FRAMEWORK FOR REGIONAL COOPERATION ON SPACE TECHNOLOGY SUPPORTED DISASTER REDUCTION STRATEGIES IN ASIA AND THE PACIFIC

Study report prepared for the Meeting of Experts on Space Applications for Disaster Management

Chiang Mai, 25-28 July 2005

United Nations
ESCAP

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

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Executive Summary

Information, communication and space technologies provide the backbone to disaster management efforts. These technologies enable the development of knowledge products and critical services, which have demonstrated their vitality in early warning, risk assessment, damage estimation and emergency communications. To harness the potential in developing and least developed countries (LDCs), it is important to ensure their access to space information products and services. More important is to create enabling institutional infrastructure, which could absorb space information products and services in terms of building strong national response mechanisms, and in enhancing community resilience, their coping and adaptation strategies. Towards this, while cooperation has been the hallmark of UNESCAP, an appropriate regional cooperative mechanism (RCM) framework definition makes it work on the ground.

Globally, there are several frameworks in operation committing the access to and outreach of space information products and services in response to key natural disasters. They have demonstrated how a sense of cooperation among space agencies can be harnessed and institutionalized. While such frameworks have worked, it is time to draw lessons and move forward in the directions that will make greater impacts on all the stakeholders, including those down the line. The experiences of UNESCAP/WMO Typhoon Committee, UNESCAP/WMO Panel on Tropical Cyclones, and UNCCD networks highlight the fact that a framework at regional/sub-regional level brings in opportunities for greater integration of stakeholders in the overall process of disaster reduction and leads to further institutional networking.

Besides bringing out a set of recommendations on integrating space information products and services for disaster reduction strategies, the present study report illustrates "a regional cooperative framework". The framework embodies the key characteristics, viz., generating political will, creating operational flexibility by accommodating all future innovations, thoughts and geopolitical realities, and encouraging ownership among the multiple stakeholders. To implement the framework, the need for "projectizing" is emphasized, through identifying a set of key activities connecting the goals of RESAP with the recent regional strategy on disaster reduction taken up by UNESCAP.

The Meeting of Experts on Space Applications for Disaster Management, 25-28 July 2005, at Chiang Mai, Thailand, examined the study report. The interests and commitments of relevant countries and governmental, private, and inter-governmental institutions were taken into account to arrive at the following recommendations:

It is recognized that disaster reduction is most effective at the community level. The policy framework is to develop a cost-effective approach to address the end-user specific needs of space data and information and provide greater opportunity to integrate them into operational disaster reduction strategies.

A framework, centred on three aspects – political will, flexibility and ownership – is to be implemented by addressing collectively the goals common to a region or sub-region.

The following steps could be taken to put the proposed framework into action:

(a) Strengthening national risk assessment capabilities: Setting up regional/sub-regional networks for risk assessment (Asia-Pacific Risk Assessment Network or APRAN) by (i) identifying the project areas of common interest among the stakeholders, including the donors, (ii) devising regional action plans for APRAN for floods and

drought in different region/sub-regions (APRAN 1, APRAN 2, etc.), and (iii) establishing operating principles (shared responsibility, linkages and participatory approach);

(b) Integrating space technology applications in and Early Warning System: Developing strategic actions that could facilitate integrating space components in a multi-hazard warning system based on national and regional requirements;

(c) Promoting forums of EO satellite operators for disaster management: UNESCAP to support a forum of EO satellite operators in the Asia-Pacific region (China, India, Japan, Republic of Korea, Thailand, and progressively others) to work together, in the framework of cooperation and information sharing, in order to help LDCs by providing EO products in a participatory manner, and by sharing of knowledge and expertise, including capacity-building;

(d) Promoting communication-satellite-based emergency communication: UNESCAP and APSCC to work with ITU and other relevant stakeholders to explore the possibility of (i) establishing a satcom-based stand-by emergency communication capacity for the region, (ii) promoting multi-tasking of broadband satellite networks, and (iii) encouraging satcom applications for disaster management based on the Tampere Convention;

(e) Promoting space-based products and services for disaster management: Identify a set of intermediate and final products and services for various phases of management of major disasters (hazard zonation/risk assessment followed by early warning, emergency communication, impact mapping and modelling, and damage assessment) for easy adoption by disaster management authorities;

(f) Promoting local intermediary organizations: Strengthening local intermediaries, taking into account the supply-intermediary-demand chain in the Regional Cooperative Framework: space information products and services from the supply side (space agencies/commercial players) to the demand side (the end-users – civil defence organizations, government agencies and community-based organizations), provided through intermediaries (institutions processing intermediate products and value-adding with local information to assist the end-users with tailored information);

(g) Promoting rural information centres as community-based disaster risk reduction hubs: Promoting appropriate policy and institutional mechanism to empower disaster preparedness at the community level as recommended by the Hyogo Framework for Action – by organizing rural kiosks and community e-centres to function as community-based disaster reduction tools

(h) Harnessing the Charter on Space and Major Disasters support to help LDCs: Negotiate the role of UNESCAP in the International Charter on Space and Major Disasters mechanism to extend special privileges to LDCs in the Asia-Pacific region, in terms of capacity-building and other support to LDCs, considering their higher degree of vulnerability and weaker institutional base;

(i) Synergizing United Nations and regional initiatives in the Framework of Cooperative Mechanisms: Evolve a virtual network involving United Nations agencies and regional initiatives like ADRC, ADPC, APSCC, APRSAF, AP-MCSTA, ASEAN Committee on Disaster Management (ACDM), ASEAN SCOSA, the Typhoon Committee, the Panel on Tropical Cyclones, the Mekong River Commission, etc., and space agencies and satellite operators, including private, space-based ICT service providers like Shin Satellites, Asia Satellites, APT Satellites, Intelsat, Inmarsat, and others;

(j) Fostering "public-private partnerships": Work out with space agencies and the private sector a framework for providing images to LDCs for disaster risk reduction

purposes, similar to what is done n the Tampere Convention. Encourage private insurance companies to make investments in risk transfer and funding by awareness creation, capacity-building, and developing appropriate risk assessment/damage estimation procedures, particularly for building community resilience;

(k) Use of RS/GIS in the Universalizing Impact Assessment Methodology: Encourage the integration of remote sensing and GIS inputs in the disaster impact and assessment methodology "Universalizing Impact Assessment Methodology" (developed by UNDP and ECLAC).

The recommendations were deliberated during the Eleventh Session of the UNESCAP Intergovernmental Consultative Committee (ICC) on the Regional Space Applications Programme for Sustainable Development (RESAP) on 6-7 September 2005 at Isfahan, Islamic Republic of Iran. The ICC views have thus been integrated to reflect the wider responses from the stakeholders, especially those represented during the Expert Group Meeting at Chiang Mai and the 11th ICC meeting.

In fact, the recommendations, as listed above, have captured two aspects. Firstly, they are intended to promote operationally demonstrated space applications for disaster reduction that focus on those aspects that could connect MDGs, WSSD, WSIS, RESAP, WCDR Kobe, and UNESCAP regional strategic framework on disaster management in Asia and the Pacific. Secondly, it promotes a vision to realize space technology supported regional/sub-regional cooperation, which could also support the members and associate members of UNESCAP in strengthening their national disaster reduction strategies.

Framework for Regional Cooperation on Space Technology Supported Disaster Reduction Strategies in Asia and the Pacific

I. INTRODUCTION

1. The past few decades have witnessed a great increase in the incidence and impact of disasters, especially in Asia and the Pacific region. As a result, the process of sustainable development continues to be adversely affected; infrastructure and livelihoods on a large scale suffer frequent damage; further impacts may also be seen in the worsening poverty and the growing disparity. Natural hazards cause a high number of lives to be lost, but relatively small property losses, in the least developed and developing countries, while in the relatively developed countries, where disaster prevention and mitigation measures are well-established, the loss of life is relatively small but economic loss is quite high.

2. A case in point in recent times is the year 2004, which witnessed floods in Bangladesh, China, India, Indonesia and the Philippines, cyclones in Japan and Viet Nam, earthquakes in Indonesia, the Islamic Republic of Iran and Japan, and the catastrophic tsunami that struck countries around the Indian Ocean. The Asian tsunami of December 2004, in particular, exposed the vulnerability of the region. It adversely affected the process of stability and growth. The region felt the constraints of not having enough apparatus to warn of the tsunami before it struck the coasts of the Indian Ocean. Among the disasters facing the region, floods, cyclones, typhoons and drought are considered the severest, followed by earthquakes, windstorms, landslides and others. Global climate change is likely to accelerate the number and extent of disasters.[1, 2] But the increasing vulnerability of the citizens has to be arrested; they are to be assisted in every way during the crisis; they have to be empowered to overcome the risk; and there should be efforts to make them more resilient by enhancing their coping mechanisms.

3. The World Conference on Disaster Reduction (WCDR), Kobe (Japan), in January 2005, set in motion a collective vision to mitigate the effects of natural disasters by mainstreaming sustainable development, multi-hazard prevention strategies, and a well-knit institutional infrastructure for early warning systems. Visibly, there is a paradigm shift worldwide from a traditional relief approach to disaster preparedness, a more holistic and long-term strategy, which incorporates vulnerability reduction as part of the development planning process.[3] This comprehensive approach recognizes that disaster reduction is most effective at the community level if the specific local needs are met.

II. REGIONAL STRATEGY FOR DISASTER REDUCTION

4. Regional cooperation has been the hallmark of UNESCAP. Regional cooperation has delivered long-term growth and development in the areas of trade, transport, energy, water and other fields. The initiative for a regional strategy for disaster reduction, taken up by UNESCAP, is based on the universally accepted

fundamental concept of "Living with Risk".[4] The key elements include strategic planning (political will and participation of all stakeholders; knowledge management), community-based disaster risk management (DRM), popularizing good practices (including those based on space technology applications), promotion of sub-regional networking and mechanisms, and partnerships for disaster reduction (public-private partnerships, for instance).[5]

5. The framework envisages a paradigm shift from crisis management to risk reduction; addressing risk from uni-dimensional to multi-dimensional angles; from an agency-specific issue to whole-of-government issues; from sectoral issues to those that cover whole communities.[6] It emphasizes (a) a participatory approach, from planning for the community to planning with the community, (b) putting community at the front, from top-down prescriptions to local-level planning, (c) focusing on enhancing community coping mechanisms and resilience, and (d) making the transition to the new policy regime – from regulatory as primary vehicle to multiple interventions such as ecological, financial (risk transfer), and technological.

III. INFORMATION AND KNOWLEDGE INFRASTRUCTURE

6. Rightly focused upon as a part of the regional strategy of UNESCAP, knowledge plays a key role in disaster reduction.[5] The community holds tacit knowledge, acquired from their real-life experiences, local wisdom, inherent coping mechanisms and resilience. It has to be cross-fertilized with explicit knowledge, the derivatives of science and technology. Fusion as well as diffusion of tacit and explicit knowledge calls for institutional mechanisms in place that organize, manage and apply this cross-fertilization to bring down the risk at community level. The knowledge base of a country (an aggregate of tacit and explicit knowledge) becomes enhanced by the integration of knowledge products and the enrichment of nodal agencies for disaster management (also called the knowledge repository) by integration of global knowledge diffusion processes (Fig. 1).

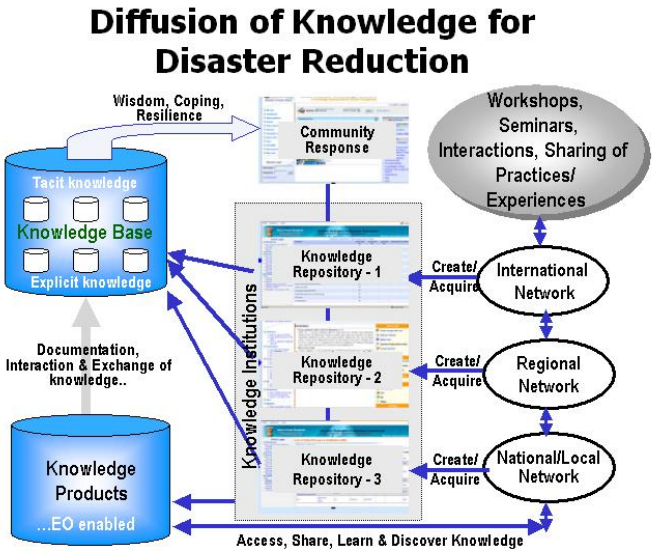


Fig. 1: Knowledge management cycle in disaster reduction

7. The quest for knowledge introduces the use of space technology in disaster reduction. As content and conduit, space technology (although to a limited extent of operationalization, especially in the developing countries of the region) has demonstrated operationally a variety of critical and valuable applications in the areas of early warning, risk assessment, impact mapping, preparedness and mitigation measures, and emergency communication (Fig. 2). The ability of Earth observation (EO) satellites lies in capturing the vagaries of natural disasters in near-real time. EO inputs also help in addressing the terrain, geophysical characteristics, and weather-related vulnerability and risk scenarios and, thus, make them a powerful tool for producing the knowledge products. Space information products and services further enrich the knowledge base of a country, to help it manage natural disasters. The question is obviously whether access, affordability and usefulness are in tune with the existing institutional, policy and technological frameworks that characterize the developing countries of the regions.

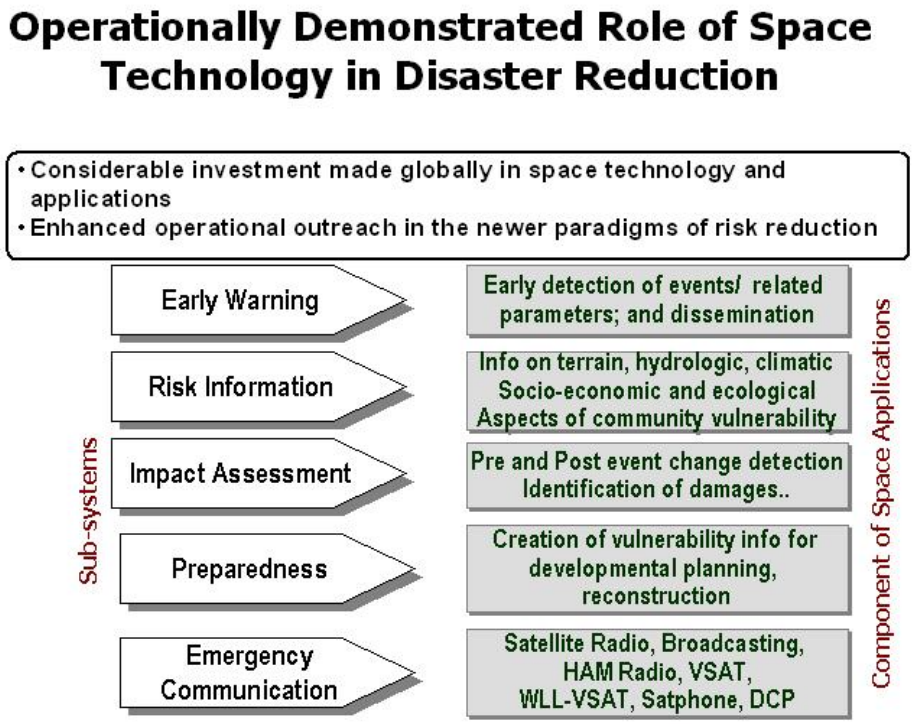


Fig. 2: Operational aspects of space technology in disaster reduction

IV. INFORMATION REQUIREMENTS AND SPACE-ENABLED PRODUCTS AND SERVICES

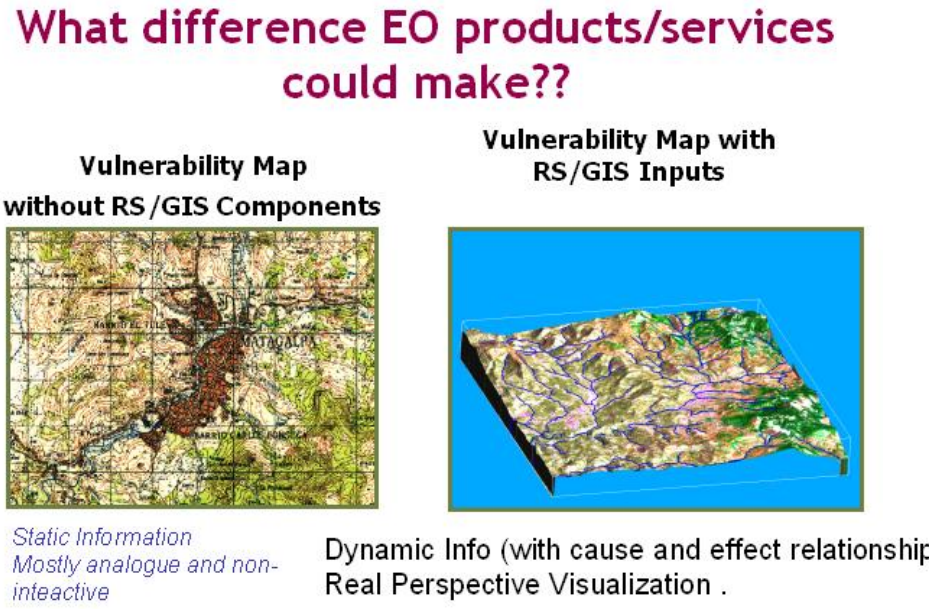
8. The UNESCAP secretariat, while carrying out a survey on requirements of operational disaster management agencies in the region, found that the space information products and services have attracted the largest demand in the areas of

hazard zonation / risk assessment, followed by early warning, emergency communication, impact mapping and damage assessment.[7] Of course, the survey was conducted before the tsunami of December 2004. Post-tsunami disaster reduction activities have placed a focus on early warning systems. Yet another aspect of requirements is the quality and timeliness of the products. While pre- and post-disaster scenarios require value-added "actionable" products that can be used for making decisions and taking action, such as hazard zonation maps, disaster reduction plans and the like, rapid/impact mapping has been the requirement during a crisis in an almost near-real-time situation.[8] Some operationally demonstrated space information products and services, used during the various phases of disaster management cycle of some key disasters, are listed in Annex I.

EO-based 'Actionable' Knowledge Products

Applications	Scale				
	1:5000	1:10 000	1:50 000	1:250 000	1:1000 000
Space map Large ortho mosaic	QUICKBIRD IKONOS	QUICKBIRD IKONOS SPOT 5 IRS (Cartosat)	SPOT LANDSAT IRS (IC, ID, Resourcesat)	LANDSAT ENVISAT/ASAR RADARSAT	VEGETATION MERIS ENVISAT IRS (IC/ID/P4/ Resourcesat)
Large scale Geological map	QUICKBIRD IKONOS	QUICKBIRD IKONOS SPOT 5 IRS (Cartosat)	SPOT LANDSAT IRS (IC, ID, Resourcesat) ERS, ENVISAT RADARSAT	LANDSAT ENVISAT/ASAR RADARSAT	VEGETATION MERIS ENVISAT IRS (IC/ID/P4/ Resourcesat)
Vulnerability map					
Impact Assessment Map	No archive	No archive	SPOT LANDSAT IRS (IC, ID, Resourcesat) ERS, RADARSAT		
Land Surface Deformation			ERS, ENVISAT		
DEM Hydrological Network	IKONOS	IKONOS SPOT 5 IRS (Cartosat)	SPOT ERS, ENVISAT RADARSAT		

Cartographic product Thematic product Vector product



(*Source*: UNOSAT[9])

Figs. 3 and 4: Some key EO products

9. Space information products and services, derived from meteorological satellites (i.e., global products of NOAA, GOES, FY, INSAT and others, available on the Web), have established operational applications at broader levels in addressing the natural disasters of meteorological origins. But they are more impressionistic than "actionable" locally. Moderate and high-resolution EO basic products from a variety of sensors and platforms, such as SPOT Vegetation, Envisat MERIS, ASAR, Radarsat, IRS WiFS, LISS 3 and 4, Cartosat, Ikonos, and QuickBird, provide valuable data, which need substantial value addition to turn them into "actionable" knowledge products (cartographic, thematic and GIS-based vector products, as shown in Fig. 3). Yet another aspect is uniqueness of the products in terms of providing contour visualization through digital elevation modelling (DTM), as depicted in Fig. 4.[9] High-resolution data, as well as the service providers, are in the commercial domain. In the recent disasters like the tsunami, Bam earthquake, and others, it was clearly seen that service providers of high-resolution data have not acted on commercial considerations while responding to these disasters.[11] However, a framework is needed to harness and institutionalize their support.

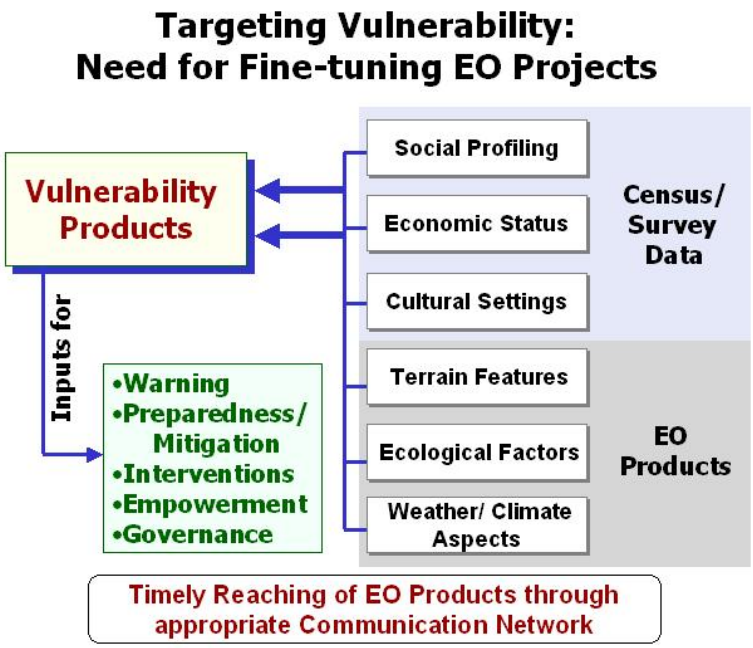
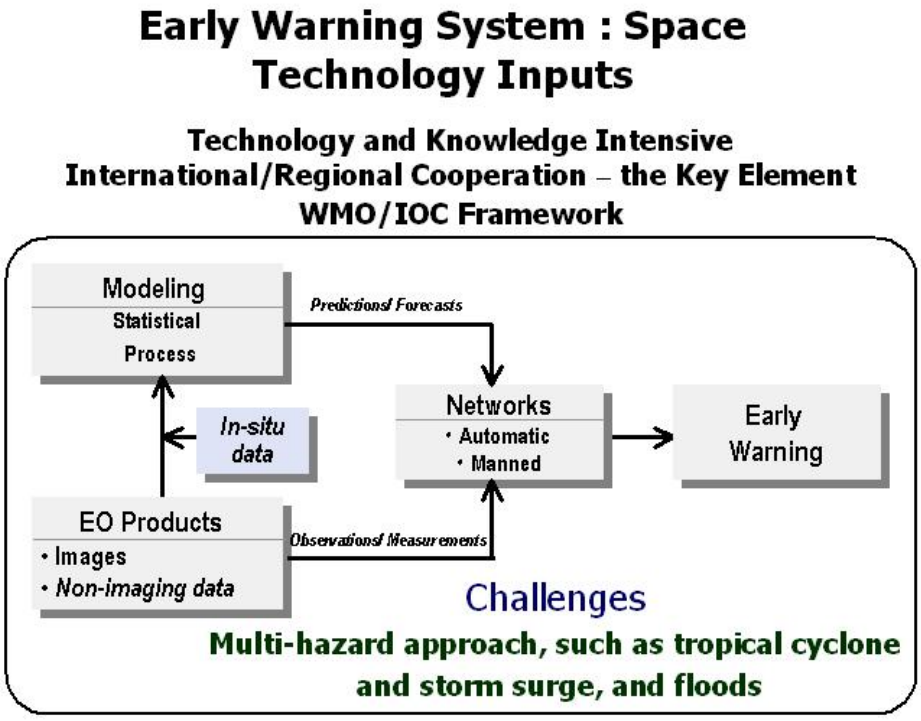


Fig. 5: An example of EO-enabled knowledge products: vulnerability products

10. There has always been a gap between space-enabled products and their utilization down the line. Besides the institutional and policy-related factors, one reason has been a mismatch between what is required for action on the ground and what is delivered to the end-users. Secondly, the potential of EO products, in synthesis with other collateral *in situ* information, has yet to be harnessed fully. For example, vulnerability products are derivatives of community social profiling, economic status, cultural settings, terrain features, and ecological factors, as well as weather/climate aspects (Fig. 5). Some of them are amenable to EO products in the real sense, so to make them utilizable, it is important to have strong institutional capability in the developing and, especially, the least developed countries.



(*Source*: NOAA/GEOSS[10])

Fig. 6: Components of an early warning system (EWS)

11. The post-tsunami scenario is driven by the need to have networks of early warning systems (EWS) in the region. In fact, an EWS is technology and knowledge intensive. International/regional cooperation holds the key. The World Meteorological Organization (WMO) provides a framework for setting up an EWS. However, densification and multi-tasking of an EWS are the most important issues. In fact, there are three pillars for building an EWS: modelling (statistical and process-based), EO products (imaging and non-imaging), and networks (automated and manual). Improvements or multi-tasking of an EWS depend on all the three (Fig. 6). Unless there are strong institutional bases and networks, developing an EWS is a difficult task from all points of view: technologically and operationally. Such a scenario presents a strong case for international/regional cooperation.

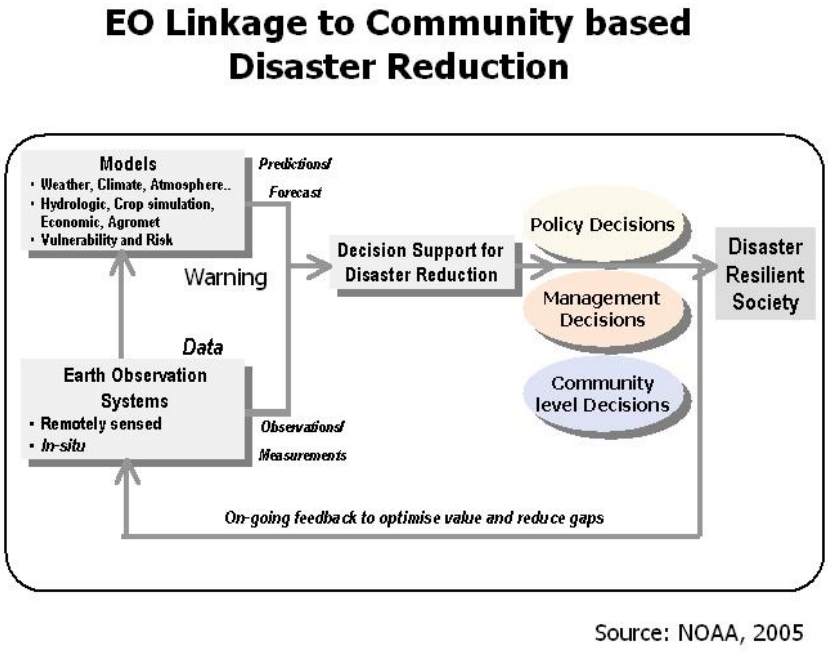
12. Satcom-based emergency communication has demonstrated immense potential in emergency management. The satellite communication sector, having moved into the private domain, can be harnessed only through public-private partnership. The Tampere Convention, an international treaty on the provision of telecommunications for disaster mitigation and relief operations which has come into effect only recently, is expected to enhance the penetration of emergency communication. Removing regulatory barriers and strengthening trans-border cooperation between countries, as facilitated by the Tampere Convention, is an enabling step in this direction.

13. The quest for universal methods for the assessment of socio-economic and environmental impacts due to natural disasters has always attracted priority. This is important for better coordination of national and international efforts in disaster reduction. The United Nations Development Programme (UNDP) and the Economic Commission for Latin America and the Caribbean (ECLAC) have succeeded in developing an operational method, and it was put to use in post-tsunami rehabilitation efforts.[5] In fact, major international agencies – World Bank, Asian Development Bank and Japan Bank for International Cooperation – used this method for reconstruction activities. It is important to integrate EO products while universalizing this method in the region.

V. ADVANCES IN SPACE TECHNOLOGY: TRENDS AND EMERGING APPLICATIONS

14. Over the last 15 years, EO technologies have undergone phenomenal changes. Coarse, medium and hyperspectral sensors and platforms have been developed by major space agencies in response to scientific and environment-related issues. As happened with satcom, high-resolution imaging moved into the commercial arena. Constellations of smaller, faster and cheaper satellite missions are emerging as promising tools to capture the natural disasters in real time and to monitor them regularly. Disaster monitoring constellations (DMCs) also provide a unique opportunity for cooperation.[12] Already, a DMC is in the pipeline, led by Surrey Satellite Technology, Ltd. (SSTL) in partnership with Algeria, China, Nigeria, Turkey and the United Kingdom. Each of the partners owns its satellite but they also provide images to non-partners free of charge in response to disasters. China's proposed small satellite constellation is yet another milestone to build a DMC through regional cooperation.[7]

15. There is another school of thought on constructing DMCs, which brings in the concept of intelligent, autonomous and event-driven missions. Formation flying and event-triggered missions, developed by National Aeronautics and Space Administration (NASA), are an attempt to monitor moving targets such as cyclones, typhoons and the like. Some of the intelligent missions like EO-1 have demonstrated the ability to capture floods, volcanoes and other surface anomalies autonomously. [13, 14, 15, 16] NASA's Global Earthquake Satellite System (GESS) is yet another example of building a DMC for earthquake predictions well in advance.[17] It is expected that such missions would make great contributions in coming years to regional disaster reduction strategies.



(*Source*: NOAA/GEOSS[10])

Fig. 7: Space information products and services: towards community-based disaster reduction

16. Parallel to the advances in EO technologies, there are also developments in modelling and networking, which enable better decision support mechanisms at policy, management and even up to the community levels. In synergy, it is an end-to-end capability linking space-based products and services directly to the community levels (Fig. 7). This provides the technological backbone to catalyze community-based disaster reduction strategies. One of the concepts in this direction has been the tasking of rural kiosks to function as community-based disaster reduction centres by providing timely access to warnings, emergency communication, tele-medicine and related advisories. There is a success story worth highlighting in this context. India, for example, has set up a satcom-based broadband tele-medicine network, which was multi-tasked during the tsunami period (because terrestrial communication had broken down completely) to function as community kiosks delivering e-governance services, identifying missing children, and providing a variety of relief and rehabilitation services. Of course, there are complex issues like convergent technology regime (choice of appropriate technology), innovative model-of-use (commercial vs social), and the variety of institutional structures (private-public partnership), which need to be studied in this context.[18]

VI. EXISTING FRAMEWORKS: OPPORTUNITIES AND PITFALLS

17. International cooperation has been recognized as one of the important strategies for providing access to EO products for civil defence / disaster management agencies in support of emergency management. The International Charter for Space and Major Disasters, implemented in 2000 to ensure immediate access to EO data from participating space agencies (CNES, ESA, CSA, ISRO, NOAA, CONE and JAXA) to the organizations dealing with major disasters, is a major step in this direction.[19] The main features include an operational mechanism, which delivers EO products to civil protection agencies, emergency and rescue services, and to signatories during emergency situations. The United Nations has been a cooperating body since 1 July 2003, and therefore a certain number of specialized United Nations agencies (UNOSAT) can request activations of the Charter. Since its institution, the Charter has been activated more than 60 times, and more than 60% of Charter activation has been for United Nations bodies.

18. UNOSAT, a project executed by UNOPS and implemented by a United Nations-led open consortium of value-adding private companies and specialized public resource centres, is another example initiated with support from the ESA, European Organization for High Energy Physics (CERN), CNES, and the Governments of France and Norway. It aims to provide the United Nations system, local governments and implementing partners with EO products in connection with emergency relief, post-crisis recovery, vulnerability reduction and sustainable rehabilitation (<www.unosat.web.cern.ch/unosat/asp/charter.asp>).

19. Towards a Global Earth Observing System of Systems (GEOSS), an initiative by the Intergovernmental Group on Earth Observations (GEO) is an important step in putting in place a global system of systems for improved coordination of observations (space and *in situ*). In the GEOSS framework, GEO has already been set up with a secretariat for monitoring a 10-year implementation plan. The central focus has been on observing and understanding the Earth system more comprehensively, in order to expand worldwide capacity for achieving sustainable development with enhanced socio-economic benefits. Reducing loss of life and property from natural and man-made disasters has been one of the core areas of GEOSS (<earthobservations.org>).[10]

20. Global Monitoring for Environment and Security (GMES), jointly led by the European Commission and ESA, has been established as a European capacity to produce and disseminate timely and reliable information in support of policy sectors concerning the environment and security. GMES focuses on providing large-scale, operational end-to-end services, primarily looking at EU policy sectors. GMES services are relevant to humanitarian aid and disaster risk reduction. There are initiatives by commercial agencies as well.[20] For instance, SERTIT Service, which operates through ESA and CNES, has been providing value-added products in support of the International Charter. It is a good example of public-private partnership.

21. The frameworks, as discussed above, have helped in promoting EO products that aid in disaster reduction in the framework of cooperation. However, most EO products have been used during the response phase, without the participation of stakeholders and without capacity-building mechanisms at the user's end. In both the pre- and post-disaster phase, combining EO products with socio-economic and other *in situ* data adds substantial knowledge and provides structured solutions to the demands of international, national and local-level users. A summary of the frameworks, highlighting their opportunities and pitfalls, is given in Table 1. Therefore, there is a need for an arrangement that inspires the participation of stakeholders, enables capacity-building, and establishes stronger links to the end-users. To enable such arrangements, nations need an appropriate framework, which could work well on the ground and address the existing gaps.

Table 1: A summary of opportunities and pitfalls

Frameworks	Access to EO Products	Participation of Stakeholders	Capacity-building of End-users	Linkages
"Charter"	Yes (during response phase)	No	No	Yes (relief agencies)
UNOSAT	Yes (during response phase)	No	No	Yes (relief agencies)
NOAA initiatives	No	No	Very limited	No
Initiatives of academic institutions and commercial entities	No	No	No	No

VII. REGIONAL COOPERATIVE MECHANISM: A FRAMEWORK

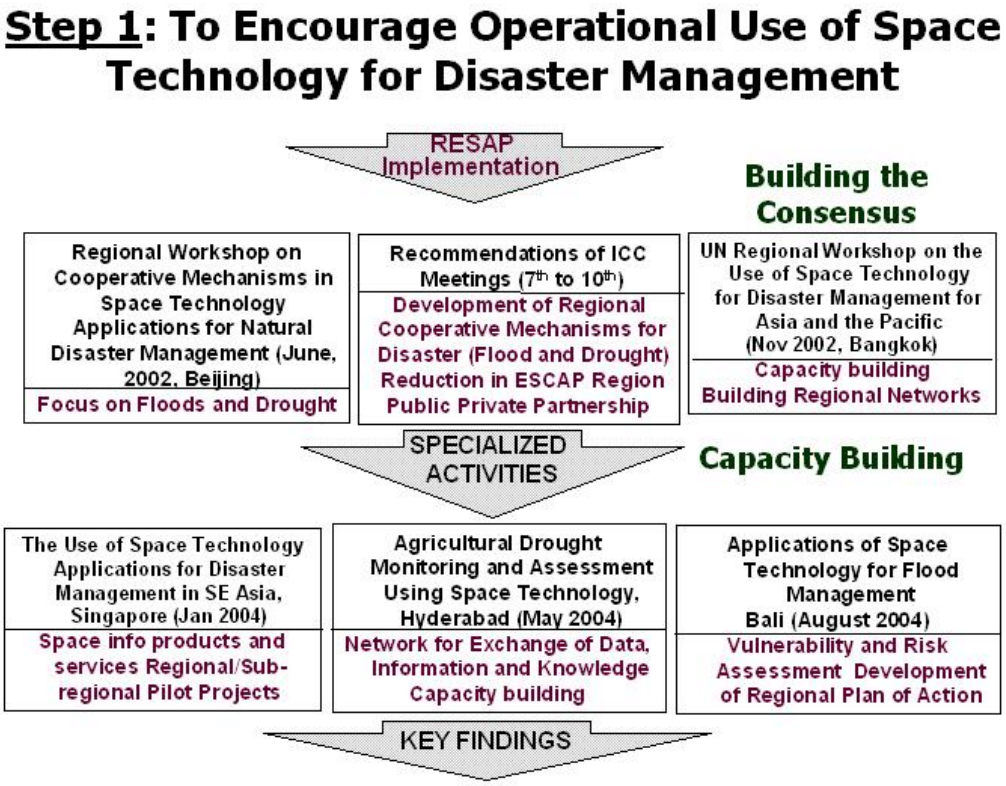
22. The Regional Cooperative Mechanism (RCM) has been an important component of the implementation of the Regional Space Applications Programme for Sustainable Development in Asia and the Pacific (RESAP). With the backdrop of major initiatives taken up by UNESCAP as a part of its regional strategy on disaster reduction, it is proposed to recast RESAP mechanisms by placing more focus on developing national and regional capacity (a) to assess hazards and risks, (b) to promote preparedness and risk reduction, (c) to establish and multi-task national and regional warning systems, (d) to enable thematic tasking of rural kiosks to function as community-based disaster reduction centres, and (e) to develop linkages to other UNESCAP/United Nations initiatives and to regional programmes like BIMSTEC, ASEAN, SAARC and others.

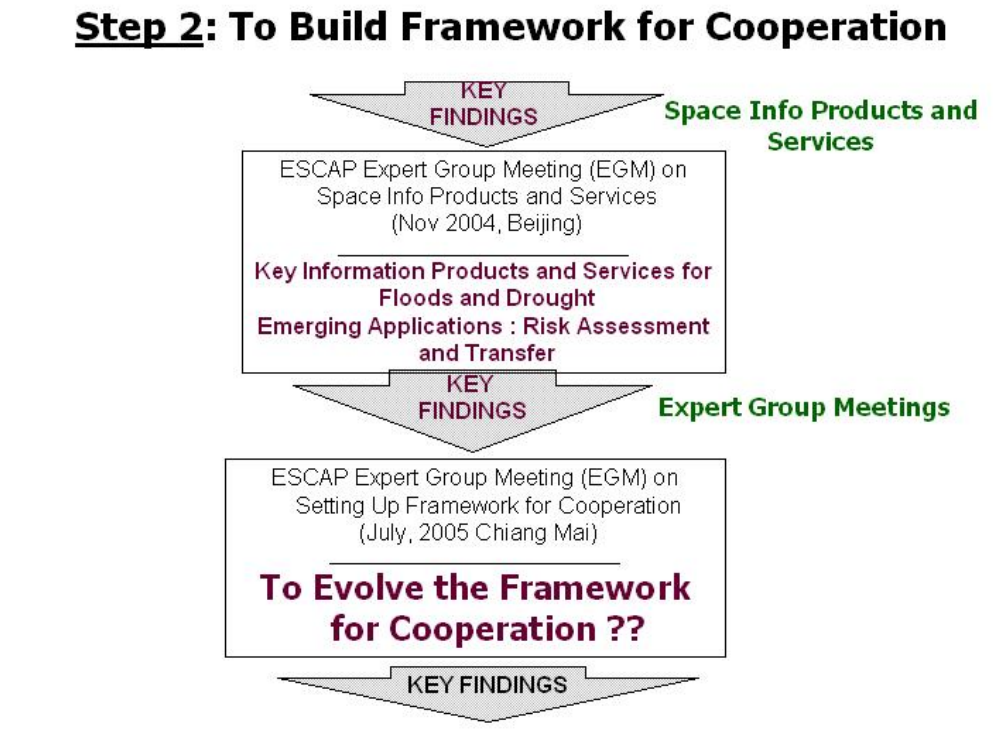
23. The recasting of RESAP starts with the above issues and their contexts brought into the deliberations of bodies such as the Intergovernmental Consultative Committee (ICC), Regional Working Groups (RWGs), dialogue forums, Asia-Pacific Regional Space Agency Forum, Asia-Pacific Multi-lateral Cooperation, Asia-Pacific Satellite Communication Council and the related initiatives of UNESCAP and other United Nations agencies. In the context of RESAP implementation, the efforts in encouraging operational use of space technology for disaster management are merging into a visibly distinct framework. For example, regional workshops at Beijing and Bangkok in June 2002 and November 2002 and the subsequent deliberations during ICC and RWG meetings have led to decisions (a) to identify floods and drought as the main focus, and (b) to place emphasis on building the regional networks and enhancing national capacities to integrate space technology applications, while addressing these disasters. To strengthen these decisions further, specialized workshops at Singapore (January 2004), Hyderabad (May 2004) and Bali (August 2004) were organized, which brought into focus the issues related to space information products and services, as well as their access and outreach in the region through the networks for exchange of data, information and knowledge. The Regional Action Plan, regarding vulnerability and risk assessment, was envisaged as a key area for building RCM (<www.unescap.org/icstd/SPACE/index.asp>). The UNESCAP Expert Group Meeting (EGM) on key information products and services for floods and drought, held at Beijing in November 2004, emphasized integrating space information products and services in risk reduction strategies while building the RCM (Figs. 8 and 9).[21, 22]

A Framework for Regional Cooperation: The Key Characteristics

24. The proposed framework is centred on three aspects: ***political will, flexibility and ownership***. Where does the political will come from? Certainly, it comes from popular demand, especially by empowering communities and enabling them to benefit directly or indirectly. Flexibility aims to address the enormous range of social and cultural settings that characterize the region. It is also to be seen as a “living” framework that is able to accommodate advances in technologies and concepts The ability to encourage ownership means that the framework would be accepted and owned by all the stakeholders.[23] The challenge is therefore to create a framework that strikes a balance between the scientifically sound, the diplomatically acceptable, and the politically relevant.

25. What moves through the frameworks are space information products and services from the supply side (space agencies and commercial players) to the demand side (the end-users: civil defence organizations, government agencies and community-based organizations) through the intermediaries (institutions that generate value-added products, service providers, networks of SMEs, and so forth). In the present context, the supply side may be outside the developing countries (especially in the case of LDCs), and there may not be any links between it and the end-users or intermediaries. The RCM not only has to enable linkages but also has to streamline the supply-intermediary-demand chain. The strategy lies in projectizing the RCM on those activities most common among the stakeholders at various levels and in addressing the cross-sectoral issues.





Figs. 8 and 9: A road map for the evolving regional cooperative framework

26. Projectization of the proposed framework for the RCM involves a set of activities in tune with the regional requirements (Fig. 10). While it aims ultimately to address community empowerment (access to warnings, emergency communication, weather, tele-medicine, etc.), capacity-building (institution strengthening), and better governance for disaster reduction (databases, decision-support mechanisms, rural kiosks, etc), projectization would make it easier to carry out the identified tasks in the mission mode, and it would automatically set up the regional networks.

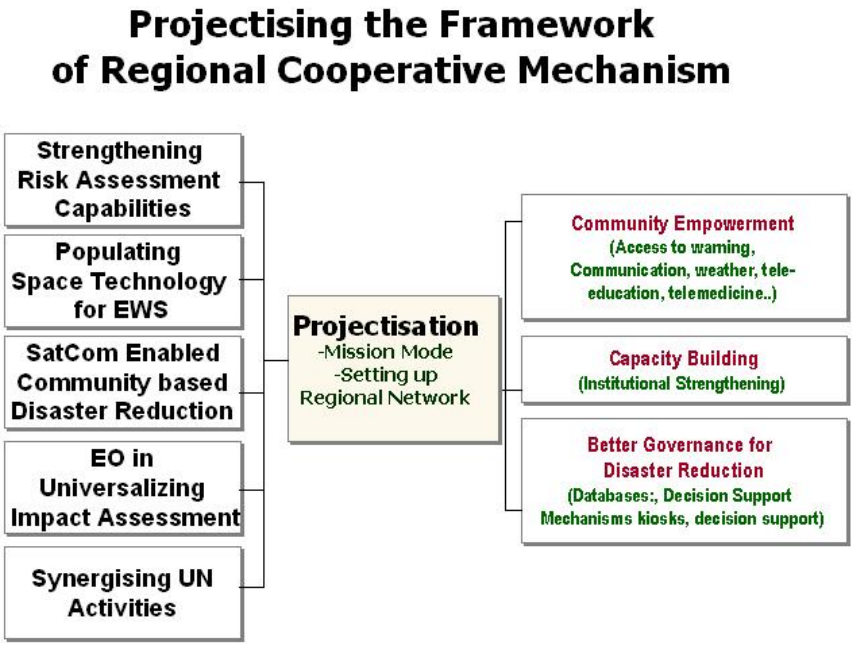


Fig. 10: Projectization of the proposed framework for the RCM

27. In order for the proposed framework for the RCM to work, the following strategies and actions are suggested:

- ***Strengthening National-level Risk Assessment Capabilities***

While regular activities would include creating awareness, imparting training and education, and facilitating information / knowledge sharing between the member and associate member countries to encourage hazard zonation and risk assessment activities, taking up regional/sub-regional risk assessment projects in selected pockets of LDCs assumes greater significance in the proposed framework. One instance is the global Thematic Programme Networks (TPN) of UNCCD (<ww.unccd.int/actionprogrammes/asia/regional/tpn5/menu.php>), which places its focus on a participatory approach with in-built capacity-building mechanisms (details in Annex II); efforts could be made to launch regional/sub-regional risk assessment pilot projects covering the areas most vulnerable to floods and drought. Projects could be

dovetailed with other contemporary missions, including the “Asia Cover” and UNCCD TPN projects.

Risk assessment triggers a wide range of activities in disaster reduction. Risk indicators, such as hazard, exposure and vulnerability-related parameters, are to be harmonized through various control measures like physical planning and economic and technological interventions, as well as adaptability factors. It is therefore necessary to recognize risk assessment as the central focus of setting up regional/sub-regional networks.

In setting up the regional/sub-regional networks for risk assessment (which is proposed to be called the Asia-Pacific Risk Assessment Network (APRAN), depicted in Fig. 11), Change Fig. 11 to APRAN, there are three aspects that must be considered: (a) identification of the project areas of common interest among the stakeholders, including the donors, (b) regional action plans for APRAN for floods and drought in different region/sub-regions (APRAN 1, 2, and so on), and (c) operating principles (shared responsibility, linkages and a participatory approach), which could evolve further. It is important to emphasize that APRAN addresses those gaps, which have been part of other existing frameworks (as discussed in section V).

- ***Populating Space Technology Applications for Early Warning System***

Suggested actions

- To develop a consolidated plan for space components of a multi-hazard (including tsunami) warning system based on national and regional requirements for increased utilization of space-based data, products and services;
- To increase national and regional utilization of space-based capabilities through educational and capacity-building activities for early warning studies.

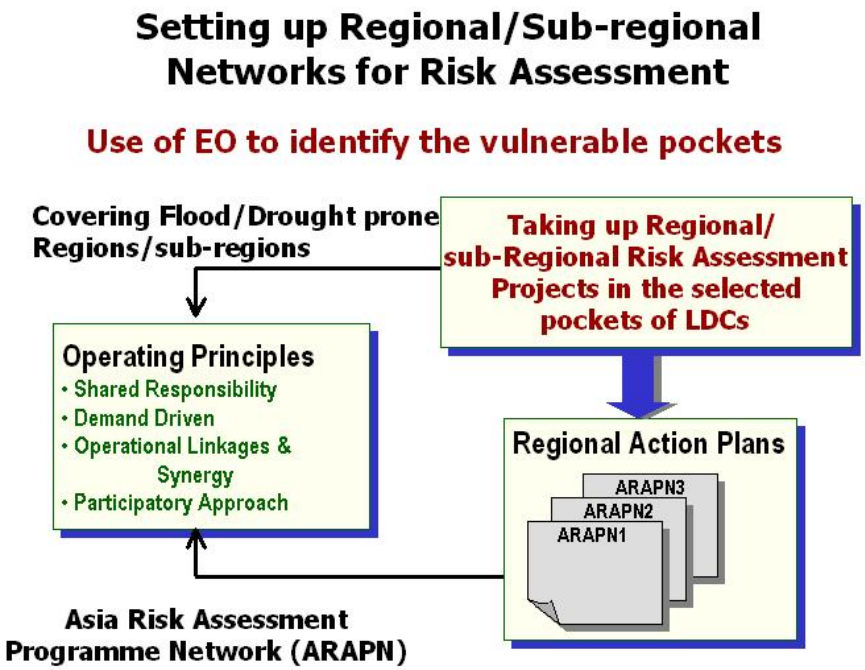


Fig. 11: The various components of the proposed Asia-Pacific Risk Assessment Network

- ***Promoting Space-based Products and Services for Disaster Management***

Suggested actions:

- Identify a set of intermediate and final products and services for various phases of management of major disasters (hazard zonation / risk assessment followed by early warning, emergency communication, impact mapping and modelling, and damage assessment) for easy adoption by disaster management authorities;
- Address users' specific needs to develop easily understandable and affordable, tailored information products and services for each disaster with the end-user agencies that are dealing with that particular disaster;
- Promoting local intermediary organizations. Take into consideration the supply-intermediary-demand chain in the Regional Cooperative Framework: space information products and services from the supply side (space agencies and commercial players) to the demand side (the end-users: civil defence organizations, government agencies and community-based organizations), provided through intermediaries (institutions processing intermediate products and value adding with local information to assist the end-users with tailored information);
- Carry out studies on guidelines and methods for space-enabled products that are affordable in support of cooperative mechanisms, and on related

mechanisms at local, national and regional levels.

- ***Promoting Communication Satellite-based Emergency Communications***

Suggested actions

- UNESCAP and APSCC to work with ITU and other relevant stakeholders to explore the possibility of establishing a satcom-based, stand-by emergency communication capacity for the region;
- Multi-Tasking of Broadband Satellite Networks: The advent of broadband satellites in Ku and Ka regions holds greater potential for wide-ranging mainstream applications;
- Multi-tasking of larger bandwidth is simpler and may provide better emergency services;
- Tampere Convention: Implementation of the Tampere Convention is likely to trigger wide-ranging satcom applications for disaster management.

- ***Promoting Rural Kiosks to Function as Community-based Disaster Risk Reduction Hubs***

Suggested actions

- Encourage livelihood frameworks that recognize peoples' vulnerability context, community-based disaster management and risk transfer, and financial mechanisms;
- Such approaches are being pursued by several agencies, with the aim of integrating poverty alleviation and disaster reduction strategies;
- Promote space applications, particularly satcom-based rural kiosks in underserved areas and high-resolution remote sensing and GIS for risk assessment at the community level;
- Enable the connection of micro-level risk to the vulnerability of ecosystems;
- Empower appropriate policy and institutional mechanisms to implement such approaches.

- ***Operational Use of RS/GIS in Universalizing Impact Assessment Methods***

Suggested actions

- Acceptability of assessment methods (developed by UNDP and ECLAC) gaining ground;
- Integration of RS and GIS inputs in the assessment method;
- Highlight the vulnerable communities in LDCs while integrating RS and GIS;
- The aspects related to national capacity-building and institutional strengthening, in the above context.

- ***Synergizing United Nations Initiatives in the Framework of Cooperative Mechanisms***

Suggested actions

- A "virtual" network involving:

- Synergy of disaster reduction activities within and across United Nations agencies (including UNESCAP) and regional organizations such as the Asian Disaster Preparedness Centre (ADPC), Asian Disaster Reduction Centre (ADRC) and the like;
- Space agencies, including private, space-based ICT service providers like INMARSAT, Shin Satellites, Asia Satellites, APT Satellites and others;
- The network could be focused on exchanging knowledge and experiences and sharing wisdom and perspectives on managing floods and drought, particularly in the common river basins (for floods) and in agro-ecological zones (for drought).

♦ ***Fostering Public-Private Partnerships***

Suggested actions

- In the case of satcom applications, INTELSAT, Ericsson and others have demonstrated their support through United Nations agencies and enabled emergency communication networks in several vulnerable pockets;
- A similar framework could be worked out for providing high-resolution imagery to LDCs, possibly for pilot demonstrations;
- The private insurance sector could make investments in risk transfer/funding; the trend could be encouraged by creating awareness, building capacity and developing appropriate risk assessment and damage estimation tools and methods.

♦ ***Forum of EO Agencies for Disaster Management***

Suggested actions

- A forum of EO agencies (China, India, Thailand and Japan for example) may work together, in the framework of cooperation and information sharing, to help LDCs by providing EO products in a participatory manner, sharing their knowledge and expertise (including capacity-building activities). The forum could be considered in line with the UNESCAP/WMO Typhoon Committee and the UNESCAP/WMO Panel on Tropical Cyclones (details in Annex III);
- Bringing Disaster Management and Space Agencies Closer: Providing an institutional interface between conventional disaster management authorities and space agencies at international, regional, sub-regional and national levels;
- In recognizing the cross-sectoral linkages of disaster management, the focus is on integrating space applications appropriately.

♦ ***Harnessing "Charter" Support to Help LDCs***

Suggested actions

- At UNESCAP level, efforts could focus on maximizing the benefits from the International Charter on Space and Major Disasters;
- Expanding the scope to include hazard/ risk assessment, early warning and emergency communication. As the present focus of the Charter is primarily

disaster impact assessment, it is desirable to accommodate disaster mitigation related services also;

- Extending the special privileges, in terms of capacity-building and other support to LDCs, considering their higher degree of vulnerability and weaker institutional base;
- Negotiating the role for UNESCAP in helping LDCs in the overall Charter mechanisms.

A Vision
Towards a Regional Cooperative Mechanism on Space Technology for Disaster Reduction in the Region

28. The success of UNESCAP's regional strategies on disaster reduction lies in enhancing the knowledge management capacity at various levels in the region. The RESAP agenda complements the knowledge-building processes. The recent tsunami, aside from the unprecedented damage and destruction it caused to lives and livelihoods, has also brought in new opportunities for working together in a framework that encourages political will, flexibility and ownership. The recommendations, as listed above, have been drawn up in order to aid in developing and implementing a framework that could put in place the RCM for disaster management. Above all, it is important to recognize that space applications have a definite role to play in disaster reduction if used strategically and as an integral component of national/international response mechanisms.[24, 25] It plays an equally effective role in addressing cross-sectoral issues such as poverty alleviation and disaster reduction.[26] In developing and least developed countries of the UNESCAP region, the trend that is gaining ground is to tackle disaster reduction and poverty alleviation together.[27]

A vision for the framework could therefore be constructed wherein regional/sub-regional cooperation that is supported by space technology would help the member and associate members of UNESCAP in strengthening their national disaster reduction strategies.

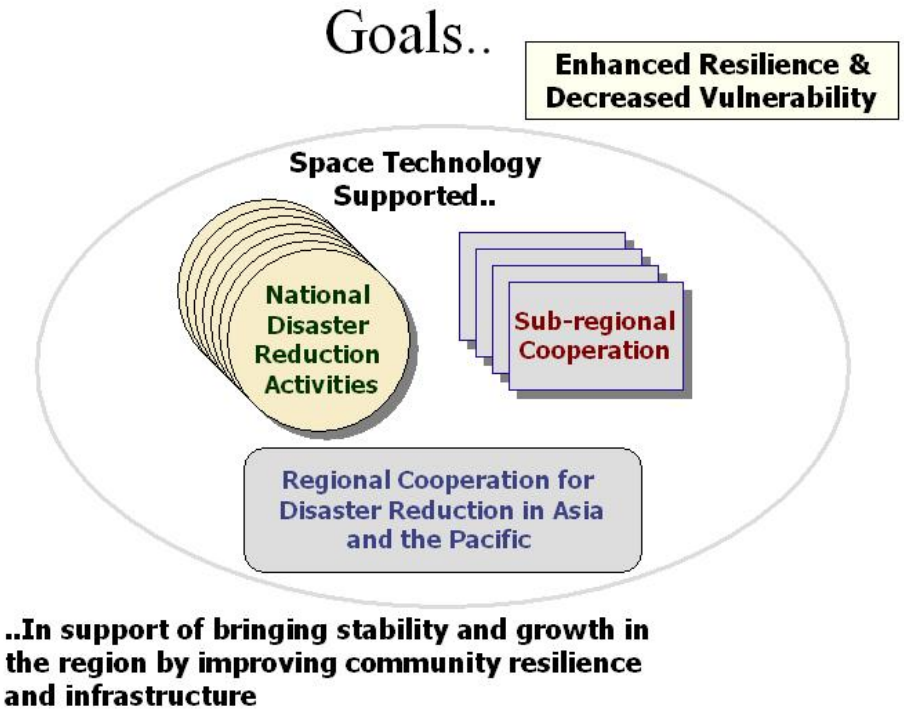


Fig. 12: Regional cooperation framework supported by space technology

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Annex I

Space Technology-based Operational Products and Services for Disaster Management

FLOODS

Management Phases	Information Needs	Space Information Products	Space Information Services
Mitigation and preparedness	Drainage networks and flow in vulnerable areas	Remote sensing/GIS-based maps on flood plain zoning; identifying river migration using multi-date satellite data for flood protection measures. Use of advanced flood forecast models with satellite inputs on land use, terrain, geomorphology etc.	Flood zoning; upgrading of current flood forecast models to use satellite inputs; use of river migration data for flood protection planning; regulations on use of flood plains for developmental activities
Response	Rainfall in catchment areas. Water level in rivers and streams. Run-off prediction. Terrain relief and slope. Extent of affected areas. Damage assessment	Near-real-time maps for monitoring and mapping of flood-inundated areas. Damage assessment of agricultural crops. Marooned villages and other infrastructure	Use of flood inundation information for planning rescue and relief operations. Use of damage estimates for relief and rehabilitation to governmental and international funding agencies and donors
Recovery	Flood-resilient land use. Drainage structures. Long-term measures for flood reduction	Maps for identification of safe areas for rehabilitation. Locations for flood protection measures	Regulations in flood plains, flood protection measures, and optimal rehabilitation site selection

CYCLONES/TYPHOONS

Management Phases	Information Needs	Space Information Products	Space Information Services
Mitigation and preparedness	Vulnerable areas. Cyclone resilient measures. Wind loads and structure interaction models	Sea surface temperature (SST), and cloud and wind vector-based monitoring and assessment of intensity. Cyclone/typhoon warning dissemination. Use of satellite-derived parameters (sea surface temperature, wind, cloud types, liquid water content, etc.) in numerical weather prediction model for improved predictions	Use of process models with satellite-derived parameters for improved forecasts and early warning
Response	Cyclone track and intensity. Prediction of time and location of landfall. Dissemination of warning messages. Affected areas. Damage assessment	Emergency communication for rescue/relief operations. Information and maps on flood inundation due to cyclonic rains. Assessment of damage to crops	Use of emergency communication tools for rescue/relief agencies. Use of damage statistics for relief
Recovery	Cyclone resilient engineering structures	Planning of rehabilitation and reconstruction with ortho-photos from aerial data	Identification of suitable locations for rehabilitation and creation of shelters

DROUGHT

Management Phases	Information Needs	Space Information Products	Space Information Services
Mitigation and preparedness	Vulnerable areas. History of recurrence and intensity	Monitoring of crop condition using NDVI data from satellites. Integrated surveys for combating drought on a long-term basis	Planning mitigation measures for combating drought
Response	Rainfall anomalies and vegetation condition assessment. Areas affected and severity. Assessment of damage	Assessment of likely damage and yield loss to crops	Updating information on drought situation. Planning relief measures
Recovery	Drought combating / proofing. Soil conservation measures. Water harvesting schemes	Long-term planning for combating drought (soil/water conservation, check dams, water harvesting structures, groundwater development)	Used for long-term measures to achieve drought-proofing

LANDSLIDES/EARTHQUAKES

Management Phases	Information Needs	Space Information Products	Space Information Services
Mitigation and preparedness	Seismic zonation and vulnerability. Guidelines for structural engineering. Risk assessment framework	Maps showing geological and tectonic features and studies of regions	Used for micro-zonation / risk assessment data for development planning and enacting building regulations/codes
Response	Monitoring strain accumulation. Seismic observation network. Areas affected by earthquake. Damage assessment	Emergency communication support with space systems. Damage assessment through high-resolution remote sensing of worst-affected areas	State relief agencies to use high-resolution data (large-scale maps) and emergency communication facilities for effective rescue and relief operations
Recovery	Earthquake resilient structures	Identification of safer locations for rehabilitation	Useful for rehabilitation planning using the scientific data and reconstruction with earthquake resilient structures

FOREST FIRES

Management Phases	Information Needs	Space Information Products	Space Information Services
Mitigation and preparedness	Forest-fire-prone area identification. Monitoring and warning network	Mapping of fire-prone areas (through indicators such as vegetation cover, dryness, temperature etc.)	Forest Survey of India and state forest depts. to identify priority areas for planning fire prevention / fighting measures. Use of satellite data for regular monitoring of high-risk areas
Response	Identify affected areas. Assessment of damage	Extent of burnt areas and damage assessment	State govts. and forestry depts. to use damage assessment data for appropriate relief
Recovery	Regeneration of forests	Mapping of water sources / land potential to identify potential regeneration sites	State govts. use data for planning regeneration strategy

United Nations Convention on Combating Desertification

The United Nations Convention to Combat Desertification (UNCCD), adopted in Paris on 17 June 1994 and opened for signatures on 14-15 December 1994, entered into force on 26 December 1996. The UNCCD aims to promote effective action through innovative local actions and supportive international partnerships. Countries affected by desertification have been implementing the Convention by developing and carrying out national, sub-regional, and regional action programmes. The Convention states that these programmes must adopt a democratic, bottom-up approach, including strong participation by non-governmental organizations in such programmes' development and implementation. In addition, these action programmes must be fully integrated with other national policies for sustainable development.

Desertification can be reversed only through profound changes in local and international behaviour. Step by step, these changes will ultimately lead to sustainable land use and food security for a growing world population. Combating desertification, then, is really just part of a much broader objective: the sustainable development of countries affected by drought and desertification.

National, Regional and Sub-regional Programmes

National Action Programmes (NAP) are one of the key instruments in the implementation of the Convention. They are strengthened by Action Programmes at the Sub-regional (SRAP) and Regional (RAP) level. National Action Programmes are developed in the framework of a participative approach involving the local communities and they spell out the practical steps and measures to be taken to combat desertification in specific ecosystems (<www.unccd.int>).

The International NGO Network on Desertification and Drought (RIOD), set up in November 1994, is a network of NGOs originally involved in negotiating the UNCCD and now involved in helping to implement the Convention. RIOD's intent is to allow free information exchange among NGOs and CBOs (community-based organizations) in order to increase the effectiveness of their efforts to combat desertification.

In cooperation with UNDP and the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), UNESCAP has finalized a project on promoting methods for assessing socio-economic impacts of natural disasters in Asia, which is scheduled to be implemented in 2004. The project would involve review of relevant methodologies, including the one proposed by UNECLAC and establishment of pilot projects on the application to assess impacts of natural disasters on poverty reduction programmes.

Annex III

UNESCAP/WMO Typhoon Committee and Panel on Tropical Cyclones

The framework of the UNESCAP/WMO Typhoon Committee (established in 1968) and the WMO/UNESCAP Panel on Tropical Cyclones for the Bay of Bengal and Arabian Sea (established in 1972) has been promoting cooperative activities in the fields of (a) meteorology (including climate), (b) hydrology and water resources, (c) capacity-building in mitigation and preparedness against tropical cyclones, typhoons and other water-related natural disasters, (d) training and research, (e) environment monitoring and (f) sustainable development in the Asian and Pacific region.

Member countries of Typhoon Committees are Cambodia, China, the Democratic People's Republic of Korea, Hong Kong, China, Japan, the Lao People's Democratic Republic, Macao, China, Malaysia, the Philippines, the Republic of Korea, Singapore, Thailand, the United States, and Viet Nam, while the Members of the Panel on Tropical Cyclones include Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka and Thailand. These two inter-governmental bodies have a secretariat, or technical support unit, to serve as their executive arm. These bodies have, generally, held sessions within their respective regions annually. The Committee/Panel has a defined area of responsibility and has formulated a regional cooperation programme. Within this context, each regional body drew up a tropical cyclone operational plan or manual and a technical plan and its implementation programme. They also conducted special projects and activities, as well as regularly monitoring and reviewing the plans and the progress made.

Topics on which these bodies provide guidance include:

- Meteorological and hydrological risk management;
- Meteorological observing systems (radar, automatic weather stations);
- Tropical cyclone structure and motion;
- Satellite techniques for tropical cyclone rainfall estimation;
- Use of satellite data for tropical cyclone forecasting;
- Tropical cyclone forecasting and related numerical weather prediction;
- Tropical cyclone warning systems;
- Tropical cyclone operational arrangements;
- Tropical cyclone research;
- Flood forecasting;
- Human response to warnings.

The main function of the Typhoon Committee is to advise Members on the technical and administrative coordination of plans for the implementation of improved meteorological, hydrological, disaster prevention and preparedness, and other facilities needed in the mitigation of typhoon damage. Specifically its functions are as follows:

a) to advise and assist countries in the international exchange of meteorological and hydrological data, and distribution of typhoon forecasts and warnings;

b) to advise and assist countries in the operation and improvement of meteorological observing networks, telecommunication systems and facilities as required for typhoon forecasting and warning, including storm surge forecasting;
c) to advise and assist countries in the operation and improvement of existing and new hydrological stations required for flood forecasts and warnings;
d) to advise countries on arrangements for the most effective means of disseminating typhoon and flood warnings within the country and to assist in organizing measures for the improvement of community preparedness and disaster prevention;
e) to advise and assist countries in organizing their programmes of training and research in typhoon forecasting and warning, and hydrology and flood control measures;
f) to keep under constant review and circulate information on the progress achieved in the latest research studies relating to typhoon, storm surge and flood forecasting;
g) to encourage and to promote cooperation in research activity aimed at gaining a better understanding of typhoons and, hence, at improving forecasting methods;
h) to conduct, under specific instructions from the Typhoon Committee, studies on such specific problems concerning typhoons as would facilitate carrying out more effectively the advisory functions stipulated under (a) to (e), with a view to supporting the action programme;
i) to assist the countries, on request, in the preparation of applications for technical, financial and other assistance for typhoon damage control;
j) to publish the Typhoon Committee Newsletter once a year;
k) to publish the Typhoon Committee Annual Review.

The Typhoon Committee also maintains close contact with the Members by correspondence on all matters relating to implementation of recommended programmes. It undertakes surveys, compiles statistics and prepares various reports and Technical Notes for circulation to Members.

It has been widely accepted that Members of the Typhoon Committee, including the Philippines, have derived immense benefits through the work of the Committee (<www.tcsphilippines.org>).

In recent years, they have also been focusing on activities such as capacity-building of national meteorological and hydrological services, the promotion of studies and coordination of the exchange of knowledge about tropical cyclones, drought, severe weather and flood warnings, remote sensing, Asian monsoon climatology and prediction, regional climate modelling, regional climate change including sea level rise and their impacts, El Niño / Southern Oscillation (ENSO), atmospheric pollution including haze and its impacts on the region, assessment of water resources, and natural disaster mitigation and management. Under these activities, WMO and UNESCAP have been organizing training and capacity-building activities.

In Asia and the Pacific, close cooperation among countries has provided important forums for coordinating international efforts for better risk management and one instance of such sub-regional cooperation has been the UNESCAP/WMO Typhoon Committee, through which technical cooperation among the experts of its Members and other related international organizations continues to expand on several aspects of water-related disaster risk management, such as flood hazard mapping, sediment disaster forecasting and warning systems and improvement of operational flood forecasting models. In addition to these technical aspects, efforts are also made to improve assessment of socio-economic impacts of water-related disasters, with the aim of improving the formulation of policies on disaster risk management.