

# **Knowledge Systems in Upland Farming Practices in the Philippines and Implications for Climate Change Adaptation<sup>1</sup>**

Maria Victoria O. Espaldon

## **Abstract**

The paper focuses on the importance of multiple knowledge systems on enhancing the adaptive capacity of farming communities in the Philippines. It discusses the epistemologies of knowledge that are pertinent to strengthen the resilience of small farmers and farming households, who are one of the most vulnerable groups in the event of climatic variabilities, climatic extremes and climate change. It also brings to the discussion the need for effective communication system to disseminate the knowledge systems related to climate change in order to promote sound adaptation strategies. The paper also draws insights from researches undertaken in Bukidnon and Misamis, Oriental Philippines.

## **Introduction**

Local communities, governments and different sectors all face the challenges brought about by the growing evidences of climate changes, both globally and in the Philippines. The debates on whether the climate has indeed changed or not has been relegated to the background at the moment because of the escalating impacts on human lives and communities caused by intensifying natural disasters, ENSO events, and unpredictable occurrence of rainy and dry season, events which are related to changing climatic patterns. Faced with the current climate variability and probable changing climate in the future, we have no choice but to act. The vulnerabilities of different sectors to climatic variability and changes however vary from sector to sector and depends on multiple factors, one of which is level of income, education and social networks (Adger, 2001). For farming communities in the Philippines, living with weather spells life and death.

This paper seeks to present a conceptual framework for understanding adaptations among farming communities in the Philippines, the role of different types of knowledge systems in enhancing the capacity of farming households and communities to adapt to climate variability and climate change and cite some working models of farmers' adaptation to climatic changes.

---

<sup>1</sup> Paper presented in the International Conference on Climate Change Adaptation in Southeast Asia, Bali, Indonesia. February 23-27,2008.

## **Evidences of Climate Change in the Philippines and Impacts**

Key evidences of climate change are becoming to be mainstreamed. Scientists are in agreement that over the last 150 years, the Earth has warmed by seven tenths of a degree C (Espaldon et al, 2007). Surface temperature and solar irradiance (Solanski et al 2004) show human footprints into the increase in the average global temperature. In the Philippines, increasing trends in the temperature observations for period 1951-2006 are very apparent. Temperature projections for the Philippines yielded an increasing scenario based on two projections: low and high. The projection is within the range of 0.8 to 2.4 C. Reduction of rainfall has also been noted in some areas, particularly during El Nino events while an increase over Western Visayas. These changes however are not statistically significant yet, and could be attributed to seasonal variations or climate variability. However, mixed or weak rainfall trends are predicted by global climate change models which are consistent with the prediction of Hulme and Sheard (1999) of drier period. In terms of geographical tracks, the number of tropical cyclones appearing in the Western Pacific seems to be increasing. However, the World's Meteorological Organization (2006) is in consensus to say that no individual tropical cyclones can be directly attributed to climate change. Projection for tropical cyclones resulted to an increased intensity from the present day conditions to an increased carbon dioxide state of the atmosphere in the future.

Climate change is expected to have adverse impacts on many sectors at different ecosystems in a landscape (Figure 1). Based on IPCC 4<sup>th</sup> Assessment Report, sea level rise is a threat to coastal communities and island ecosystems. Weather changes and climate variability could severely affect coastal fisheries because of coral bleaching. With climate change, fisherfolks and coastal cities are expected to be severely affected by floods. It is also expected that with limited rainfall available during the growing season and too much water rainfall during wet months, agricultural productivity will decline. Our two most important crops, rice and corn will be at risk and hence, coupled with increasing population, more people are at risk of hunger.

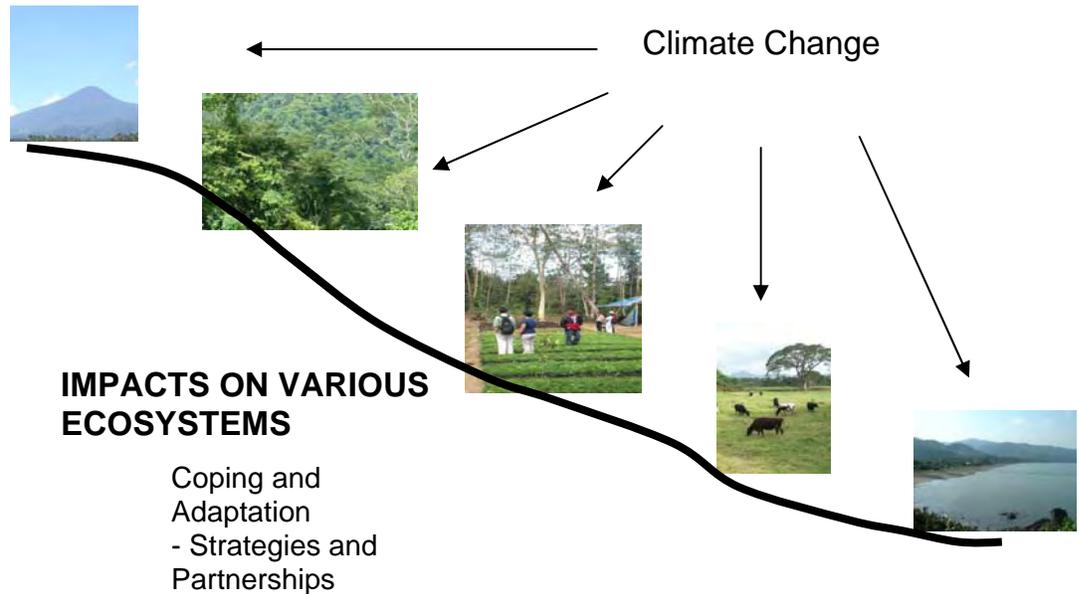


Figure 1. Climate Change Impacts and Adaptation in a Landscape

The El Nino of 1997-1998 has given the agriculture sector a preview of the extent of damage of prolonged dry months. However, this has also been a period where tobacco and abaca production improved. Indeed, some crops are adapted to more dry seasons than others, and can be used as basis for crop selection. IPCC (2007) reports other adverse impacts of climate change-- increased occurrence of pests and diseases, severe soil erosion and hence more application of fertilizers to restore fertility, milk production may be declining because of limited water intake; shortage of water supply and consequently water crisis for growing population; increased risk of flooding, reduced stream flow, increased frequency of grassland fire. Climate change also poses threat to human health such as heat stress, increased cases of malaria and dengue, increased risk of food and water shortage and floods.

The IPCC (2007) has proposed two general strategies on adaptation that can be used—the macro and microstrategy. Macrostrategy involves rapid development—which means that with sustainable development, increase of incomes will happen, including education and technical skills, and the whole package of social development, and these changes can enhance social capital and reduce the vulnerability of countries to climate change. On the other hand, micro strategy aims to modify the management of highly

vulnerable sectors to climate change. This is where development profession is most interested.

While IPCC has a set of recommendations, the Philippines has a basket of adaptive measures, both evolved and indigenous to cope with climate changes. Two categories of adaptive measures, soft and technological approaches, are available. Soft approaches refer to modes of arrangements among stakeholders which are more process rather than technology-centered. The farmer-scientists approach and landcare are examples of soft approach which is inclined towards strengthening capacities of individual farmers/sectors to enable them to build strong partnerships with others (LGU, NGOs, Gas, IRAs), while the technological approaches focus on simple transfer of technologies from source to communities. Technologies that can be relevant in climate change risk reduction include crop management such as varietal selection; biomass and nutrient management including composting; water management; and efficient energy utilization. Indigenous technologies are also available for further promotion and dissemination to other similar places, with due consideration of free and prior informed consent (FPIC) of the origin of these technologies.

Reducing vulnerability to climatic risks can be approached in two ways (Figure 2): that of understanding the external side of vulnerability and that of understanding coping and adaptation mechanisms. The understanding of climate change risks and the extent of exposure covers enhancing the science of climate change—a need for improved projection of likely climate variability and change; and determination of the sectors in particular locations that are most and least vulnerable.

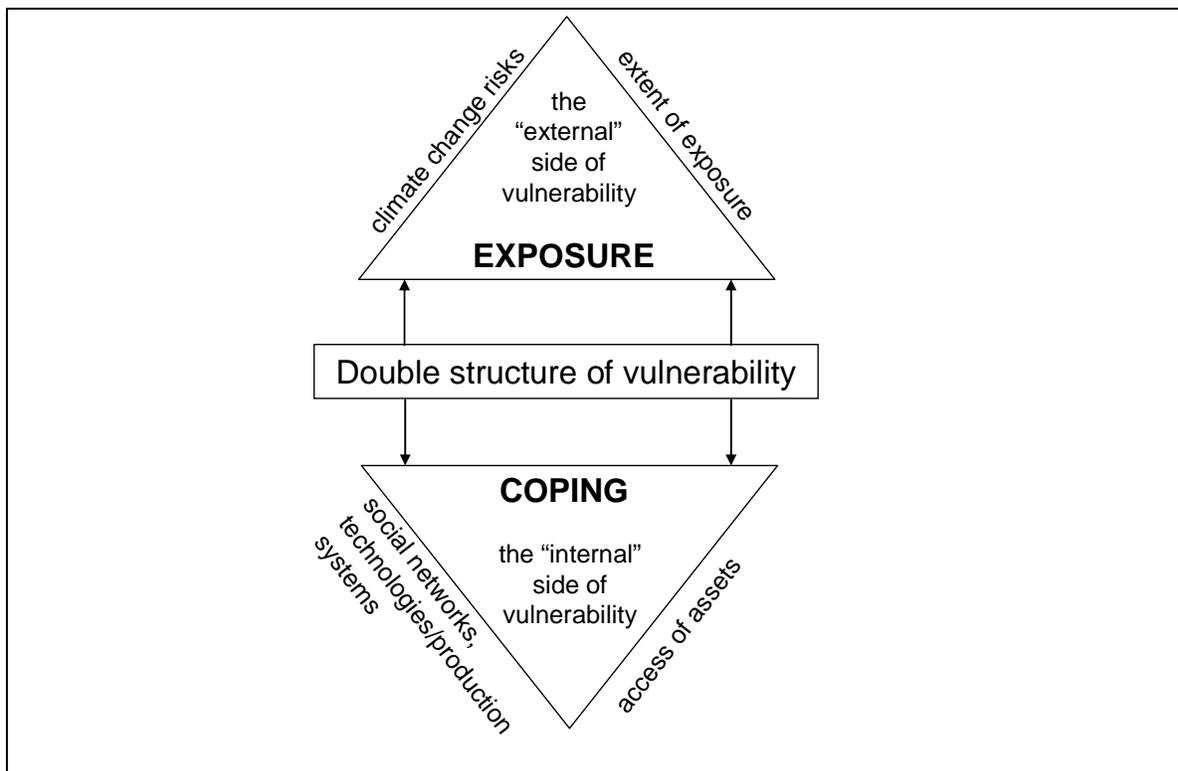


Figure 2. Conceptual framework for vulnerability analysis  
(Modified from Kasperson, 2001)

### **Knowledge Systems in Climate Change Adaptation**

The knowledge systems in climate change adaptation and coping mechanisms can be gleaned from the various practices of the farming households in the Philippines. Knowledge is a term which came from Latin word *keno* and it begins with perception, requires a subject and an object and it results from the subjectivization of objectivity. This means that knowledge is borne out of an experience, by a subject—humans, on a particular object. In our study, the object is climate which is very close to the heart and life of a farmer. Whilst knowledge is oftentimes misconstrued as objective, knowledge generation depends on the subject who perceived the experience and analyse the condition and came up with what we call “knowledge”. In this regards, this is also called “wisdom”.

Knowledge system is defined as a body of propositions actually adhered to (de facto or formal) that are routinely used to claim truth (Feyerabend 1987 cf: Reid, et al 2006). Zermoglio et al (2005) defined knowledge system as “ a construction of a groups perceived reality, which the group members use to guide behavior toward each other and the world around them.” We have two distinct types of knowledge—science and indigenous knowledge. Again, Zermoglio defines science as a body of knowledge that can be validated through a process of peer review and therefore can be replicated. Traditional ecological knowledge on the other hand is a “cumulative body of knowledge, practice, and beliefs, evolving by adaptive process and handed down through generations by cultural transmission” about local ecology (Berkes 1999 cf: Reid et al 2006). While science transmission is through the formal scientific societies and institutions, traditional ecological knowledge is transmitted through cultural practices and norms—arts, folklores and music, oftentimes it is transmitted orally and has been imbibed in the traditions and definitely a product of the people rich experiences in the past. Local knowledge, on the other hand, refers to place-based experiential knowledge, and may not necessarily be very ancient, and is basically oral and practice based (Reid et al 2006).

### **Science as a Source of Adaptation Mechanisms**

Scientific tradition has evolved and generated massive following—primarily because science has generated massive knowledge system to promote the understanding of socio-ecological systems. In this context, a number of mechanisms have evolved and were deliberately developed to primarily address some environmental stresses related to climatic variability and changes.

In **rice production**, the use of early maturing rice varieties as a strategy in unstable production areas can be used in face of climatic variability (O’Toole and Chang,

1978 in Lansigan et. al., 2000). Ratooning for shorter growing periods, planting lodge-resistant, non shattering, and waterlogged resistant varieties, establishing windbreaks in strategic areas, developing methods to conserve rainwater to extend cropping period, and developing simple implements for rapid harvesting and postharvesting handling are also some of the possible coping strategies in rice production (Pantastico and Cardenas, 1980 in Lansigan et al, 2000).

The Organic Rice Farming and Bio-Diverse, Integrated, Organic (BIO) Farm System is another technology that is particularly relevant to address climate change issues in terms of its overall impact of reducing the energy consumption of the rice production system. Mendoza (2004) indicated that cash capital expense in organic rice farming utilized only 33 percent (39 US\$ ha<sup>-1</sup>) compared with conventional farm which spent 118 USD ha<sup>-1</sup>. Data also showed that organic farming improved soil quality and despite the slightly lower yields in organic (3.25 t ha<sup>-1</sup>) compared to yields obtained in conventional farms (3.52 t ha<sup>-1</sup>), organic farming yielded net revenue higher (332 US\$ ha<sup>-1</sup>) than that in the conventional farm (290 USD ha<sup>-1</sup>). Moreover, organic farms consumes less energy – one ton of paddy rice used only 170 fossil fuel based energy inputs (FFEI) while 884 Mcal in conventional farms (Mendoza, 2004).

Another approach that is being tested is the use of BIO farm system. Mendoza (2007) said that it provides the best operation framework for the project's objectives. The objectives of the mini-scale (BIO) farming are:

1. To evaluate how much food can be produced for the household given a limited resource (land, labor, capital) on a sustainable basis.
2. To evolve adaptive farming practices during the dry months since water is fast becoming a limiting resource.
3. To integrate over time through trial and error all possible but practical technologies and farm practices or systems that can be harnessed.
4. To operationalize the doing and learning principle on knowledge building/exploration or a case of a scientist being a farmer actualizing all the processes and activities in the farm.

Mendoza said that the resilience and adaptability of the BIO farm was proven after the occurrence of Typhoon *Milenyo* last September 28, 2006. Many of the crops survived. Some of these were *okra*, *saluyot*, *camote*, *gabi*, *cassava*, *kangkong*, *Jatropha* seedlings, and *calamansi*. In addition, he also observed that during the dry months, plants became drought tolerant while during the wet season, it became water logged tolerant. He added that this can be attributed to the combination of mulching and organic fertilizer application to the plants.

Another adaptation strategy that is being tested is biomass and nutrient management which is expected to reduce the use of chemical fertilizers and pesticides such as the vermicomposting. It can also be a good alternative source of income (Binahon, 2007). Adorada (2007) said that this technology produces compost worms and vermicompost. Aside from the economic viability of vermicomposting, it affects water,

air, and land resources in positive ways: organic waste management, air pollution control, and reduction in the application of fertilizers and pesticides.

### **Traditional Ecological Knowledge in Climate Change Adaptation**

Monsalud et al (2003) reported that indigenous practices for crops and livestock to lessen the effects of El Niño are still widely used in some provinces such as Bulacan, Pampanga, Catanduanes, and Camarines Sur. Indigenous technologies such as smoking or *pausok*, use of herbal pesticide, lighting of lamps at night to scare insects, and putting of poison frogs in the field are being practiced in Pampanga as plant pest controls. Meanwhile, farmers from Catanduanes and Camarines Sur practice the smudging technology, soapy water spray or water mixed with small pepper juice extract.

The use of animal manure as soil fertilizers are also being practiced in the four provinces while Pampanga is the only province out of the four study sites that uses composting and guano as fertilizers. Diagonal planting, soil cultivation, covering of young plant during intense heat, and non-weeding are some of the other methods identified in planting. Although some of the technologies were proven effective through time, the authors said that some practices still needed further study.

Some farmers in Camarines Sur practice non-weeding of plants (Monsalud et al, 2003). However, weeds are known to compete with plant's growth leading to decrease in crop yield. Weeds can reduce grain yields of upland rice in the Philippines by about 80 percent (Mercado, 1979, in Legaspi et. al., 1989). In a field experiment to determine the effects of handweeding on grain yields in upland rice at UPLB by Legaspi et al (1989), results showed that the absence of weed control produced only 50kg/ha of grain. Meanwhile, single weeding increased yield to 2000 kg/ha, double weeding to about 2500 kg/ha, and complete weed control produced 3000 kg/ha of grain. Thus, they concluded that optimal weeding increases grain yield of upland rice.

Meanwhile, Monsalud et al (2003) said that in livestock production, used corn and sugarcane stalks, vegetable rejects, and leaves of crops were used as alternative animal feeds and feed supply. *Darak* or rice bran is mixed with commercial feeds to serve as filler. Study also revealed the use of *supak* method of feeding and *kumpay*, a kind of grass or coarse food fed to horses or cattle. Monsalud et al (2003) explained that the *supak* method is "a force-feeding method for animals using bamboo tubes containing rice bran. The bamboo tube is placed inside the animal's mouth to feed the animal."

To prevent the spread of diseases in animals during El Niño, Monsalud et al (2003) said that respondents from Catanduanes use *huag* or ring made of rattan that is placed around the animal's neck to ward off insects. Moreover, their respondents from Pampanga popularly use *pausok sa gabi* or smoking. Meanwhile, strict quarantine is practiced in Camarines Sur to avoid contamination and spread of diseases (Monsalud, 2003).

Upland households cope with the problem of El Niño by selling their livestock or their farm lands, planting root crops, consuming less, changing their social activities, and by selling a smaller proportion of their production. Meanwhile, others transferred to areas where cropping is favorable or worked as hired laborers or food vendors (Rola et al, 1998). Another vulnerable group to climate change are the indigenous peoples. Bornaes (2004) noted that Subanens of Mt. Malindang, Misamis Occidental practice land and crop rotation, shift in agricultural crops, expansion of area of cultivation, out-migration, family planning, formation of organizations, and change in food consumption. However, Subanen people remained vulnerable to the impacts of adverse environmental conditions due to lack of skills to shift to other livelihood activities and lack of assistance from the concerned institutions and agencies. Other strategies adapted by households during El Niño crisis were reallocation of household budget, borrowing money, availment of credit, sale of assets, praying, and seeking support from community and kin (Reyes, 1999; Peras, 2005). Again, the social capital remains central to enhancing capacity of poor households to climatic risks.

### **Multiple Knowledge Systems in Climate Change Adaptation**

While some adaptation strategies are purely coming out of the laboratories of universities and research institutions, other adaptation strategies are a mix of both the science (or technical knowledge/ formal) and the local knowledge, experience and instincts of farmers. A study conducted in 2005 and 2006 noted that the farmers of Tanauan City, Batangas Province employed a mix of local knowledge, experts opinion and science (via a seed company) to adapt to two major stresses: climatic changes and globalization (Acosta-Michlik et al 2005, 2006). Farmers source their new seeds from a seed company that deliberately developed a particular crop variety (i.e. eggplant) that is drought resistant—a coping strategy to low precipitation in the last few years. When interviewed, majority of the farmers observed the changing patterns and felt hopeless because their farms are all rainfed. They grow vegetables that they can readily market to Tanauan City which is one of the advantages of this agricultural community. Their concern however is that they have to compete with producers from other municipalities and provinces. Their public market is now considered major “bagsakan” (trading post) by other farmers from neighboring areas.

Villanueva and Espaldon (2007) examined landcare as an approach that enhances that adaptive capacity of upland communities to climate variability. Landcare is an extension approach for rapid diffusion of conservation farming, agroforestry practices and other natural resources management systems. It also refers to a group of people who are concerned about land degradation problems. It is an approach that engages the three institutions: local government unit, people’s organization and research institution as facilitator and source of major strategies. Villanueva (2006) notes that landcare brings together the strong points of communities, institution and their networks and a strong research support in order to attain ecologically sound conservation farm practices. Landcare as a triadic partnership consists of grassroots Landcare groups, local government units and technical service providers. A survey of 850 households indicated

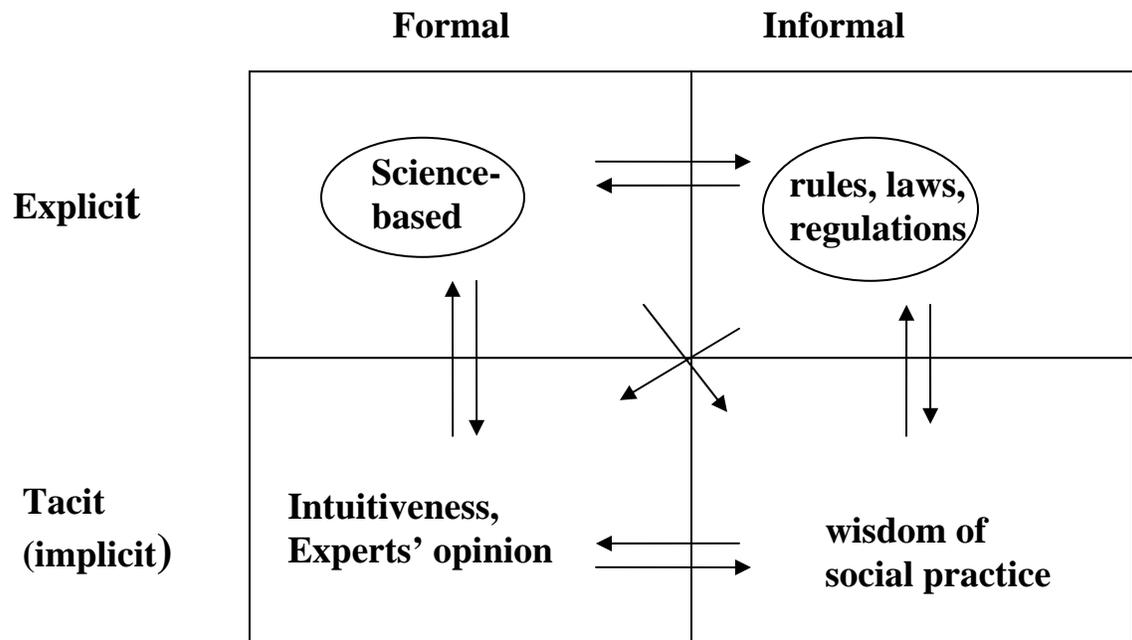
that Claveria Landcare Association (CLCA) composed of farmers themselves helped the communities by applying conservation farming techniques which assisted them reduce their vulnerability to extremely dry season and unreliable rainy season.

On the other hand, the Binahon Agroforestry farm in Lantapan, Bukidnon is a model upland farm that incorporates sustainable agricultural practices. The farm applies the natural vegetative strips (NVS) together with other farm practices for soil conservation and protection. The practice of contour farming in the area is climate-resilient and more sustainable compared with the conventional farming system. The farm uses simple and practical method that can be adopted by small scale farmers.

Clearly, in these cases, the active interplay of indigenous or local social network (and accompanying local knowledge) and the technical knowledge generated by the research institution which is the World Agroforestry Center (or ICRAF) has improved the resilience of farming households of Claveria, Misamis and the Binahon Farm, Lantapan Bukidnon.

### **Conceptual Framework**

Strengthening the adaptive capacity of our farming communities is one of the two pronged approach to deal with climate variability and climate change. Scientific knowledge admittedly can be very useful in this regard. Yet this is not the sole source of knowledge especially in the case where local ecology and natural resources management in particular locality is concerned. In this context, it makes good sense to include local and traditional knowledge in determining appropriate and socially and culturally acceptable adaptation strategies. In this regard, it is important to understand existing traditional knowledge and practices in various localities and culture in the Philippines that are promising in terms of climate change adaptations. This however must take into



**Figure 3. Use of multiple knowledge systems**

account the protocol for use and exploration of indigenous resources including knowledge systems, one that is formal and informal, tacit and explicit. Formal knowledge is primarily based on science (explicit) and on experts' opinion (value of implicit or tacit knowledge borne out of scientific expertise and hence sound speculation). The other knowledge is informal which to some extent includes the rules, laws and regulations (many are not evidence based); and the wisdom of social practice or what we earlier called local or traditional ecological knowledge (Figure 3).

## **Conclusion**

We have some adaptation strategies that are both available in research institutions and as well as in farming communities' local baskets of wisdom. However, we do not want to be trapped in the view that adaptation process is a simple selection of a particular technology or strategy. "Environmental problems (including climate change) are socio-natural problems", hence would require a paradigm that would look at the climate change adaptation from this coupled ecosystems lens: social and natural systems. Reducing vulnerability to climate risks hence requires that we view vulnerability to climate change not only its external side, the exposure per se, but also the complex process of coping and adaptation which requires that technologies be set within the socio-economic-political context. Because of this, we should not be remiss in considering that there are already knowledge resources available and one of the challenge is selecting and putting together appropriate mix of strategies.

## References

- ACOSTA-MICHLIK, L. 2005. Intervulnerability Assessment Shifting Foci from Generic Indices to Adaptive Agents in Assessing Vulnerability to Global Environmental Change.
- ADORADA, J.L. 2007. Assessment of Vermicomposting as a Waste Management Technology and a Livelihood Alternative. Unpublished undergraduate thesis. University of the Philippines Los Baños. Philippines.
- AGUIERO, M. 2002. Carbon Stocks Assessment of a Tropical Secondary Forest in the Mt. Makiling Forest Reserve, Philippines. Unpublished undergraduate thesis. College of Forestry and Natural Resources. University of the Philippines Los Baños. Philippines.
- ARTISTA, C.R. 1999. Determination of Water Budget in Molawin, Watershed, Makiling Forest Reserve, Philippines. Unpublished undergraduate thesis. College of Forestry and Natural Resources. University of the Philippines Los Baños. Philippines.
- BALLARAN, V.G. 2006. Prediction of Philippine Rainfall Using Artificial Neural Network Models. Unpublished thesis. University of the Philippines Los Baños. Philippines.
- BORNALES, R.G. 2004. Adaptation and Vulnerability of Subanen Community to the Adverse Environmental Conditions in Mt. Malindang National Park, Philippines. Unpublished dissertation. University of the Philippines Los Baños. Philippines.
- BUGAYON, J.G. 2002. Biophysical treatability Study of a Meat Processing Wastewater. Unpublished thesis. University of the Philippines Los Baños. Philippines.
- CALUB, B.M. and LASCO, R.D. 1999. Socio-Cultural, Economic and Biophysical Evaluation of Indigenous Fodder Trees under a Silvopastoral System in Dela Paz, Batangas. Proceedings of the PSAS 36<sup>th</sup> Annual Convention, 21-22 October 1999, Metro Manila, Philippines. P 135 - 144
- CODILAN, J.M. 2003. Vegetation Analysis of Tigbi Watershed in the Makiling Forest Reserve. Unpublished undergraduate thesis. College of Forestry and Natural Resources. University of the Philippines Los Baños. Philippines.

- COMBALICER, E.A. 2000. Application of GIS in Determining Soil Erosion Potentials of the Lower Magat Watershed in Nueva Vizcaya. Unpublished undergraduate thesis. University of the Philippines Los Baños. Philippines.
- CROSBY, P. 2005. A paper presented at GEOG 241 at the Department of Geography. University of the Philippines Diliman. Philippines.
- DELA CRUZ, N.E. 2003. Geographic Information System (GIS)-Assisted Soil Erosion Modeling for Sustainable Watershed Resource Management. Unpublished dissertation. College of Agriculture. University of the Philippines Los Baños. Philippines.
- ESPALDON, M.V.O.E. 2007. A Year After the Milenyo: Issues and Challenges. A presentation for the UPLB IdPCC Round table and Panel Discussion. October 01, 2007. Philippines.
- ESPALDON, MVO., M. Tapia, J. D. Villanueva, and P. J. Sanchez. 2006. Philippine Landcare after nine years: Assessment of impacts at the watershed, community and farm level. Ocasional Paper No. 4. World Agroforestry Center. Nairobi, Kenya.
- ESPALDON, MVO, RT PEREZ, T.LAWAS, AJ. ALCANTARA, A. DE ASIS, R. SANGALANG. 2007. Climate Change and Environment: Reducing Vulnerability to Climate Change in the Philippines. Paper presented to FAO Forum on Climate and Environment. World Renaissance Hotel. Makati City, Decemebr 13, 2007.
- GAYAS, M.P. 2002. Soil Erosion Assessment at Molawin and Maitim Creeks in College, Laguna and Maitim, Bay Laguna. Unpublished undergraduate thesis. College of Forestry and Natural Resources. University of the Philippines Los Baños. Philippines.
- GUILLERGAN, S.N.J. 2005. Ecological Analysis of Solid Waste Management in Boracay Island, Philippines. Unpublished dissertation. University of the Philippines Los Baños. Philippines.
- LANSIGAN, F.P., DE LOS SANTOS W.L., COLADILLA, J.O. Agronomic Impacts of Climate Variability on Rice Production in the Philippines. Agriculture, Ecosystems and Environment 82 (2000) 129-137. Elsevier Science B.V.
- LANSIGAN, F.P. et. al. 2007. Assessing the Effect of Climate Change on Rice and Corn Yields in Selected Provinces in the Philippines. A paper presented on the 10<sup>th</sup> National Convention on Statistics, October 1-2, 2007, Mandaluyong City, Metro Manila, Philippines.

- LEGASPI, B.A.C. et. al. 1989. Optimal Weeding Treatments in Upland Rice: A Crop Competition Experiment. *Tropical Pest Management*, 1989, 35 (1) 34-38. School of Environmental Science and Management. University of the Philippines Los Baños. Philippines.
- MENDOZA, T.C. 2004. Evaluating the Benefits of Organic Rice Farming in Rice Agroecosystems in the Philippines. *Journal of Sustainable Agriculture*, 24 (2): 93-115. Philippines.
- MONSALUD, F.C., and J. Montesur. 2003. Coping Strategies against El Niño: The Case of Selected Communities in Talugtug, Nueva Ecija, Philippines. A CGPRT Centre Working Paper No. 72. Philippines.
- MONSALUD, F.C. and J. Montesur. 2003. Stabilization of Upland Agriculture under El Niño-induced Climatic Risk: Impact Assessment and Mitigation Measures in the Philippines. A CGPRT Centre Working Paper No. 71. Philippines.
- PATACSIL, L.B.. 2001. Treatability Study on the Wastewater Generated by a Polymer-Lens Manufacturing Plant. Unpublished thesis. University of the Philippines Los Baños. Philippines.
- PERAS, R.J.J. 2005. Vulnerability and Adaptation Strategies of Pantabangan-Carranglan Watershed Communities to Climate variability and Extremes. Unpublished thesis. University of the Philippines Los Baños. Philippines.
- RACELIS, E.L. 2000. Carbon Stock Assessment of Large Leaf Mahogany (*Swietenia macrophylla* King) and Dipterocarp Plantations in the Mt. Makiling Forest Reserve. Unpublished thesis. University of the Philippines Los Baños. Philippines.
- RIVERA, M.C.N. 2003. Comparative Analysis of the Costs and Benefits of Potential Climate Change Mitigation Options in the Philippine Forestry Sector. Unpublished dissertation. University of the Philippines Los Baños. Philippines.
- SEMINIANO, S.C. et. al. 2005. Managing Vulnerabilities and Coping Mechanisms: The Case of FSTP in Cebu. A paper presented during the Philippine National Convention and Annual Meeting of the International Society for Southeast Asian Agricultural Sciences (ISSAAS-PHILIPPINES), October 27, 2005, Tagaytay Country Hotel, Tagaytay City. Philippines.
- TAMAYO, R.O. 2002. Carbon Stocks Assessment of a Mid-montane Forest in Mt. Makiling Forest Reserve. Unpublished undergraduate thesis. University of the Philippines Los Baños. Philippines.

VILLANUEVA, JD. 2006. Assessing the Role of Landcare in Enhancing the Adaptive Capacity of Communities of Claveria, Misamis Oriental to Climate Variability. An MS Thesis. Department of Geography, College of Social Sciences and Philosophy, University of the Philippines Diliman.