hydro-Meteorological Service of Vietnam was the honoured guest on the final evening.



*Components of the National Drought Early Warning and Monitoring System in the Philippines. Presented by Dr. Aida Jose.*



*Resources, proposed activities and information flow regarding El Niño (EN) and La Niña (LN) at and between the international, regional and national levels. Solid arrow head: Forecast, monitoring and other scientific information. Open arrow head: Feedback.  
Prepared by Louise Bohn, Mick Kelly and Luong Quang Huy on behalf of the workshop participants.*



## CONCLUSIONS AND RECOMMENDATIONS

### Preamble

Climate extremes are a major cause for loss of life, destruction of infrastructure, depletion of food and water resources, displacement of communities, outbreak of disease and economic hardship around the globe. El Niño and La Niña events are the most important cause of climate extremes lasting from a season to a year or more in the tropics and subtropics. Responding effectively to the challenge posed by these events is essential if sustainable development is to be secured.

The workshop participants recognize the important step the United Nations has taken through Resolution 52/200 in calling for action to develop a strategy to mitigate the harmful effects of the El Niño and La Niña phenomena and to develop capabilities to better manage the impacts of climate extremes.

The workshop participants recognize the significant contribution of the scientific and technical assessments of the 1997/98 El Niño event made by the World Meteorological Organization and other United Nations agencies to review human dimensions and implications for policy development, as documented, for example, in report WMO-No.905.

The workshop participants also recognize the contribution made by other agencies, as evident in the International Decade for Natural Disaster Reduction and other international and regional initiatives, in promoting the development of response strategies with regard to natural disasters, some of which are directly caused by El Niño and La Niña events.

Finally, the workshop participants recognize Decision 10/CP5, resulting from international efforts to implement the UN Framework Convention on Climate Change, which calls for capacity building in developing countries to promote an effective response to the threat of long-term climate change induced by human activity. The participants emphasize that developing effective response strategies to manage short-term climate impacts represents a critical, precautionary step in responding to long-term change. The participants also note that Decision 10/CP5 states that the capacity-strengthening process “must be country-driven, reflecting their national initiatives and priorities, and that it is primarily to be undertaken by developing countries and in developing countries in partnership with developed countries.”

With this in mind, the workshop participants arrived at the following conclusions and recommendations. Most of the conclusions and recommendations concern all nations of the Southeast Asia region, though, in keeping with the workshop's purpose, specific attention was paid to the particular situation of Cambodia, Laos and Vietnam.

### **Impact assessment**

The workshop participants concluded that El Niño and La Niña have an extremely serious impact on Southeast Asia, with some of the most important impacts relating to typhoons, flooding and drought with seasonal incidence, frequency, severity and timing affected.

The overall severity of El Niño and La Niña impacts on the countries of the region is beyond question. Impacts can be readily observed in terms of human suffering and economic loss. Nevertheless, over the region as a whole, there are many different climatological effects and societal consequences that may be completely opposite in sense and differ significantly in timing from one area to the next.

Many countries report that the most severe impacts are in the agricultural sector through flooding and drought. Some countries report severe impacts on water resource availability affecting hydroelectric power generation and domestic and industrial consumption. Impacts on transportation, fisheries, population movements and health also occur.

It is apparent that there are both positive and negative impacts. Even a single effect on climate may have diverse consequences. A greater frequency of tropical storms, for example, may bring essential rain for crop development whilst causing serious dislocation to the same agricultural system through storm damage and flooding.

Local factors such as topography can mitigate, reinforce or transform the overall pattern of climate disruption and this process must be better understood. Relatedly, some areas are more sensitive to impacts than others. In Vietnam, for example, it is the central region of the country that appears most sensitive to El Niño and La Niña.

The workshop participants noted that sensitivity to climate extremes can be exacerbated by human activities such as deforestation and land clearing (increasing runoff and erosion), building of dykes (restricting flow and adding to flooding) and over-reliance on inadequate and fragile infrastructures, especially for housing, food storage and transport of goods. This process, too, needs to be monitored and understood.

The workshop participants concluded that, although much work had been done already in the region, improved understanding the geographical and temporal distribution of effects on climate and societal consequences on Southeast Asia must be a priority. Furthermore, in view of the difficulties in responding to extreme El Niño and La Niña impacts following in close succession, as has recently been experienced, the participants called for increased efforts to understand the effects of long-term climate change on the characteristics - the frequency, magnitude and regional effects - of these phenomena.

Finally, workshop participants noted that El Niño and La Niña are processes of global dimension with cross-border impacts, underlining the need for cooperation between the nations of the region. Neither El Niño nor La Niña respects national frontiers.

- It is recommended that more studies be undertaken at the country-level to define the complex spatial and temporal variability of the effect of El Niño and La Niña on climate. The availability of national climate records is an essential prerequisite to support such studies.
- It is recommended that research be undertaken to identify more precisely which aspects of regional climate variability are related to El Niño and La Niña and which to other processes. Without this information, the simple application of El Niño-based forecasts may be risky.
- It is recommended that more impact studies are undertaken to quantify social and economic consequences and the processes that link climate effects to sectoral impacts. This information will support accurate assessment of the scale of the problem, the effective allocation of resources, and the development of a rational response strategy. Such studies should cover sectoral indicators (agriculture, water supplies, storm damage to infrastructure, health, and so on) including both economic estimates and broader measures of human welfare. It is noted that economic estimates are of particular importance in mobilizing governmental and intergovernmental support.

- The collection and archiving, in readily-accessible format, of relevant biophysical and socio-economic data, covering, for example, crop production, health, storm damage and losses and emergency assistance, is essential to monitor quantitatively impacts and develop appropriate policies and strategies for mitigation.
- It is recommended that training opportunities in climate impacts assessment be increased, covering both biophysical and socio-economic aspects, to support expanded study of El Niño and La Niña impacts.
- It is recommended that significant input be obtained from end users, from government ministries through to individual farmers, regarding their perception of impacts to determine precisely what information is needed concerning climate effects and impacts on sectoral activities to support the development of effective response strategies.
- It is recommended that more attention is paid to how El Niño and La Niña characteristics (frequency, magnitude, regional effects) are related to natural climate trends and, in the longer-term, to the effects of climate change induced by human activity. Additional research and expertise on this issue is needed not only within the region but also world-wide.
- It is recommended that training courses, workshops and fellowships are organized to assist the research community of Southeast Asia to take advantage of the latest techniques and analyses available internationally for the identification of climate effects and sectoral impacts and that, through this process, the scientists of the region share their own experience and expertise with other nations.
- It is recommended that scientists involved in the study of the El Niño and La Niña phenomena actively engage with the policymaking community in order to disseminate appropriate information and promote awareness of the need for an effective response.
- It is noted that the scientific community has a clear responsibility to convey information and findings within each country and in regional fora to all stakeholders - politicians, government agencies, end users in agriculture, industry and so on, the media and the general public. Because

of the widespread nature of the consequences of El Niño and La Niña, the stakeholder community should be considered to extend across the entire population.

- Finally, it is necessary to emphasize that not all the impacts of climate variability are negative and that an effective response strategy must contain elements directed towards taking full advantage of potentially beneficial effects as well as mitigating adverse consequences.

### **Prospects for prediction**

The workshop participants noted that monitoring of climate developments and societal impacts is a critical prerequisite for an effective response strategy for El Niño and La Niña. They also concluded, with concern, that in some, if not many, countries no point of responsibility for these important activities exists.

Maintaining and, where appropriate, strengthening weather and climate monitoring networks throughout the Southeast Asian region is of critical importance if early warning systems are to be successful.

Over 700 stations in Vietnam are already monitoring effects on climate. However, there is a need for improvements in certain monitoring devices and data sources such as radar and satellite-based systems. The situation with regard to monitoring is not so good in Cambodia and Laos and this point requires attention.

The workshop participants emphasized that regional cooperation between national meteorological agencies in sharing data, information and techniques is essential to support an effective response whether at the national or regional level.

The situation with regard to monitoring sectoral impacts, on agriculture, water supplies and so on, requires attention in many countries. While impacts are generally reported, there is no coherent mechanism for collating this information and ensuring an appropriate degree of consistency.

The workshop participants concluded that, while climate prediction on the monthly and seasonal timescales is, for the most part, at an experimental stage, forecasts can, if developed and disseminated with due care, prove an essential component of the response to El Niño and La Niña.

The development of a monthly to seasonal climate forecasting capability should be pursued in all nations of the region.

Climate forecasts can be made by statistical or dynamical, usually model-based, methods. For many of the nations of the Indochina region, statistical forecasting represents an appropriate first step in developing a local predictive capacity. Attempts to forecast directly secondary impact variables, such as agricultural yields, rather than, say, rainfall (often a very difficult variable to predict) may prove worthwhile in situations where that secondary variable integrates over time what may be diverse climate effects. Exchange of ideas and techniques between nations must be an important component of the development of forecast capacity.

Model-based forecasts, developed by regional groups or the broader international community, can also be of considerable value and every effort should be made to access, and most importantly acquire the skills to interpret, these products. These forecasts provide the first warning of developments within the global climate system that may lead to an El Niño or a La Niña event, its progress and ultimate breakdown.

Finally, the workshop participants emphasized that there is a critical need to involve forecast users in the process of forecast development. Too often, forecasts are issued in an inappropriate form or without adequate information to enable reliable end-use. Without this involvement, it is unlikely that forecasts will be effectively used, to the detriment of all concerned.

- It is recommended that all countries continue to maintain and upgrade, as necessary, their weather and climate monitoring facilities and that appropriate agencies also take responsibility for monitoring of El Niño and La Niña impacts. Particular attention should be paid to the situation in Cambodia and Laos.
- It is noted that, given the widespread nature of effects on climate and their geographical progression, regional cooperation must continue to ensure appropriate exchange of meteorological and climatological data within the Indochina region and between all the nations of Southeast Asia in support of region-wide monitoring and early warning. Data exchange should be carried out in real-time whenever possible. The distribution of data on-line should be pursued

in order to achieve more efficient data exchange, though this will require the expansion of Internet access in certain countries.

- It is recommended that further means of funding data exchange should be pursued with international agencies such as the World Bank and other international bodies, programmes and initiatives. The Grant Support Scheme to Protect the Mekong River, for example, should be encouraged to develop, or modify existing, data collection or dissemination systems relevant to the impact of El Niño and La Niña.
- It is recommended that monitoring of the state of the global climate system be ongoing in all countries of the region - the most accurate 'forecasts' of the occurrence of El Niño and La Niña at this time are derived from direct observations of key indicators - and that extra effort be made to place the potential impact into a regional context. Access to information on El Niño and La Niña should be facilitated by the Internet and, in this context also, access to the Internet should be expanded, where necessary.
- It is recommended most strongly that useful statistical forecasts be developed as a matter of urgency in the Indochina nations. Vietnam, for example, though pursuing energetically seasonal forecasting using statistical techniques, does not believe it has forecasts of sufficient skill for public delivery. Yet this capability is available elsewhere and valuable lessons may be learnt from international experience. Seasonal forecasts of local rainfall, temperature, floods and storms should be given high priority, with prediction of selected secondary (that is, impact) variables, such as crop yields or water availability parameters, explored.
- It is recommended that every effort be made to access, and to gain the skills to interpret in the local context, the dynamical predictions of the El Niño-Southern Oscillation phenomenon and the related occurrence of El Niño and La Niña events that are now available. The skills to interpret these forecasts reliably, assessing their local implications, are essential because of the multiplicity of predictions that are available and their large-scale and temporally-averaged nature.
- It is recommended that research be undertaken to develop ways of 'downscaling', through statistical means or regional models, the dynamically-produced large-scale forecasts to a regional, national and local scale. Similarly, generalized seasonal forecasts must be interpreted in

terms of synoptic-timescale processes (for example, the onset and decay of the rainy season) until a seasonal predictive capability that generates synoptic-scale information directly is developed.

- It is recommended that efforts are made to ensure that those concerned with developing dynamical predictive schemes in the major centres recognize the strong demand for localized and synoptic-scale forecasts and that, despite the technical challenges this will involve, devote considerable efforts to extending performance in this area.
- It is recommended that, whatever the predictive technique that is used, due attention be paid to the estimation of levels of forecast skills. Skill estimates should be made available to users as an intrinsic part of forecast delivery and may be designed to reflect user interests (for example, expressed in terms of secondary, impact variables).
- It is recommended that an assessment be carried out in the Indochina nations to determine training needs with regard to forecast capacity.
- It is recommended that local meteorologists and climatologists gain experience of interpreting model-based forecasts by working 'on the bench' in modelling institutions during the actual production of these forecasts.
- It is recommended that the World Meteorological Organization be formally approached by national meteorological services, and other organizations such as forecast groups in China, Japan, Australia, the United States, the United Kingdom and elsewhere contacted on an informal basis, to provide El Niño and La Niña assessments in advance to the countries of the region. It is recognized that the preparation of operational assessments of this nature may not be considered to be within the existing remit of the World Meteorological Organization and will have resource implications. Nevertheless, El Niño and La Niña represent a global problem, requiring a high degree of international cooperation such as is already manifest in support for this agency. Moreover, the multiplicity of forecasts, at times divergent and of varying reliability, warrants the intervention of a single, authoritative agency to provide a clear guide to reliability and community consensus. Furthermore, the World Meteorological Organization is encouraged to hold: 1) an expert meeting; and 2) a sessional meeting on El Niño and La Niña during the year 2000.



- It is recommended that a small regional task force be established to interpret the many forecasts available from the international scientific community and make this information available at the national level in the Southeast Asia region. A roster of experts should also be established to exchange information, views and forecasts regarding El Niño and La Niña. This process may be facilitated through the development of an e-mail list or similar and could result in a regular outlook bulletin.
- It is recommended that regular, regional climate fora be held in Southeast Asia to review developments and exchange ideas, with each country actively involved.
- It is recommended most strongly that climate forecasts be developed in both generalized and targeted formats. While generalized climate forecasts will be of interest to some user groups, more targeted climate forecast information relevant to the more precise needs of users (in agriculture, water supply, natural disaster planning and so on) must also be developed. Accordingly, action should be taken by forecast providers and others to identify just who are the relevant user groups.
- It is noted that, if climate forecast information is to be used effectively, users must gain ‘ownership’ of forecast products. Discussion groups involving forecast providers and forecast users should be established so that appropriate and effective feedback and interaction occur. It is recommended that scientists from data and forecast centres go into the field and interact with users at all scales to appreciate user needs.
- It is recommended that the necessary expertise be gained and, perhaps, a task group be set up in each country to interpret model-based dynamical forecasts models for local user needs, translating effects on climate into estimates of potential sectoral consequences.
- It is recommended that, through workshops or other means, users become familiar with probabilistic forecast information. This is necessary because of the potentially greater value of probabilistic information compared to forecasts expressed as a single definite outcome.

- It is recommended that efforts be made to ensure that end users and policy makers respond positively and appropriately to forecast information, so achieving maximum benefit. This may require changes in practice and attitude. Studies are required to identify the most appropriate responses. There are diverse biophysical and socio-economic constraints on user responses; these constraints must be addressed directly if forecasts are to be used effectively.
- Finally, it is recommended that strenuous efforts be made to raise general public awareness of the availability and meaning of El Niño and La Niña assessments and forecasts.

### **Responding to El Niño and La Niña**

Recognizing that the coming months may prove a critical period in the development of conditions in the key El Niño indicator regions of the tropical Pacific, workshop participants took the decision to focus on what is needed to prepare the ground for a concerted response to avert the effects of the next major development in the El Niño/La Niña process, whenever that should occur. Specific action points are outlined in the following section. Here, more general conclusions and recommendations are advanced.

The workshop participants noted that awareness of the significance of El Niño and La Niña is far higher in the region as a result of the events of the past few years and that there is considerable regional experience and expertise in coping with related hazards gained through historical time. Nevertheless, it is clear that much must be done to improve existing response strategies.

The workshop participants strongly endorsed moves towards a proactive approach to managing the impact of climate hazards in general and the impact of El Niño and La Niña in particular. The development of effective national and regional frameworks to facilitate prompt action is essential.

The workshop participants noted that three issues - improving communications at all levels, mobilizing government support, and raising the awareness of key stakeholders and of the public at large - must be acted upon with some urgency to lay the groundwork for an effective response.

The workshop participants recognized the critical role the scientific community must play through the provision of sound, technical advice.

Finally, the workshop participants noted that any activities should be undertaken in full awareness of, and coordinated with, efforts already being undertaken by institutions such as the United Nations, the Food and Agriculture Organization and other international, regional and national organizations.

- It is recommended most strongly that communication channels within each nation, and between the nations of the region, be opened with some urgency and cover all responsible agencies and sectoral interests both within government, the private sector and wider community. Integrated systems management must be a critical aspect of an effective response strategy; the cooperation that is necessary can only be ensured when communication channels are fully open and operate without distortion.
- It is recommended most strongly that, with government support, a national focal point within an appropriate agency be established in each country. Each focal point will maintain an information database available to national users and will act as a link point for international support, information dissemination and the mobilization of national and international experts. The national focal point could also act as a communication point for a regional network covering the Indochina region or Southeast Asia as a whole.
- It is recommended that governments and existing task forces, institutions and all stakeholders be alerted to the likely breakdown of the prevailing La Niña event, and that political commitment be mobilized to ensure an effective response to the next El Niño event, whenever that might occur. Initially, a workshop may be the most appropriate means of opening communication channels, raising awareness of the issue, encouraging participants to consider their capacity to respond and identifying constraints and barriers. At the next stage, a task force may be established to promote and coordinate activities. Every effort should be made to inform and educate those in government regarding the possibility of impacts and to encourage the development of contingency plans and a national response strategy.
- In Vietnam, it is recommended that an interagency task force be established involving the Hydro-Meteorological Service of Vietnam and other stakeholder agencies.

- In Laos, it is recommended that a specific El Niño task force be established by the Natural Disaster Management Committee and involve all stakeholders such as the meteorological, agricultural and environmental agencies.
- In Cambodia, it is recommended that a task force be established involving relevant institutions and committees such as those responsible for agriculture, hydrology, meteorology, environment, health and disaster management.
- It is recommended most strongly that these national task forces be adequately resourced and be supported by firm political commitment. Full use should be made of existing institutional structures, wherever possible, to avoid duplication of effort. Full use should also be made of existing understanding, including traditional knowledge, of response measures and strategies. These national task forces could usefully share experience with one another through the national focal points and a wider regional network.
- It is recommended that each nation assess its capacity to respond to El Niño (and La Niña) impacts. Experience of the impact of the 1997/98 El Niño event within each nation should be reviewed and an assessment made of whether or not lessons learned from that event have been acted upon as a preliminary assessment of the effectiveness of existing response strategies. The possibility of financial support to underpin the necessary further development of regional response strategies from international agencies concerned with disaster management and related issues, such as the Asian Development Bank and the World Bank, should be explored.
- It is recommended that national governments, as member states of various international organizations, encourage the development of an international policy framework or action plan on El Niño and La Niña, mirroring the development of the International Decade for Natural Disaster Reduction Action Plan for the Future, International Strategy for Disaster Reduction, and similar initiatives. National and regional strategies should be coordinated with existing frameworks and there may be benefits to further integration.
- It is recommended that El Niño and La Niña training and public awareness activities be developed and implemented covering effects, impacts and response actions. These activities will require funding from government or other sources. Where possible, materials developed

elsewhere should be used and adapted to local needs. User specific information and approaches should be employed through workshops, the media, booklets, and all other means that are available. Advantage can be taken of special occasions (such as WMO 2000, 23<sup>rd</sup> March 2000, the golden jubilee of the World Meteorological Organization) to educate the public, relevant agencies and key stakeholders regarding El Niño and La Niña by holding events, publishing articles in newspapers, issuing pamphlets, and so on.

- It is noted that any national response strategy ultimately depends on the mobilization of support and action at the community level. Care must be taken that ‘top-down’ organization does not exclude the ‘grassroots’ on which action at all levels must ultimately depend.
- It is recommended that, in each nation, a publication, entitled “El Niño Outlook” or similar, be published in the national language(s) on a regular basis and be distributed to key agencies concerned so that those agencies are kept informed of developments.
- It is recommended that full use be made of the comprehensive report *The 1997-1998 El Niño Event: A Scientific and Technical Retrospective* (WMO-No. 905, available from the World Meteorological Organization, 7 bis, avenue de la Paix, P O Box 2300, CH-1211, Geneva 2, Switzerland, fax: 41-22-7332829, e-mail: ipa@gateway.wmo.ch). This report contains valuable lessons from the last El Niño event including recommendations based on this experience, as well as a guide to the global climate system, El Niño processes and techniques for forecasting climate variability. It also provides textual and display materials that may, with due acknowledgement, be used in developing local materials.
- Finally, it should be noted that, in transmitting any information regarding El Niño and La Niña, care should be taken that the wording is not unduly alarmist but presents a carefully-crafted and authoritative assessment. There are still uncertainties in predicting these events. Moreover, even if an event does occur, there are marked differences in impacts among, and within, different countries. There are regions where signals are strong but, in others, signals are weak.

## **Action points**

Recognizing their responsibility to respond to the latest information regarding the likely breakdown

of the prevailing La Niña event, the workshop participants identified three key recommendations for immediate action that constitute a precautionary response to the latest assessment, preparing the ground for more concerted action as circumstances require.

The workshop participants noted that a more definite assessment should be available by June 2000 and strongly supported the existing proposal that a regional outlook forum be held about that time. By then, it may be possible to provide clearer guidance regarding future prospects.

The recommendations for action are that:

1. In each country, a workshop should be organized bringing together representatives from government agencies and other stakeholders to draw attention to the latest assessment, provide information about potential impacts, open channels of communication, ensure full cooperation, and mobilize support for the strengthening of response strategies, thereby facilitating further action as later developments dictate.
2. In each country, meteorological and climatological agencies should ensure prompt and continual monitoring of El Niño forecasts available internationally, and of local indicators of effects and impacts, and make this information widely available in appropriate forms.
3. Each national meteorological agency should formally request, as a matter of urgency, that the World Meteorological Organization make available regular El Niño advisory reports, as undertaken during the last El Niño event, to ensure a single, consistent, authoritative source of information. It is recognized that the preparation of operational assessments of this nature may not be considered to be within the existing remit of the World Meteorological Organization and will have resource implications. Nevertheless, El Niño and La Niña represent a global problem, requiring a high degree of international cooperation such as is already manifest in support for this agency. Moreover, the multiplicity of forecasts, at times divergent and of varying reliability, warrants the intervention of a single, authoritative agency to provide a clear guide to the scientific consensus.

Finally, the workshop participants endorsed a statement prepared by Simon Mason and Roger Stone regarding the likely breakdown of La Niña conditions. See accompanying box. This statement

presents an expert assessment of the current forecasts and is carefully worded, calling for precautionary action without being unduly alarmist. It will be used as a basis for reports to relevant agencies and stakeholders, press releases and information for the general public, prepared by workshop participants on returning to their own countries.

## **BREAKDOWN OF LA NIÑA LIKELY: NEED TO MONITOR KEY EL NIÑO INDICATORS AND OPEN CHANNELS OF COMMUNICATION**

Statement issued by participants at the workshop  
*Impact of El Niño and La Niña on Southeast Asia*  
Hanoi, Vietnam  
23<sup>rd</sup> February 2000

The latest evidence from oceanographic and atmospheric information from across the equatorial Pacific Ocean is suggesting that the current La Niña pattern will soon wane. Ocean-atmosphere model predictions, together with our understanding of the normal course of the life cycle of La Niña, suggest that the current La Niña will fade out by about June 2000.

Some predictions suggest that there is potential for warming of the ocean in the central and eastern Pacific beyond June 2000. Such warming would indicate a shift toward an El Niño phase (that is, the opposite pattern to La Niña) developing the second half of the year 2000, though of unknown magnitude at this stage.

It should be emphasized that the forecasts that are being made by some agencies of an El Niño in the Pacific Ocean this year are being produced while most indicators are still at a pre-development stage. Therefore, there still exists some time for conditions to take a different course over the next three months to May 2000.

Nevertheless, it is strongly suggested that local meteorological, climatological and other institutions, as a precautionary response to this assessment, should monitor key parameters, such as sea surface temperature and other El Niño indicators, very closely over the next three to six months in order to gauge the further potential, or otherwise, of El Niño development later this year.

It is further recommended that effective communication channels between local meteorological and climatological agencies, other relevant agencies and stakeholders in potentially-affected sectors be set up with some urgency in order to facilitate appropriate means of dissemination of warnings and other information and, if it proves necessary, more concerted action at a later date.