



Indigenous Peoples, Marginalized Populations and Climate Change: Vulnerability, Adaptation and Traditional Knowledge

19-21 July 2011 ♦ Mexico City, Mexico

MEETING REPORT

Reference details

Report editors: Kirsty Galloway McLean, Ameyali Ramos-Castillo and Jennifer Rubis.

Photographer: Citt Williams

Further information

For an electronic version of this publication, or for further information about the workshop, please contact:

<p><i>Sam Johnston</i></p> <p><u>United Nations University – Institute of Advanced Studies: Traditional Knowledge Initiative</u></p> <p>Building 1, Level 3, Red Precinct Charles Darwin University, Casuarina Campus Ellengowan Drive Darwin, NT 0909 Australia</p> <p>Tel: +61 8 89 46 67 92 Fax: +61 8 89 46 77 20 Email: tki@ias.unu.edu http://www.unutki.org http://www.ias.unu.edu</p>	<p><i>Douglas Nakashima</i></p> <p><u>Local and Indigenous Knowledge Systems (LINKS) Programme, UNESCO</u></p> <p>Section for Small Islands and Indigenous Knowledge Division of Science Policy and Sustainable Development UNESCO (United Nations Educational, Scientific and Cultural Organization) 1 rue Miollis 75732 Paris Cedex 15 FRANCE</p> <p>Tel : +33 1 45 68 40 64 Fax : +33 1 45 68 58 08 Email: links@unesco.org http://www.unesco.org/links http://www.climatefrontlines.org</p>
---	--

Table of contents

Table of contents.....	3
International Steering Committee	4
<i>International Panel of Experts</i>	<i>4</i>
<i>Conference Convening Committee.....</i>	<i>4</i>
Preface.....	5
Background Information	6
<i>Introduction.....</i>	<i>6</i>
<i>Workshop Series</i>	<i>7</i>
<i>Aims.....</i>	<i>7</i>
<i>Participation and Documentation.....</i>	<i>8</i>
Workshop Convenors.....	10
Donors	11
Officers	12
<i>Meeting Co-Chairs.....</i>	<i>12</i>
<i>Panel Chairs.....</i>	<i>12</i>
<i>Rapporteurs.....</i>	<i>12</i>
Opening Panel.....	13
Panel Discussions	15
<i>Panel A: Indigenous peoples' foundations for adaptation decision-making.....</i>	<i>15</i>
<i>Panel B: Adapting livelihoods to enhance climate resilience.....</i>	<i>18</i>
<i>Panel C: Dimensions of climate change vulnerability.....</i>	<i>23</i>
<i>Panel D: Dimensions of climate change resilience.....</i>	<i>26</i>
<i>Panel E: Managing water resources in changing environments.....</i>	<i>30</i>
<i>Panel F: Bringing local tools and methods into national adaptation planning and implementation.....</i>	<i>32</i>
<i>Panel G: Local knowledge and agricultural biodiversity in Latin America.....</i>	<i>35</i>
<i>Panel H: Achieving food security in small island states.....</i>	<i>38</i>
Outcomes.....	42
<i>Network.....</i>	<i>42</i>
<i>Database</i>	<i>42</i>
<i>Output Timeline</i>	<i>43</i>
Closing Plenary.....	44
<i>Open Mic.....</i>	<i>44</i>
<i>Closing Address</i>	<i>44</i>
ANNEXES.....	45
<i>ANNEX A: List of Participants.....</i>	<i>45</i>
<i>ANNEX B: Compilation of Abstracts.....</i>	<i>45</i>
<i>ANNEX C: Side Event.....</i>	<i>45</i>
<i>ANNEX D: Glossary</i>	<i>45</i>

International Steering Committee

International Panel of Experts

Kate Brown, University of East Anglia, UK

Edwin Castellanos, Research Center for the Environment and Biodiversity, Universidad del Valle de Guatemala, Guatemala

Herminia Degawan, International Alliance of Indigenous and Tribal Peoples of Tropical Forests, Philippines

Igor Krupnik, National Museum of Natural History, Smithsonian Institution, USA

Penehuro Lefale, National Weather Service Department Meteorological Service of New Zealand

Roger Pulwarty, Chief, Climate and Societal Interactions Division, National Integrated Drought Information System, USA

Saul Vicente Vasquez, International Indian Treaty Council, Mexico

Conference Convening Committee

Gerardo Arroyo O'Grady, Mexican National Institute of Ecology

Kris Ebi, Intergovernmental Panel on Climate Change Technical Support Unit Working Group II

Kirsty Galloway McLean, United Nations University

Terence Hay-Edie, United Nations Development Program / GEF Small Grants Programme

Sam Johnston, United Nations University

Douglas Nakashima, United Nations Educational, Scientific and Cultural Organization

Ameyali Ramos Castillo, United Nations University

Jennifer Rubis, United Nations Educational, Scientific and Cultural Organization

John Scott, Secretariat of the Convention on Biological Diversity

Hans Thulstrup, United Nations Educational, Scientific and Cultural Organization

Jaime Webbe, Secretariat of the Convention on Biological Diversity

Preface

When considering climate change, indigenous peoples and marginalized populations warrant particular attention. Impacts on their territories and communities are anticipated to be both early and severe due to their location in vulnerable environments, including small islands, high altitude zones, desert margins and the circumpolar Arctic. Indeed, climate change poses a direct threat to many indigenous and marginalized societies due to their continuing reliance upon resource-based livelihoods. Thus, there is a need to understand the specific vulnerabilities and adaptation capacities of indigenous and marginalized communities.

Indigenous and marginalized peoples, however, are not just victims of climate change. Their accumulated knowledge makes them excellent observers of environmental change and related impacts. Attentiveness to environmental variability, shifts and trends is an integral part of their ways of life. Community-based and local knowledge may thus offer valuable insights into environmental change due to climate change, and complement broader-scale scientific research with local precision and nuance. Finally, indigenous societies and marginalized populations have elaborated diverse coping strategies to deal with change. While the environmental transformations caused by climate change are expected to be unprecedented, indigenous and local knowledge and coping strategies may nonetheless provide a crucial foundation for community-based adaptation measures.

The aim of the workshop was to identify, compile and analyze relevant indigenous and local observations, knowledge and practices related to understanding climate change impacts, adaptation and mitigation.

Lead authors and contributing authors of the IPCC Fifth Assessment report assisted in organising the meeting and provided expert presentations. The workshop provided a key opportunity to ensure that experience, sources of information and knowledge (scientific, indigenous and local), along with data and literature (scientific and grey), focusing on vulnerable and marginalized regions of the world will be made available to the authors of the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report and the global community. A detailed technical report from the workshop will be submitted to IPCC lead authors, IPCC technical support unit, and IPCC co-chairs of Working Group II.

On behalf of the Conference Steering Committee, we are delighted to present this report of the international workshop on Indigenous Peoples, Marginalized Populations and Climate Change: Vulnerability, Adaptation and Traditional Knowledge. An additional annex containing papers prepared for the workshop and a more detailed technical report will be made available as a follow-up to this publication.

Minnie Degawan

Igor Krupnik

September 2011

Background Information

Introduction

The Intergovernmental Panel on Climate Change (IPCC) is an international scientific body tasked with evaluating the risk of climate change caused by human activity. The panel was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). The IPCC is composed of government representatives with relevant expertise. Nongovernmental and intergovernmental organizations are allowed to attend as observers at the invitation of the IPCC.

A main activity of the IPCC is publishing Assessment Reports (ARs) on topics relevant to the implementation of the United Nations Framework Convention on Climate Change (UNFCCC). These reports are based mainly on peer reviewed, published scientific literature and are the most widely cited reports in almost any debate related to climate change. Governments and international organizations generally regard the IPCC reports as authoritative.

Since 1990, the IPCC has published four comprehensive Assessment Reports (ARs) reviewing the latest climate science as well as information relevant to its three working groups which address:

- The Physical Science Basis (Working Group I),
- Climate Change Impacts, Adaptation, and Vulnerability (Working Group II), and
- Mitigation of Climate Change (Working Group III).

The ARs are prepared by teams of authors with relevant expertise. Authors for the IPCC ARs are selected from a list of researchers prepared by governments, observer organizations, and academia on the basis of scientific merit and academic credentials.

The IPCC is currently working on its Fifth Assessment Report (AR5), which will be published in 2014. Like previous ARs, the outline for AR5 was developed through a scoping process that involved climate change experts from all relevant disciplines, representatives from governments, and other interested stakeholders. The outline was adopted during the 31st IPCC session in Bali, 26-29 October 2009 and specifically notes that “Chapters 14-17 will include case studies of, e.g., Least Developed Countries, indigenous peoples and other vulnerable countries and groups” (IPCC-XXXI/Doc 20, Rev.1).

The IPCC AR4 noted that indigenous knowledge is “an invaluable basis for developing adaptation and natural resource management strategies in response to environmental and other forms of change.” This was reaffirmed at the 32nd Session of the IPCC in 2010 which stated that “indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost-effective, participatory and sustainable” (IPCC-XXXII/Doc 7). There has also been an increasing realization that the observations and assessments of indigenous peoples and marginalized populations provide valuable regional *in situ* information, offer regional verification of global scientific models and satellite data sets, and provide the basis for successful adaptation and mitigation strategies.

But observations and assessments by indigenous peoples, marginalized populations and developing country scientists have remained relatively inaccessible to the IPCC process,

mostly due to language and socio-cultural barriers. For the most part, indigenous and marginalized people's knowledge published in grey literature (i.e. literature that is unpublished or published outside peer-reviewed academic forums) or that is made available through non-written media has remained outside the scope of IPCC assessments.

At its 32nd session, the IPCC recommended broadening the participation of regional experts, the inclusion of grey literature, literature in other languages, and the organization of workshops - particularly in developing regions - to collect and assess relevant *in situ* observations and scientific data on topics relevant to AR5 (IPCC-XXXII/Doc 7).

Workshop Series

Noting that assessing impacts on all regions and populations is the mandate of Working Group II and that issues related to indigenous peoples and marginalized populations will be prominent in several of the chapters of the AR5, IPCC and UNU in July 2010 agreed to co-organize two workshops to redress the shortfall of available information on indigenous and marginalized peoples and their climate change adaptation and mitigation. Subsequently SCBD, UNDP and UNESCO agreed to help co-convene these events.

The two workshops – which will focus on adaptation and mitigation respectively – are intended to bring together lead authors for the AR5, indigenous peoples and marginalized population experts, and developing country scientists. The workshops allow for more in-depth focus on the topics and regions for which IPCC is seeking input. The workshop outcomes will be made available to Working Group II and Working Group III lead author meetings for the AR5, as well as to the general public. An international panel of experts will oversee both workshops.

Aims

The overall aims of this workshop were to:

- Advance understanding of climate change vulnerability, adaptation and mitigation with respect to indigenous peoples and marginalized populations, with particular attention to vulnerable regions.
- Compile regional and local data that are relevant for understanding climate change impacts, adaptation and mitigation involving local and indigenous knowledge holders, marginalized populations, developing country scientists and consulting also grey literature.
- Engage indigenous peoples, marginalized populations and developing country scientists and their research in international climate dialogues and debates.
- Provide policy-makers with relevant information on the vulnerabilities, knowledge and adaptive capacity of indigenous peoples and marginalized populations.

Participation and Documentation

Participants

The workshop on *Indigenous Peoples, Marginalized Populations and Climate Change: Vulnerability, Adaptation and Traditional Knowledge* was attended by 84 participants, representing research scientists, indigenous community representatives and international organizations.

A detailed review was undertaken of over 350 international submissions. Abstracts were assessed according to the following criteria:

- Criterion 1: Relevance to the workshop theme *Climate Change Vulnerability, Adaptation and Traditional Knowledge*, i.e. concerning specific knowledge and practices of indigenous peoples/local communities/marginalized populations about climate change impacts and/or adaptation.
- Criterion 2: Anchored in one of the following two categories: (1) based on field data and/or knowledge that comes from the communities of interest, whether indigenous, local or marginalized; or (2) concerning a comprehensive literature review on a specific topic relevant to the workshop theme.
- Criterion 3: Based either on rigorous and thorough research, or – in the case of abstracts submitted by indigenous or marginalized communities and/or their representatives – on an in-depth understanding of the knowledge and practice being discussed.
- Criterion 4: Particular attention was given to abstracts submitted from (or pertaining to) regions of heightened vulnerability to climate change. Such regions included small islands, low-lying coastal regions, high altitudes, the Arctic, and desert margins.

50 experts were selected to present papers during the workshop. Presentations were given in eight panel sessions (run in two parallel sessions over three days). A list of participant names and biographies is available in a separate document as outlined in Annex A.

Abstracts

A complete list of accepted abstracts is available in a separate document as outlined in Annex B.

Papers

Draft papers were submitted prior to the workshop. Finalised papers have been requested to be submitted by 10 September 2011, and will be made available in a separate document shortly after this date.

Presentations

Please see the abstracts and papers for details of the issues discussed in each presentation.

Side Event

A two-part side-event was organised, to report on regional and global networks and initiatives in community-based climate adaptation. Presenters included the Indigenous Peoples' Climate Change Assessment, EALAT (*Reindeer Herding Vulnerability Network*), National Water Commission, Mexico (CONAGUA) UNDP/GEF Small Grants Programme, UNESCO's Climate Frontlines and UNU-IAS Traditional Knowledge Initiative.

Workshop Convenors



Intergovernmental Panel on Climate Change



Mexican National Institute of Ecology



Secretariat of the Convention on Biological Diversity



United Nations Development Programme - GEF Small Grants Programme



United Nations Educational, Scientific and Cultural Organization – Local and Indigenous Knowledge Systems



United Nations University

Donors

Many thanks to our generous donors for making this meeting happen.



Officers

Meeting Co-Chairs

Herminia Degawan and Igor Krupnik.

Panel Chairs

Edwin Castellanos, Herminia Degawan, Igor Krupnik, Roger Pulwarty and Saul Vicente Vasquez.

Rapporteurs

Viviana Figueroa, Kirsty Galloway McLean, Terence Hay-Edie, Douglas Nakashima, Ame Ramos Castillo, Jennifer Rubis and Hans Thulstrup.

Opening Panel

The opening panel started with a welcome address delivered on behalf of the Mexican National Institute of Ecology.

Vicente Barros provided an overview of the IPCC including its function, rules, and procedures. Barros also presented a synthesis of the key findings from Working Group I to the 4th Assessment Report including risks to unique and threatened systems, risks of extreme weather events, distribution of impacts, aggregate impacts and risks of large-scale discontinuities. Barros then provided a summary of emerging issues that include Article 2 of the UNFCCC, equity between developed and developing countries, technologies especially those related to renewable energies, and commitments to emission reduction through existing infrastructure. Barros closed his presentation with a review of topics relevant to Working Group II and details in the AR5 outline relevant to the workshop.



Photo 1: Vicente Barros, Keynote Address

Igor Krupnik and Minnie Degawan, as co-chairs of the workshop, shared their perspectives on bringing local and indigenous knowledge into international climate change processes. Drawing on experiences as a steering committee member of the 2007-2008 International Polar Year (IPY), Igor described efforts to bring together social scientists and indigenous peoples of the Arctic. He detailed elements of the process of

engaging social sciences, indigenous peoples and polar residents into the IPY. Minnie, a Kankanaey Igorot from the Philippines, discussed how knowledge is passed down from generation to generation and how climate change, alongside other factors, erodes these traditional knowledge systems. She also spoke about the long struggle of indigenous peoples to have this knowledge respected and recognized in international fora, including through the adoption of the UN Declaration on the Rights of Indigenous Peoples. She ended by encouraging participants to see workshops like these as opportunities that could open new doors for indigenous peoples to be able to participate in processes that inform national policies on climate change.

Panel Discussions

Panel A: Indigenous peoples' foundations for adaptation decision-making

Chair: Saul Vicente Vazquez

Myrna CUNNINGHAM KAIN *Climate Change: Adaptability measures of Indigenous Peoples and African descendants of the Caribbean Coast of Nicaragua*

Son Ngoc HO *Vulnerability and adaptation to climate change among Indigenous communities in northern Vietnam*

Darren KING *Climate Change and Māori Society: Risks, Capacities and Opportunities*

Andrew ONWUEMELE *Documenting Indigenous knowledge of Climate Change, Coping and Mitigation Mechanisms: The Case of the Niger-Delta, Nigeria*

Wilfredo V. ALANGUI *Forest of the Lost Child, Dus Ailal & Dahas: Recognizing Indigenous Peoples' Traditional Knowledge in Forest Management as Means for Climate Change Adaptation and Mitigation*

John LERNER *Climate Change Vulnerability, Adaptation and Indigenous Knowledge in Clayoquot Sound British Columbia*

Summary of presentations

Myrna Cunningham Kain presented a study on climate change adaptability measures used by the indigenous people of the Nicaraguan Caribbean. Information was gathered from twelve case studies to identify vulnerabilities and risks arising from climate change. Participants reported increases in the strength of winds and frequency of storms, resulting in modified local ecosystems and an increase of health problems. The loss of forest areas has impacted on biological diversity, livelihoods and social fabric of indigenous peoples. The primary adaptability measures include delimitation and ownership of territories, promotion of social control mechanisms, and cultural revitalisation.

Son Ngoc Ho reported on vulnerability and adaptation to climate change among Indigenous communities in northern mountain regions of Vietnam. This study found that different ethnic groups with different socio-economic status and cultural differences are vulnerable to climate and other stresses in context-specific ways. Most adaptation options, such as intensified agriculture, are short-term coping responses, which may undermine future adaptive capacity. Creation of livelihood opportunities and ensuring the ability of indigenous peoples to contribute to government policies will be central to ensure communities are resilient to climate change.

Darren King discussed key spheres of influence that complicate the climate change issue for Māori Society in New Zealand. Strategies to ensure long-term sustainability in the face of climate change include Māori defining their own aspirations, collaborating and driving new research and strategies, drawing on customary values and knowledge,

and participating in discussion and active solutions at all levels ranging from local to national business and political fora.

Andrew Onwuemele reported on qualitative and quantitative studies documenting indigenous knowledge of climate change in the Niger-Delta region. Although many respondents did not understand the term 'climate change', the results revealed a high percentage of respondents agreed that climatic elements (rainfall, temperature) were changing (91%) and that over half noted that this had negative impacts on their livelihoods. A variety of coping strategies based on traditional practices have been adopted, including livelihood diversification, changes to planting dates and crop species, and relocation.

Wilfredo V. Alanguí reported on three case studies on traditional forest management as practiced by the indigenous peoples of Loita Maasai (Kenya), Miskitu (Nicaragua) and Dayak Jalai (Indonesia). The studies show that indigenous peoples' worldviews and their indigenous knowledge of forest management are their best protection from climate change. Recognition, protection and fulfillment of indigenous peoples' rights over their forests and the sustained use of their knowledge in forest management are crucial to ensure resilience.

John Lerner presented a study on climate change adaptation in the Clayoquot UNESCO Biosphere Reserve in British Columbia. The communities hope to respond proactively to climate change through reducing unsustainable human use and by restoring natural habitats where possible, and by strengthening key community assets, including health and safety resources, local economies, food supply systems, housing and infrastructure and cultural, social and political resources.

Key Points Raised in the Discussions

Foundations for decision-making

Indigenous peoples should participate in decision-making on adaptation as they are vulnerable to the effects of climate change, not only because they are exposed to many risks, but also because they are highly marginalized economically and socially, and especially because their territories are not legally secure.

The issue of traditional knowledge cannot be separated from the topic of spirituality and worldview, land and biodiversity of indigenous peoples. For example, the wisdom to interpret the nature and behavior of birds and trees and use it in weather forecasting.

Local languages are key to building and transmitting knowledge. However, the current trend is that native languages are threatened around the world and thereby lose an important part of traditional knowledge.

Indigenous and marginalised people are involved in these problems and are developing policies to address this situation. In many cases they have developed their own regulations to protect forests, waters, to protect each other and outsiders. The discussion also noted that indigenous peoples' traditional knowledge is constantly adapting to changes in the environment.

Recommendations

Sharing traditional knowledge and scientific knowledge is key in further developing knowledge essential to fighting climate change. However, it is necessary to get free, prior and informed consent from indigenous peoples and their communities before doing any research to further develop such projects, to enable them to participate fully in the process.

Adaptation measures are related to the reconstitution of territorial and cultural heritage of indigenous peoples, as well as the security of their territories.

It is important to promote the educational processes from the indigenous peoples' intercultural education, including intergenerational dialogue, the revival of traditional economic and productive practices, production of traditional and culturally appropriate foods, and strengthening of native languages. Projects where Western scientists can learn from indigenous and marginalized communities should also be encouraged. Training of youth to enable them to continue with the lifestyles of the older generations should be promoted as a strong foundation for the process of adaptation to climate change.

Public policy must consider the different levels and realities of indigenous peoples and marginalized populations, including their participation in the development of these policies.

The United Nations Declaration on the Rights of Indigenous Peoples must be used as the foundation for any negotiations with indigenous peoples, including those relating to climate change.



Photo 2: Andrew Onwuemele and Petter Jacobsen

Panel B: Adapting livelihoods to enhance climate resilience

Chair: Roger Pulwarty

Petter JACOBSEN *Tlichó Traditional Knowledge of Climate Change and the Impacts on Caribou Hunting*

Piedad MARTIN *The native Kokonukos and peasants define their own route of adaptability to the climate change: experience in the Colombian Andes*

Victoria SHARAKHMATOVA *Socio-Economic Conditions and the Impact of Climate Change on Traditional Land-Use for Indigenous Peoples of the North as a Subject of Sociological Research*

Henri Ole SAITABAU *Impacts of Climate Change on the Livelihoods of Loita Maasai Pastoral Community and Related Indigenous Knowledge on Adaptation and Mitigation*

Silvia SILVESTRI *How Kenyan Farmers Perceive and Adapt to Climate Change and what are the barriers to adaptation: a community-based perspective in pastoralist areas*

Sabine TROEGER *"Everything that is happening now is beyond our capacity!"—Nyangatom Livelihoods under Threats*

Summary of presentations

Petter JACOBSEN presented on the traditional knowledge of the Tlicho and the impacts of climate change on a society in northern Canada whose economic and cultural life centres on caribou hunting. Tlicho elders observe that the caribou are moving farther North, away from the community. This affects the timing of the hunt and obliges people to travel further, increasing cash dependency for fuel. In the Tlicho worldview, natural and social spheres are closely interlinked. They therefore understand climate change as the consequence of changing lifestyles, an increasing disconnect from nature and an accompanying disrespect for the spiritual values of the hunt.

Piedad MARTIN presented the experience of the indigenous Kokonukos and peasant communities of the Colombian Andes, where science and traditional knowledge were combined to enhance local understandings of climate change and helped identify options for adaptation. Response centred on mechanisms rooted within the local social fabric such as enhancing protection for native plant varieties, reinforcing the exchange of plant varieties and related knowledge through bartering, and the setting up of early warning systems for natural disasters that are based on local observations of climatic conditions and elders' knowledge.

Victoria SHARAKHMATOVA reported on the outcome of a survey of the socio-economic conditions and the impact of climate change on indigenous peoples in Kamchatka, Russia. She drew attention not only to direct threats from climate change on indigenous livelihoods, but also to increased impacts from the expansion of extractive industries due to a warming climate. She concluded by underlining the importance of establishing climate change monitoring networks that directly involve indigenous peoples.

Henri Ole SAITABAU, a member of the Loita Maasai pastoral community of Kenya and Tanzania, provided information on indicators that predict the coming of rain or forewarn of impending drought, so as to guide the community in critical decision-making with respect to their livelihood. In addition to highlighting the challenges associated with living on a territory that straddles two countries, he also emphasised the grave consequences of climate change on the ceremonial life of the community.

Silvia SILVESTRI investigated how pastoral communities in Kenya perceive and adapt to climate change. Older and experienced pastoralists were found to have a better overall understanding of climate change than their younger counterparts. The negative impacts of climate change were more strongly associated with drought (too little rain) than with flooding (too much rain). She concluded that government support is an important necessity for increasing community resilience.

Sabine TROEGER presented the numerous challenges facing the Nyangatom agro-pastoral peoples of southern Ethiopia where severe climate change impacts appear to be shaking the very foundations of their society and traditional livelihood. Environmental changes are so drastic that people are considering re-naming their seasonal calendar as traditional indicator species are no longer reliable. The difficulties brought on by drought are intensified by conflicts with hostile neighbouring groups and diminished access to pastoral lands due to the establishment of protected areas.



Photo 3: Piedad Martin presenting

Key Points Raised in the Discussions

Cosmology and representation of climate change processes

For the Tilcho hunting peoples (Subarctic Canada), physical and social spheres are interlinked, Nature is social. This means that the environment is shaped by human action, and that explanations for environmental change must be sought in human conduct. Tilcho elders understand climate change as a consequence of the improper and disrespectful behavior of their people (often younger Tilcho) who, due in part to changes in lifestyle, are no longer closely linked to the land and who no longer hunt spiritually.

1. Understandings of climate change are rooted in specific cosmologies.
2. For communities, explaining climate change is also an opportunity to reaffirm core cultural values.

Challenge of integrating indigenous perspectives into compartmentalized science:

The case studies illustrate how societal and physical changes are all recited as part of the same story. These case studies could provide inputs to several chapters of the IPCC report, as indigenous responses are integrative.

Knowledge of climate change impacts may vary with age (and gender):

In the case of farmers in Kenya, older and more experienced farmers were aware and knowledgeable about climate change and its impacts, while other groups reported no experience with nor impact from climate change.

Climate change impacts on social and spiritual life

For the Loita Maasai pastoral peoples (Kenya/Tanzania), climate change has resulted in increased drought, causing poor harvests, livestock loss and a proliferation of invasive plant species. In addition, drought undermines social and spiritual life as conditions required to perform key ceremonies depend on rains. Ceremonies (age group graduation for men and fertility rituals for women) cannot be conducted without plants and insects, as well as honey, which are all rain-dependent. To add to the difficulty, as several villages come together for ceremonies, if rains are interrupted and a ceremony must be stopped, then the assembled persons must remain on site until the ceremony can be completed. This creates considerable socio-economic stress, as in one case presented, villagers had to remain on site for 2 years before the ceremony could be recommenced and completed.

Impact is due to the irregularity of rains (changes in seasonality and within seasons) as opposed to increase/decrease in annual precipitation totals

Nyangatom pastoralists of Ethiopia point to the irregularity of rains, as well as their lack of predictability. On some occasions there is too much rain causing floods and on other occasions not enough.

Traditional calendars and climate change

Several peoples report that their traditional calendars no longer work. This may be interpreted in several ways. The collapse of traditional calendars and accompanying failure of prediction capacity may represent a severe perturbation of knowledge systems, which may weaken adaptation capacity, not only materially but also intellectually. On the other hand, despite the 'failure' of calendars, people may nevertheless retain their capacities to predict weather (e.g. Cauca, Columbia example), and others are considering renaming or reorganizing the components of their traditional calendars (e.g. Nyangatom, Ethiopia).

Diminished adaptation options due to encroachment on traditional territories:

Two major alternative pastoral areas that Nyangatom pastoralists of Ethiopia relied on in the past in times of drought are no longer accessible due to armed conflicts with neighbouring pastoral groups (Turkana). The other area where they move their herds in hard times is now bounded by a national park where grazing is illegal but may be tolerated. External encroachment reduces traditional adaptation options. Expansion of extractive industries in Kamchatka (Russia), facilitated by global warming, is a secondary threat from climate change on indigenous peoples in the Arctic.

In the Cauca Basin (Colombia) the need to end conflict between the rural farmers and indigenous peoples have been recognized. However while people report that they are protectors of the land they also report feeling alone in the process.

Proposals to diversify livelihood options may not align with local values and aspirations.

Adaptation options do not always fit with what people would like to do. Capacity and resources are important but not the only issues. Insecurity of rights and loss of traditional knowledge may play important roles. Measures must be related to what communities are already doing. The cultural significance of hunting for instance, may differ from one group to the next. For some, hunting is recreation, while for others hunting is a sacred way of life.

Land use changes for carbon sequestration and introduction of new crops such as sugar cane are recommended at the national level (Nyangatom, Ethiopia) without concomitant assessments of the resource requirements (e.g. water) to support the proposed alternatives.

Other social and economic changes may hamper climate change adaptation:

For example, the Tilcho peoples (Canada) are now sedentarized and would no longer consider displacing the community in order to follow the caribou herds when changes in their migration routes due to climate change takes them further and further from the village. Therefore recent changes from nomadic to sedentary lifestyle can diminish climate change adaptation capacity (exacerbate vulnerability). Other practices which could be used as informal adaptation strategies, such as bartering (exchange of products), are being lost.

Indigenous capacities are not broadly recognized and are being eroded.

This includes knowledge, know-how, practices and other assets (e.g. sustainable food systems and livelihoods, resource management strategies, social linkages and safety nets) that sustain livelihoods, ensure food security and community resilience. "Everything is beyond our capacity" (Nyangatom). At the same time, support to these communities that would allow them to benefit from scientific knowledge and technology is not being realized. Common grounds for communication and joint action are needed. This is a critical input to mainstreaming adaptation information and strategies into practice (all cases presented indicate this broader issue) and to ensure that seasonal or short-term adjustments do not engender long-term risks in the context of adaptation to climate change.

Opportunities exist to create synergies between traditional knowledge and western science. Joint fact finding or co-production of early warning information systems, for example, would better inform adaptation and redefine the role of extension as facilitation as opposed to technology transfer (see Kenya case-Abstract 44-Silvestri et al).

Panel C: Dimensions of climate change vulnerability

Chair: Igor Krupnik

Anne McDONALD *Can the Traditions of Her Ancestors withstand the Challenges of Climate Change: community-based marine resource management for over 1300 years among the female ama divers of Japan*

Maude BEAUMIER *Vulnerability of Inuit women's food system to climate change in Nunavut, Canada*

Nadezhda FENLY *Forests and Tuapi indigenous women: Food security promotion experience*

James FORD *Climate change and the health of Indigenous populations: What we know, don't know, and need to know*

Stefanie CHRISTMANN *How to address the local knowledge gaps and local potential for climate change adaptation adequately? A pilot research in mountain villages in Western Tajikistan*

Jan SALICK *Tibetan Ethnobotany of Climate Change in the Eastern Himalaya*

Chie SAKAKIBARA *Singing for the Whales: Environmental Change and Cultural Resilience among the Iñupiat of Arctic Alaska*

Summary of presentations

Anne McDonald focused on the resilience of the traditional knowledge of female *ama* divers in Japan, and their adaptation to a changing marine environment that is being studied and recorded by scientists. Community-based management techniques to adapt to increasing ocean temperatures and depleting marine resources include implementation of no-fish zones, decreased fishing times and diversification of livelihoods, but this is not enough.

Maude Beaumier looked at the vulnerability of Inuit women's food systems to climate change and the conditions in which it creates food insecurity. Food security and health are closely linked, particularly when food insecurity is a chronic underlying problem, with those who are food insecure more likely to suffer from compromised health status. Sharing networks are a good coping strategy, but the ability to continue these responses is stressed by the economy.

Nadezhda Fenly reported on the indigenous women of the *Tuapi* indigenous community (Nicaragua), their adaptability measures in face of climate change practiced throughout the last thirty years (adapting traditional products to meet market requirements, use of family gardens, reintroduction of traditional techniques to recover lost plants), and the impact of Hurricane Félix on their way of life and food security.

James Ford reviewed key threats to health associated with climate change, including increasing exposure to infectious diseases, exacerbated water and food insecurity, natural disasters, and population displacement. In many cases, the health consequence of climate change will be exacerbated by other global environmental stresses.

Stefanie Christmann reported on a case study in two mountain villages in Tajikistan that showed an increased potential of local communities to adapt to a changing climate if they get timely access to information and capacity building.

Jan Salick reported on quantitative changes in Alpine plant ecology and explained how climate change threats to alpine plants also threatens Tibetan health, agriculture, and traditional Tibetan culture. Tibetans adapt to climate change by modifying their agriculture and their culture. However, Tibetans are deeply worried about the spiritual implications of climate change.

Chie Sakakibara illustrated how collective uncertainty about future environmental conditions is expressed and managed in Iñupiaq practices in Barrow and Point Hope in Alaska, and by extension, how deeply climate change penetrates the cultural core of their society. Emotional intensity is revealed in the prevalence and commitment to traditional and newly invented whale-related events and performances.

Key Points Raised in the Discussions

Vulnerability

Indigenous peoples and marginalized populations are subject to multiple pressures related to climate change, as the consequences of climate change typically interact with and exacerbate a cluster of other stressors, such as the loss of biodiversity, land-use change, degradation of ecosystem services, poverty and other socio-economic trends. Secondary and tertiary effects from climate change are also significant stressors. For example, climate change impacts on food sources result in increased food insecurity of certain groups or population sectors (e.g. women) that, in turn, affects general population health and human safety. Breakdown of certain social practices and rituals is another 'secondary' impact of climate change, which affects communities' capacity to adapt.

Sectors of the community that are already more vulnerable within local social structure often suffer more severely from the effects of climate change. For example, women are the first to suffer from food insecurity. However, it is these more vulnerable segments that are often most closely interacting with the local environment and therefore they are also the first to report changes resulting from climate change.

The occurrence of unexpected and unprecedented climate events is increasing in many areas (like extreme droughts or hurricanes or extreme droughts in the areas where they have not previously occurred). In many cases such events fall outside the existing traditional knowledge, as they are not part of the oral history of these regions.

Adaptive capacity

Most indigenous and marginalised communities are implementing creative adaptive strategies to cope with climate change and its stresses. However, in many cases the environment is changing too quickly or too dramatically to enable them to adapt. Detailed local studies are essential for any reliable regional or global assessments, as all cases are different. Certain types of changes are resulting in adaptive strategies that currently exhibit a measure of success, such as changes in hunting, gathering or agricultural practices in response to changing weather patterns or distribution of local resources. In many cases, however, the scope or forces of changes seems to be beyond the capacity of communities to adapt, for example, increase in ocean temperatures, melting of sea ice, ocean acidification or extreme droughts.

There have been many reported cases of loss of traditional knowledge or abandonment of traditional ways of life. However, in certain cases, adaptive responses to climate

change also include strengthened interest in traditional knowledge and revitalization of traditional practices, including cultural and spiritual traditions, as a way of coping with the impacts of climate crises.

Recommendations

There appears to be a deficit of empirical and, particularly, indigenous-led research on the impacts of climate change on health and well-being of indigenous and marginalized communities, specifically on their mental health. Further research in this area is critical, given multiple reports that climate change is resulting in significant anxiety associated with people's inability to forecast what is really happening or to sustain their lifestyles and social institutions. This inability can manifest in communities' feeling a sense of blame for changes in the environment (e.g. resulting from breaking their age-old bonds with the Nature) or in widespread doubt that enough adaptive capacity exists to survive. Here, again, stressors of climate change commonly amplify the ongoing social transformation.

Current mitigation responses to climate change in general, and the IPCC process, in particular, are typically organized and channeled at the national level. But national strategies developed and implemented by the governmental agencies are not always helpful to ways that indigenous peoples and marginalized populations are trying to adapt to climate change. Governmental programs to assist in adaptation often result in taking the initiative out of the hands of the people. Such complicated top-down approaches can hinder rather than help early adaptive efforts, which are also intricately linked with local knowledge, sustainable livelihoods and community capacity building. Long-term, respectful collaborative relationships between communities, governmental agencies and academic institutions may help strengthen adaptive capacity of indigenous peoples and marginalized communities on the global scale.



Photo 4: IPMPCC Participants

Panel D: Dimensions of climate change resilience

Chair: Edwin Castellanos

Carlos GODFREY *Alliance of Guardians (Indigenous Peoples and Farmers) of native seeds as an autonomous measure for climate change adaptability*

Felipe Pedro MARCOS GALLEGO *Mayan Indigenous Geography IXIL: Indigenous rules on the use of water, the forest and wildlife*

Yiching SONG *The role of indigenous knowledge and biocultural systems in adaptation to climate change*

Angel MUJICA *Traditional indigenous knowledge and practices in the Andes for adaptability and diminishment of climate change impacts*

Jordi SURKIN *A Landscape of Change: Community Based Adaptation and Vulnerability to Climate Change and its Social, Institutional and Ecological Inter Linkages in Bolivia*

Lun YIN *Local Knowledge on Climate Change—A case study of a Tibetan village in Yunnan province, China*

Estelle MAWAL *The Baka of East Cameroon and the Challenges of Climate Change*

Summary of presentations

Carlos Godfrey addressed the need to recognize the important role of native seed varieties in building local resilience, arguing that a critical element in adapting to climate change pertains to the revitalization and strengthening of indigenous cultures to avoid “permanent cultural degradation”. Adaptation is a holistic strategy and not an isolated action. The main external threat comes from the actions against the autonomy of the indigenous peoples, particularly with subsidy activities that create dependency and erode the local tradition and culture.

Felipe Marcos presented the role of indigenous territories in safeguarding food security and sovereignty for indigenous Mayan peoples, in particular for the Ixil communities; the need to consider water and other components of nature from a holistic perspective not individually; for example, from the indigenous perspective, rivers are “the blood of the forests”. There is a need for legal recognition of the local indigenous institutions and production systems.

Yiching Song presented the experience of three provinces in China noting that within the last 40 years there has been a significant loss of biodiversity in agriculture: from some 12,000 varieties of traditional crops now only a set of 200 hybrid varieties are used as a result of a trend towards monocropping and the privatization of the public good. She presented the initial experience of a pilot program for an Access and Benefit-Sharing (ABS) agreement with 11 villages. Different hybrids require different forms of ABS agreements” with varying levels of benefit-sharing for “farmer-led” or “breeder led” systems of Participatory Plant Breeding (PPBs) which address climate change resilience.

Angel Mujica expressed that the diversity of cultures, knowledge and life in the Andes has not been valued in its full dimension. There are many agricultural practices already in place to deal with extreme weather conditions. Genetic diversity is one of the main strengths of the agricultural systems to produce resilience to a changing environment as well as the integrated management of plants and animals within the ecosystem.

Jordi Surkin developed a vulnerability index and map for Bolivia. The perception of rural communities are that flooding occurs more frequently, but droughts are also more intense; periods of rainfall are shorter and rain is coming later in the year. Adaptation actions are linked to cultural rituals and practices that require a strong social capital, but all of this is being eroded by actions such as migration to urban areas. One important question is whether current practices will be useful under more intense climate variability in the future.

Estelle Mawal presented a study on the vulnerability and adaptation of the Bakas group in Cameroon. Adverse climatic conditions have resulted in loss of seeds, poor harvests and scarcity of animals for hunting. The reaction has been to replace the seeds that die looking for crops that are more resistant to warmer conditions and for hunting to place traps in places near rivers. They have also diversified to use other forest products such as a liana that produces drinking water. It is important to strengthen their organizational capacities and to help them improve their agricultural practices.

Key Points Raised in the Discussions

Data, knowledge, wisdom and culture

Adaptation processes should go beyond the mere listing and analysis of local and traditional knowledge. They should emphasize the recognition, affirmation and preservation of local cultures before they disappear as they are threatened by various external pressures, particularly the interaction with outside knowledge and culture. It is important to counteract the erosion of the continuity of knowledge from indigenous cultures.

One external pressure that can be both beneficial and dangerous is the practice of subsidies. Financial assistance has shown to be important in improving the adaptive capacity of communities and is often a limiting factor for many families to be able to adopt desirable practices, such as increasing diversity of crop varieties and sources of income. On the other hand, if economic aid is used as a control mechanism to produce a dependency of the recipients, for example with the practice of conditioned transfers (when a government gives a subsidy to a family if a condition is met) then the practice can become very negative for the affirmation of local practices and culture. The term subsidy or economic assistance should be avoided; it is more proper to speak of compensation for the efforts of indigenous groups to preserve the environment.

Local practices and global pressures

Local practices are frequently undermined by strong pressures from factors of global nature deriving from political and economic trends. The establishment and support by central governments to produced cash crops for exportation, reduces the emphasis on helping to improve production for local consumption. This has resulted in food insecurity which needs to be addressed not by importing food produced elsewhere, but by enhancing the local capacities for production, therefore resulting in food sovereignty. It is also important to increase the awareness of consumers in developed markets about the impact of their decisions on the global and local environment at distant locations where the goods are produced.

Paradox of vulnerability and adaptive capacity:

We have presented many cases where indigenous knowledge and practices have been crucial for communities to adapt to harsh conditions and changing environments, therefore indicating a high adaptive capacity. On the other hand, we also know that these same regions are struck with poverty and very low development indexes which result in high vulnerability. So, communities with high capacity to adapt are also highly vulnerable. Two possible explanations were suggested: one is that rural and indigenous communities are not homogeneous and one can find a family with very good practices living next to one that is barely surviving. Also, local knowledge and practices might not be enough to confront changes of global nature that are putting these communities under stresses that were previously unknown. This brings the question of whether the current knowledge and practices will be enough to properly confront the rapid changes expected in the future. Most likely, the local knowledge will have to be complemented with outside knowledge of scientific nature. The challenge, still unsolved, is how to integrate the knowledge that was produced following different protocols and epistemologies and under different cosmovision of the Earth.

Linkages with public policies:

It is important to translate the discussions and knowledge from these meetings into public policies at the national and international level that are shaping the way indigenous communities live. Moving from discourse to action is crucial. Unfortunately, we see that many policies are contrary to the discourse heard at international meetings and also from national governments. We need to be creative to bring messages to the proper decision-makers to result in concrete actions and to modify existing institutions to include new ways of thinking. When translating local perceptions to add to the international discussion, it is important to pay attention to the language so that the original message from the indigenous groups remain.



Photo 5: Douglas Nakashima, Sam Johnston, Vicente Barros

Panel E: Managing water resources in changing environments

Chair: Minnie Degawan

Sarah DEKDEKEN *Securing food through the Lampisa indigenous practice of resource management of the Pidlisan tribe in the Cordillera, Philippines*

Prabhath PATABENDI *Climate Change Adaptation & Traditional knowledge in Agricultural Societies – A case study from Sri Lanka*

Prakash TIWARI *Changing Rainfall Pattern and its Impact on Food Security in Himalaya: Responses & Adaptation by Indigenous Marginalized Mountain Communities*

Margaret HIZA REDSTEER *Increasing Vulnerability to Drought and Climate Change on the Navajo Nation, southwestern United States*

Alemayehu HAILEMICAEL *Indigenous talent of Konso people to cope up climate change susceptibility, Ethiopia*

Chiara PERUCCA *Integrating social and cultural perspectives in addressing Climate Change: Social Water Management among indigenous Mundas in the Sundarban Forest, Bangladesh*

Summary of presentations

Sarah Dekdeken presented the Lampisa system of water management, which is practiced by the Pidlisan tribe of the Philippines. To ensure that their rice terraces receive fair distribution of the limited water resource, the community uses a system of formal (i.e. ritual, governance and structure) and informal (i.e. social prestige) rules that the community developed after a period of water scarcity.

Prabhath Patabendi spoke about the rural community in Hambantota, Sri Lanka, which is faced with declining agricultural productivity. Key contributors observed by the people interviewed include salt water intrusion, rainfall and temperature variations. While there is less rainfall, drying up of lakes and irrigation canals, the community of Hambantota also has to deal with the impacts of mega-developments and governance. While the community has its own knowledge to try and increase agricultural productivity, political governance considerations prevent this recognition.

Prakash Tiwari discussed how the indigenous agricultural peoples of the Himalayas are observing changes in rainfall and describe it as being erratic and inadequate for irrigation. Natural springs are also drying up. Coupled with labor scarcity, lack of improved seeds and extension services are leading to food deficit levels in the villages surveyed. In response, the community are revisiting their knowledge to replenish water sources through forestry and using traditional rainwater harvesting schemes.

Margaret Hiza Redsteer noted that weather monitoring data can be enriched through the sharing of observations and knowledge from indigenous peoples. The Navajo people have been observing and living with drought conditions since 1994. Their continuing situation is exacerbated by their political marginalization by the government and the denial of their right to access their rivers.

Alemayehu Hailemicael described how through historical circumstances, the Konso people of Ethiopia live in a terrain characterized by stony steep slopes. They use an

intricate system of terraces and channels to manage their water resources. This intricate system has gained international recognition for the Konso people.

Chiara Perucca explained how the traditional knowledge of the Munda peoples of the Sunderbans forest is rooted in priorities that may not always be recognized and acted upon by external agencies. Recognizing local priorities, and not just their knowledge, is important in facilitating resilience.

Key Points Raised in the Discussions

Socio-cultural systems and governance

Socio-cultural systems and institutions (cf. *Lampisa system of Kankaney people, Konso traditional culture*) are used to ensure that limited water resources can be shared among the community. These systems need to be reinforced by a sense of community unity, whether through ritual or institutionalization.

The political governance that leads to the marginalization of indigenous peoples and local communities and promotes mega-development (cf. *Navajo nation coping with drought, Hambantota rural communities with declining agricultural productivity*) needs to be considered when discussing the factors that impact a people's ability to cope with changing environmental conditions.

Knowledge transfer

Local knowledge is not static and can be transferred (cf. case study of *Munda people of Bangladesh*). Traditional knowledge may also be revived to cope when water resources become more uncertain (*traditional rainwater harvesting in the Himalayas*).

Indigenous knowledge systems are community specific and may not be easily replicated at the international level. However, there are important common aspects that should be highlighted. For instance, community ownership of adaptation systems must be ensured for these to succeed.

Points for further consideration

In terms of scientific research into climate impacts, indigenous peoples' spiritualities need to be considered. Researchers also need to share their results back to the communities.

Furthering the discussion on political marginalization, it is important to also realise that indigenous knowledge is rooted in the attachment of the peoples to the land. If the relationship with the land is threatened, traditional knowledge is lost. It is superficial to discuss issues of coping and resilience without securing the tenure of the local communities.

Panel F: Bringing local tools and methods into national adaptation planning and implementation

Chair: Saul Vicente Vazquez

Aloisio FILHO *The annual cycle and climate in the northwest Amazon: Indigenous knowledge and intercultural research to understand and manage the calendar and its variations*

Nancy MAYNARD & Mikhail POGODAEV *Sami Indigenous Traditional Knowledge and NASA Remote Sensing Technologies Working Together for Adaptation Strategies*

Joseph PAIMPILLIL *Adaptation Strategies of tribes in Western Ghat (India) and their age-old wisdom in practice*

Tristan PEARCE *Advancing Adaptation Planning for Climate Change in the Western Canadian Arctic*

Raul PONCE-HERNANDEZ *The Participatory Design of Adaptation Strategies to Climate Change Impacts: Integrating traditional knowledge and stakeholder consultation for the selection and creation of best adaptation model for the Tabasco Plains, S.E. Mexico*

María Silvia SANCHEZ CORTES *Indigenous perceptions on the change of climatic variability in a Zoque community of Chiapas, Mexico*

Summary of presentations

Aloisio Filho noted that observed changes in the northwest Amazon include bird migration, seasonal changes (fewer days for burning), changes in fish distribution/availability. IP concepts of the world are based on belonging to the Land. Balancing of that relationship is the responsibility of specially trained community members. Main challenge – maintaining TK in the face of change

Mikhail Pogodaev & Nancy Maynard presented joint work between the Sami and NASA. They noted that climate change leads to changes in land use. Changes in ice, snow and permafrost, together with rain on snow and increased development disrupts reindeer migration routes/feeding patterns. The Sami are using NASA technology to try and predict where these rain-on-snow events would take place in order to direct the herd to alternate pastures. Knowledge co-production approach in such a project is key. Projects must be based on “Indigenuity” (Indigenous + Ingenuity) and be collaborative – they must co-produce knowledge, have equal partnerships, and indigenous peoples must be at the table from the beginning.

Joseph Paimillil noted that local institutions regulate people’s interaction with the environment to maintain balance. Food security is ensured in the years of heavy rains and flooding through specific agricultural practices. Tribes use their knowledge of different plants to predict drought and flood periods, and use drought and flood tolerant varieties of rice. Issues for adaptation include problems of access to the land; knowledge transmission; settling community claims; and because TK is not incorporated into the “manuals” – it is not used by scientific community.

Tristan Pearce reported on adaptation planning in the Western Canadian Arctic. He noted that climate change is there already – with an average temperature increase of 3 degrees, changes in wind patterns, timing of freeze-up/break up, currents, and seasonal changes. Spring melt is changing – speed, duration, direction of the melt. Impacts on livelihoods include travel risks, changes to travel routes, health and availability of wildlife. *Ad hoc* adaptation is taking place, e.g., using boats to get to seals, something that used to be done on ice. Adaptation determinants include livelihoods and economic diversity to spread risks; household income; hunting knowledge; and social networks. There is a need to understand how climate change interacts with other economic, social and cultural processes, health implications, and future vulnerability based on TK.

Raul Ponce-Hernandez presented a watershed-based approach to Tabasco regional climate change adaptation planning. Observed effects include more frequent flooding, (e.g. 2007 worst flooding of a century, repeated in 2010). TK provides a deep knowledge of wetland ecology. TK was evaluated in the context of minimizing impact of catastrophic events.

Maria Silvia Sanchez Cortes reported on the Zoque community of Chiapas, Mexico. She noted that the agricultural calendar is important, e.g., grandparents used to sow the seeds in March, now in April. Regarding perception of climate change, 75% of people realize there is a change and these are the adults and elderly; young people do not see it because they do not have life experience to compare. The observed changes are attributed to the volcanic eruption of 1982 (“the earth got warmer”). Adaptation responses include harvesting in different areas, and switching to other non-local species, like zucchini and coffee. Vulnerability is not just because of climate change, but other social-economic factors; land property rights policies are also preventing adaptation – young people are not staying and learning; language retention is important.

Key Points Raised in the Discussions

Worldviews

Local traditional institutions, rooted in local epistemologies, regulate people’s interaction with the environment to maintain the balance. Indigenous peoples’ concepts of the world are based on their worldview, which is rooted in their belonging to the land. Balancing and re-balancing their relationship with the land according to their worldview is extremely important in local climate change adaptation strategies.

Knowledge co-creation

A knowledge co-production approach is fundamental for projects that strive to bring traditional knowledge and conventional science together. Projects must be collaborative, co-produce knowledge, create respectful, equitable and ethical partnerships, and ensure indigenous peoples are at the planning and decision-making table from the beginning.

While it is important to talk about the use of TK for adaptation, it is also critical to recognize the importance of indigenous peoples’ processes, techniques and tactics of developing, sustaining, and refreshing knowledge (i.e., borrowing, testing, etc.)

Barriers to the knowledge co-creation for indigenous peoples include restrictions on access to their land due to unresolved land claims, disruption of inter-generational knowledge transmission, loss of languages, and paucity of methodological guidelines for TK integration into various branches of science.

Using modern technologies

There are also technical ('Western science') tools which can be coupled with the indigenous knowledge to enhance adaptive capacity to climate change. Training in using modern technologies is a priority for many indigenous youth (e.g. reindeer herders use GPS collars to track animal movements). There are models out there that facilitate this type of capacity building, such as the University of the Arctic, which networks about 100 universities and colleges throughout the Arctic. These are linked through distance learning, enabling Indigenous students from around the circumpolar world to learn GIS, LANDSAT classification, and other scientific techniques.

Sophisticated satellites are monitoring changes (e.g. changes in coastal mangrove forests) and these data could be very useful for future climate change scenario planning at the local level.

Challenges to adaptation

Some of the challenges of adaptation that were presented in this session include problems of access to land and territories, the intergenerational transmission of knowledge and use of traditional knowledge by the scientific community.

In many cases *ad hoc* adaptation is being implemented to deal with climate changes issues, but this is only a short-term solution.

The coping skills of communities are related to factors such as lifestyle, social networking and economic diversity. More information is needed to understand how climate change itself impacts on these factors (e.g. social, economic and cultural).



Photo 6: Plenary report by Saul Vincente Vazquez

Panel G: Local knowledge and agricultural biodiversity in Latin America

Chair: Edwin Castellanos

Edgar ATENCIO *Preparing ourselves for transculturation and uncertainty: the challenge posed by the Ngobes in Costa Rica*

Paula FRANCO-MOREIRA *From global climate policies to local reality of Baniwa Indigenous Peoples from the Negro-Içana River, Brazilian Amazon*

Cecilia CONDE *Coping with the impact on climate change and climate variability on agriculture in Mexico: Results of two case studies*

Tirso GONZALES *Peruvian Indigenous Andean-Amazonian Communities' Assessment and Strategies to Tackle Climate Change. Results from the 2008 National Workshop on Climate Change, Food Sovereignty and In Situ Conservation of Native Seeds and its Wild Relatives*

Rider PANDURO *Peasants of the Amazonian-Andes and their conversations with climate change in the region of San Martin*

Fernando BRIONES *Climatic knowledge through phenological indicators and ritualization in the Ch'oles agriculture in Chiapas, Mexico*

Summary of presentations

Cecilia Conde presented case studies on coffee producers in Veracruz and maize producers in Tlaxca that analyzed the impact of climate change and adaptation on agriculture in Mexico. Traditional knowledge is a key element for adaptation to current and future climate changes and current agricultural policies (lack of technical and financial support) are the main sources of current vulnerability. Participatory techniques and agreements and actions should be considered as adaptation measures under climate change (capacity building). There are some current (mal) adaptation measures that could enhance vulnerabilities under climate change conditions.

Paula Franco Moreira reported on climate changes that the Baniwa (Brazil) have documented including increases in temperatures, unusual interruption of dry seasons and unforeseen rain as well as changes in fish reproduction and crop production. The Baniwa have used their TK as a coping strategy to climate change, but the ability to continue these responses is stressed by lack of legal and political recognition.

Edgar Atencio reported on the impact of climatic uncertainty on traditional agriculture in Ngobe territory in Costa Rica. Presented the disjunction between agricultural policy (ie terminator seeds) and development policies and Indigenous traditional practices and needs. Strengthening traditional knowledge is key to successful adaptation as is the importance of developing working relationships between scientists and indigenous peoples.

Tirso Gonzales presented Peruvian Indigenous Andean-Amazonian communities' assessment and strategies to adapt to climate change. Highlighted how different worldviews, conceptual frameworks and methods/tools (ie. science and TK) define understandings of and adaptations to climate change. Adaptation should focus on cultural affirmation.

Rider Panduro illustrated traditional agriculture in the San Margin region of the Andean Amazon. Presented the importance of traditional seed banks, traditional agricultural knowledge, and traditional calendars in climate adaptation processes.

Fernando Briones reported on the traditional knowledge of climate change among the C'holes in Chiapas, Mexico. Ritual activities are intimately tied to the agricultural calendar and define the success or failure of harvests. Traditional knowledge is flexible and helps to reduce uncertainty but, in many cases, adaptations to climate change are actually improvised coping mechanisms based on experiences and necessities.

Key Points Raised in the Discussions

Cultural Affirmation and Epistemology

Indigenous and marginalised communities are implementing creative agricultural measures – including crop and variety diversification, changes in planting dates, and outside-farm strategies – to adapt to climate change. However, in many cases external pressures (development, agricultural policies, introduction of genetically modified crops, forced migration, market economics) are leading to a loss of traditional knowledge, a fragmentation of communities and consequently, a loss of valuable adaptation strategies.

Adaptation strategies should first and foremost focus on cultural affirmation (strengthening traditional knowledge and language), on securing indigenous peoples'

rights including rights to their territories and homelands, and on converging TK and science in a way that empowers indigenous peoples. The issue of legitimacy must be addressed: the epistemology of indigenous knowledge differs from that of conventional science, but often the same standards of science are used to referee indigenous knowledge even though the two arise from different sources and processes.

Public Policy

Climate change cannot be properly addressed without considering its link with the political and economic issues facing local communities, which derive from national and international policies. Indigenous and marginalized peoples' adaptation measures must be reflected in public policies at the local, national and international level. Currently there is a marked disconnect between TK adaptation practices and public policies which often result in an undermining of traditional knowledge and practices from indigenous and marginalized peoples. As a consequence of this, their ability to adapt to climate change is severely impacted. It is important that decisions adopted at international negotiations such as COP 16 in Cancun become effective at the local level.

Climate-induced Migration

The occurrences of unexpected climate events (for example draughts, floods, and temperature variances) are having an impact on agricultural productivity in indigenous and marginalized peoples' lands. These impacts are exacerbated by a cluster of other stressors such as agricultural and market policies. As a result, many community members are forced to migrate to urban centers or other countries in order to send remittances back to their communities. This migration due to climate change and low productivity is an adaptation that challenges the resilience of communities to adapt to climate change because of the potential of negative social impacts.

Synergies between Conventions, Agreements, and Disciplines

Climate change simultaneously addresses numerous topics – health, diversity, poverty, development - cannot be addressed under the current convention arrangements and or the current disciplinary silos. It is important to enhance synergies between conventions, agreements and disciplines to promote cross-cutting themes.

Specifically, it is important to address the strong relationship between diversity (culture, knowledge, biological) and adaptation to climate change. The challenge to integrate different sources and types of knowledge is one of the most pressing issues.

Panel H: Achieving food security in small island states

Chair: Roger Pulwarty

Sione FAKA'OSI: *Reviving Traditional Coping Practices as Adaptation Strategies to Climate Change in Tonga*

Marjorie FALANRUW: *Canaries of Civilization: small island vulnerability, past adaptations to climate variability and the specter of sea level rise*

P. Brian FISHER: *Synergies between Communities Vulnerable to Climate Change: Cases of Tuvalu and Baffin Island (Nunavut, Canada)*

Jelena ILIC: *I am counting moon, I am counting fish – Traditional environmental knowledge and social vulnerability of artisan fishing community of Tarrafal, Sao Nicolau, Cape Verde*

Alan RESTURE: *Tuvalu and Climate Hazards: Enhancing Community Resilience to Climate Hazards through the Application of Indigenous Knowledge*

Carlos MONDRAGON and Frederick DAMON: *Seasonal environmental practices and climate fluctuations in Melanesia. An assessment of small island societies in Papua New Guinea and Vanuatu*

Summary of presentations

Sione FAKA'OSI discussed ongoing work in Tongan communities on the revival and recording of local and indigenous knowledge as a core element of adaptation strategies to cope with climate change and natural disasters. He outlined the particular vulnerability of low-lying island countries such as Tonga, and discussed how traditional methods are used to identify warning signs related to natural disasters and extreme events such as hurricanes, tsunamis, drought and rain. He outlined strategies such as the traditional long-term preservation of food, which serves to supplement the staple diet during periods of food shortage, such as in the aftermath of a disaster. He noted that local and indigenous knowledge is eroding due to an absence of inter-generational transmission exacerbated by the educational system, which does not recognize traditional knowledge.

Marjorie FALANRUW discussed traditional food production technologies in Yap (Federated States of Micronesia), detailing indigenous Yapese landscape architecture, agroforestry, taro patch systems and a wide variety of fishing technologies and cultural practices. She noted how climate change currently threatens vulnerable low-lying outer islands in Yap, leading to migration to the mainland causing additional pressure on the natural resources. She stressed the importance of incorporating indigenous technologies relating to food production and natural resource management into climate change adaptation strategies, warning that indigenous knowledge is fading and stressing the importance of documentation knowledge and stimulating its transmission.

P. Brian FISHER: presented a comparative study of two different island communities sharing a vulnerability to climate change; Tuvalu and Baffin Island (Nunavut, Canada). He demonstrated that despite significant different geographies, cultures, and environmental changes, climate change produces similar trajectories of societal impacts with significant implications for vulnerability, traditional knowledge, and local governance. He noted that climate change undermines human security, social capital and ecological integrity; and suggested that climate change adaptation should be viewed as

an outcome of sustainability. He discussed the impacts of climate change at the individual level – for example in the form of psychological stress – and noted that this area of research had received relatively little attention.

Jelena ILIC presented a paper on local environmental knowledge and social vulnerability among artisan fishers in Cape Verde. She outlined fieldwork through which the traditional knowledge of fishers was decoded in order to identify new adaptation strategies in the light of decreasing fish production, changing fish migratory patterns, lack of fish bites and late arrival of key fish species. She discussed the community's knowledge of the sea and traditional fishing techniques – including the observation of moon phases - and noted a current heightened risk associated with fisheries due to unexpected storms occurring out of season.

Alan RESTURE examined the role of indigenous knowledge in reducing disaster risks in Tuvalu, noting that coping and adaptation strategies are still to some extent based on local and indigenous knowledge in areas such as fisheries and the interpretation of nature for weather forecasting – for example through the application of a traditional seasonal calendar to forecast the occurrence of cyclones. He noted that an appropriate integration of western science and technology with local and indigenous knowledge has the potential to serve as a basis for sustainability and resource management in small island states like Tuvalu.

Carlos MONDRAGON and Frederick DAMON provided an overview of environmental knowledge practices and short- and long-term climate fluctuations in two small Pacific Island societies - Milne Bay Province (Papua New Guinea) and the Torres Islands (Vanuatu). They noted that in the Torres Islands, millennia of human presence has created a completely anthropogenic landscape - influenced by tides, winds and seasonal change - in which instability is constant. They discussed how the resulting resilient systems have experienced repeatedly the kind of changes that are now being felt globally as a result of climate change. From Milne Bay, they reported how recent climatic changes have challenged the application of traditional calendars. Finally, they noted that historical patterns and drivers of settlement need to be understood in planning for adaptation and recovery after extreme events and disasters.

Key Points Raised in the Discussions

Disaster preparedness and extreme event forecasting

In Tonga, traditional methods are used to identify warning signs related to natural disasters and extreme events such as hurricanes, tsunamis, drought and rain. This is done through the observation of sea, sky, wind, trees, animals and insects. Traditional food preservation is also practiced by communities. Preserved food serves to supplement the staple diet during periods of food shortage, such as in the aftermath of a disaster. In Tuvalu, germinating coconuts and taro would be stored underground in the past. In a current modification of this practice, plastic drums are used before burying – this protects crops during king tides.

In Tuvalu, traditional coping strategies are still to some extent based on traditional knowledge in areas such as fisheries, interpretation of nature for weather forecasting – for example applying traditional seasonal calendar to forecast/predict cyclones.

In Eastern Papua New Guinea, statements from the 90s onwards indicated that traditional seasonal calendars were no longer working. This observation was made in a region where change has been part of life for millennia.

Food production and agricultural biodiversity

In Yap (Micronesia), most traditional food is produced with simple tools – knife, stone, and stick – and the application of traditional knowledge. Also in Yap, practices have been identified that improve food security while maintaining soil quality. Yam are grown with constructed trellises, looped with bamboo - a simple, ingenious technique typical of traditional technologies. Planting is done in specially prepared mounds, improving soil quality. Yam twisted around the trellises, causing vines to thicken with more leaf density and more yam. This process was used and perfected well before named by western science. In comparison with yam grown on harvested trees, the yield was much higher - and deforestation was avoided.

In the Torres Islands in Vanuatu, gardens are organized in hilltop and coastal gardens, recognizing more than 6 soil types. This distribution in micro-environments allows flexibility with different crops in different contexts.

In Yap, the maintenance of a high crop variety, including multiple variety within each crop, contributes to food security in a fluctuating climate, by ensuring that crop availability overlaps. Also in Yap, cultural regulations and controls on diet preference were employed to avoid overharvesting – with some communities entitled to harvest only certain species.

Geophysical constraints

The session recognized that oceanic small island societies face particular vulnerabilities due to their size, isolation, limited resource and economic base.

In small island environments, there are specific constraints adaptation due to physical dimensions and geographical isolation. In the deep history of the Pacific, there are examples of island abandonment, cases in which no further adaptation was possible and evacuation the only remaining option.

Challenges to traditional small island societies and knowledge systems

Challenging the maintenance of traditional knowledge and practice, a shift from traditional to imported food is a critical transition occurring in most island environments. This exacerbates sensitivity to external markets. With climate change as a contributing factor, this shift is linked to a loss of traditional food sources, and has contributed to higher incidences of non-communicable diseases such as hypertension, diabetes, psychological stress. In cases cited from Baffin Island, Tuvalu and Cape Verde, it was noted that such psychological stress at the individual level has received little attention, but has however lead to higher suicide rates and anxiety.

The distribution of population in islands has changed through rural-urban migration. Likewise, the population of in smaller islands has decreased with urban drift to larger islands. Urban shifts exacerbate fragmentation and the loss of traditional knowledge. However, level of shift towards “modernization” varies greatly between islands.

Proximity and association with the capital or main island influences this relationship, with the most remote islands often adhering more to traditional structures and knowledge.

Also in Tuvalu and Baffin Island, a focus on expedient, short-term coping strategies – rather than long-term adaptive strategies - was observed. These processes have led to a decrease in self-reliance, and an increased dependence on international society, with resulting inequalities. From Tuvalu, it was noted that it is difficult to attract investment to an island that is considered highly vulnerable in the global discourse.

In the Torres Islands, 3,200 years of human presence has created a completely anthropogenic landscape, influenced by tides, winds and seasonal change. Winds are principle seasonal markers, and the basis for spatial organization. In this environment, “instability is constant”. Ritual cycles and garden production appear to be related to ENSO variation. Kava, for example, flourishes after El Nino-related droughts. However, a decade of community presence was required to understand this.

The Torres Islands and the surrounding region is a complex region, subject to multiple natural hazards. Resilient systems have evolved as a result, systems that experienced repeatedly the changes that are being experienced globally as a result of sea level rise and climate change. The scale changes – and fixed calendars - brought by western influence have been more significant than climate change. Based on multiple cases cited, historical patterns and drivers of settlement need to be understood in planning for adaptation and recovery after extreme events and disasters.

Several presenters stressed the need for island societies to take advantage of all available knowledge that is available and relevant to improve livelihoods – drawing on both traditional and scientific sources. From Cape Verde, particular emphasis was placed on the significance of pride in knowledge and experiences – viewing fisheries as an expression of freedom.

Research focus and gaps

In Tuvalu, it was noted that research is often focused on biophysical impacts in capital cities, then aggregated to national scale and applied broadly to determine vulnerability. This leads to a lack of nuance and recognition of geographical variability.

In an example from Arctic Canada, reference was made to the terms “night culture” and “day culture” as areas of research focus. Day culture relates to topics such as traditional knowledge, use of the land, traditions – while night culture relates to youth suicide, social ills. While some researchers focus their work on the “day culture” studies, others focus on its opposite. However, the two coexist in most communities.

Outcomes

Network

Participants discussed the need for a mechanism to create and support a global network of traditional knowledge holders and climate scholars to collaborate in climate change adaptation.

As an initial step towards this goal, the workshop coordinators agreed to create an email listserv to connect participants. It will provide not only a vehicle to feed projects and research outcomes into the database, but also an opportunity to highlight new initiatives and emerging themes as they develop to the network members, to encourage collaboration between TK-holders and scientific scholars.

The listserv address will be: adaptation@lists.ipmpcc.org. Posts will be archived and community members will assist with translation.

Database

UNU presented its proposal to incorporate workshop papers into an online database of best practices, methodologies and case studies of TK-Scientific knowledge co-creation for enhancing climate change vulnerability, adaptation, mitigation and governance efforts. The contents of the database will build on the data bank prepared by UNU in 2010 as part of its September 2010 publication *Advance Guard – Climate Change Impacts, Adaptation, Mitigation and Indigenous Peoples - A Compendium of Case Studies*. This publication includes a literature review and overview of more than 400 projects, case studies and research activities specifically related to climate change and indigenous peoples.

Following the success of this publication, UNU has secured the support of other UN organizations such as UNFCCC, UNDP and UNESCO¹ to build on these case studies and bring together several existing fragmented databases that address TK and scientific climate knowledge (but with a narrow thematic focus) into a global knowledge exchange platform that will cover a diverse set of topics and will be accessible in multiple languages (Spanish, French, English). The database will be hosted by these agencies and diffused *inter alia* through their extensive international networks and meetings. An expert review committee from within these organizations would oversee the maintenance, evaluation and further development of this information resource.

¹ For example, UNFCCC's Local Coping Strategies adaptation database and UNDP-GEF's Small Grants Program project database.

Output Timeline

The following tentative timetable was agreed at the meeting.

31 August 2011	Workshop Report circulated
10 September 2011	Final papers due
14 October 2011	Draft Technical Report submitted to IPCC
October-December 2011	Selection and peer review of workshop papers
12-15 December 2011	WGII 2 nd lead author meeting
December 2011	Pilot database launch
January-February 2012	Author revision of papers
28 February 2012	Reviewed papers due
April 2012	Mexico Technical Report published
Early/mid 2012	Cairns workshop on mitigation

Closing Plenary

Open Mic

Participants were invited to make short presentations through an open mic session, regarding any additional information for the report, or gaps they had identified during the workshop.

Closing Address

Myrna Cunningham Kain, Chair of the United Nations Permanent Forum on Indigenous Issues, gave a closing address to participants.



Photo 7: Myrna Cunningham Kain, Closing Address

ANNEXES

ANNEX A: List of Participants

Please see document IPMPCC/2011/Mex/Participants.

ANNEX B: Compilation of Abstracts

Please see document IPMPCC/2011/Mex/Abstracts.

ANNEX C: Glossary

Excerpted from IPCC AR4 WG2 (2007), Parry, M. L.; Canziani, O. F.; Palutikof, J. P.; van der Linden, P. J.; and Hanson, C.E., ed., Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press.

Adaptation

Adjustment in natural or *human systems* in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation – Adaptation that takes place before impacts of *climate change* are observed. Also referred to as proactive adaptation.

Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or *welfare* changes in *human systems*. Also referred to as spontaneous adaptation.

Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Adaptation assessment

The practice of identifying options to adapt to *climate change* and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility.

Adaptation benefits

The avoided damage costs or the accrued benefits following the adoption and implementation of *adaptation* measures.

Adaptation costs

Costs of planning, preparing for, facilitating, and implementing *adaptation* measures, including transition costs.

Adaptive capacity (in relation to climate change impacts)

The ability of a system to adjust to *climate change* (including *climate variability* and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Climate change

Climate change refers to any change in *climate* over time, whether due to natural variability or as a result of human activity. This usage differs from that in the *United Nations Framework Convention on Climate Change (UNFCCC)*, which defines ‘climate change’ as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global *atmosphere* and which is in addition to natural climate variability observed over comparable time periods’. See also *climate variability*.

Climate prediction

A climate prediction or climate forecast is the result of an attempt to produce an estimate of the actual evolution of the climate in the future, e.g., at seasonal, interannual or long-term time scales. See also *climate projection* and *climate (change) scenario*.

Climate variability

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the *climate* on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the *climate system* (internal variability), or to variations in natural or *anthropogenic* external forcing (external variability). See also *climate change*.

Ecosystem

The interactive system formed from all living organisms and their abiotic (physical and chemical) environment within a given area. Ecosystems cover a hierarchy of spatial scales and can comprise the entire globe, *biomes* at the continental scale or small, well-circumscribed systems such as a small pond.

Ecosystem approach

The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organisation,

Extreme weather event

An event that is rare within its statistical reference distribution at a particular place. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile. By definition, the characteristics of what is called 'extreme weather' may vary from place to place. Extreme weather events may typically include floods and *droughts* and interactions among organisms and their environment. It recognises that humans, with their cultural diversity, are an integral component of many *ecosystems*. The ecosystem approach requires adaptive management to deal with the complex and dynamic nature of ecosystems and the absence of complete knowledge or understanding of their functioning. Priority targets are conservation of *biodiversity* and of the ecosystem structure and functioning, in order to maintain ecosystem services.

Ecosystem services

Ecological processes or functions having monetary or non-monetary value to individuals or society at large. There are (i) supporting services such as productivity or *biodiversity* maintenance, (ii) provisioning services such as food, fibre, or fish, (iii) regulating services such as climate regulation or *carbon sequestration*, and (iv) cultural services such as tourism or spiritual and aesthetic appreciation.

Food security

A situation that exists when people have secure access to sufficient amounts of safe and nutritious food for normal growth, development and an active and healthy life. Food insecurity may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level.

(climate change) Impact assessment

The practice of identifying and evaluating, in monetary and/or non-monetary terms, the effects of *climate change* on natural and *human systems*.

(climate change) Impacts

The effects of *climate change* on natural and *human systems*. Depending on the consideration of *adaptation*, one can distinguish between potential impacts and residual impacts:

Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation.

Residual impacts: the impacts of climate change that would occur after adaptation. See also *aggregate impacts*, *market impacts*, and *non-market impacts*.

Indigenous peoples

No internationally accepted definition of indigenous peoples exists. Common characteristics often applied under international law, and by United Nations agencies to distinguish indigenous peoples include: residence within or attachment to geographically distinct traditional *habitats*, ancestral territories, and their natural resources; maintenance of cultural and social identities, and social, economic, cultural and political institutions separate from mainstream or dominant societies and cultures; descent from population groups present in a given area, most frequently before modern states or territories were created and current borders defined; and self-identification as being part of a distinct indigenous cultural group, and the desire to preserve that cultural identity.

Integrated assessment

An interdisciplinary process of combining, interpreting and communicating knowledge from diverse scientific disciplines so that all relevant aspects of a complex societal issue can be evaluated and considered for the benefit of decision-making.

Mitigation

An *anthropogenic* intervention to reduce the anthropogenic forcing of the *climate system*; it includes strategies to reduce *greenhouse gas sources* and emissions and enhancing *greenhouse gas sinks*.

Resilience

The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.

Vulnerability

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of *climate change*, including *climate variability* and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its *sensitivity*, and its adaptive capacity.

Welfare

An economic term used to describe the state of well-being of humans on an individual or collective basis. The constituents of well-being are commonly considered to include materials to satisfy basic needs, freedom and choice, health, good social relations, and security.