CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter covers a discussion on climate variability, vulnerability and resiliency as a concept and Landcare as an approach.

Climate variability and Climate extremes

Miller (1992) defined climate as the general pattern of atmospheric or weather conditions, seasonal variations, and weather extremes in a region over a long period (at least 30 years or can be the average weather of an area). On the other hand weather is the short-term changes in temperature, barometric pressure, humidity, precipitation, sunshine (solar radiation), cloud cover, wind direction and speed, and other conditions in the troposphere at a given place and time.

Climate variability and climate change are often interchanged. The difference between the two occurs at the temporal scale. Robledo et. al (2005) differentiated the two essential terms. Climate variability is short-term. This considers deviation from the mean values in the frequencies and intensity. The variability is associated with probability in the distribution of peak events. While, climate change is long term. This represents a trend in the change of climate variability. The figure below illustrates the distinction between climate variability and climate change.

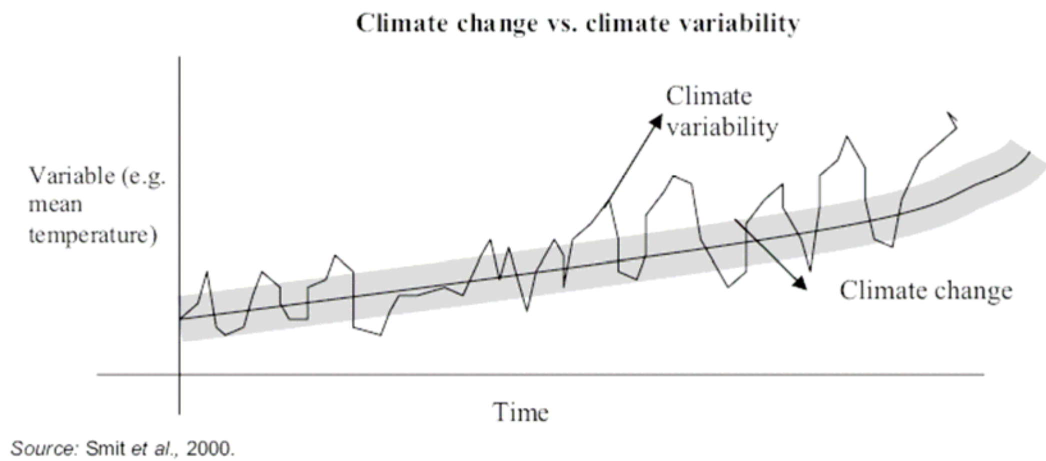


Figure 2. Climate Change vs. Climate Variability

The Climatology and Agrometeorology Branch (CAB) of the Philippine Atmospheric, Geophysical and Astronomical Service Administration (PAGASA) explained what La Niña is. The term literally means “Little Girl”; this is sometimes called El Viejo (Old Man), Anti-El Niño or “cold event/episode”. Includes oceanographic/meteorological in a large scale. This builds up over the central and eastern equatorial Pacific. During La Niña the temperature is unusually cold on the surface of the ocean. Normally accompanied with extreme climatic variability that includes intensive rains, winds, drought, etc. The occurrence can last for six to nine months.

The El Niño Southern Oscillation commonly known as El Niño means “Boy Child” or the “Little One”. It is also a large-scale oceanographic/meteorological phenomenon that develops in the Pacific Oceans and is associated with extreme climate variability. The characteristics identified by PAGASA are:

1. It occurs in the Pacific basin every 2 to 9 years;

2. It usually starts during the Northern winter (December to February);
3. Can last until the first half of the following year;
4. It exhibits phase-locking to annual cycles (El Niño and rainfall fluctuations associated with it tend to recur at the same time of the first year); and
5. It usually has biennial cycle (El Niño events will often be preceded and/or followed by la Niña)

Table 1. Climatic Conditions Observed in the Philippines (PAGASA)

During El Niño	During La Niña
Early termination of the rainy season period of dry season	Near normal or early onset of the rainy season
Early onset of the dry season or shorter rainy season	Short dry season or longer rainy season
Weak monsoon activity	Active monsoon activity
Isolated heavy downpour in a very short duration	Widespread heavy downpour
Heavy downpour in small areas	
Weak tropical cyclone activity	Near normal or active tropical cyclone activity
Very far tropical cyclone path	Near normal tropical cyclone track
Less intensity	Early development
Less number of occurrences	Near normal or above normal number of occurrences
Delayed onset of rainy season on the following year	

Source: PAGASA 1998

In a study by KLIMA of the Manila Observatory and the Department of the Natural Resources (DENR), Misamis Oriental is one of the provinces that are being identified as areas of highly at risk to El Niño. Also in the vulnerability study conducted the province was mentioned as prone to high temperature. The Manila Observatory identified Central and West Mindanao as areas highly at risk to El Niño-induced drought. The top 20 provinces at risk to drought are Sulu, Basilan, Maguindanao, Lanao Del Norte, Lanao Del Norte, Davao Del Sur, Misamis Occidental, Sarangani, Zamboanga Del Sur, South

Cotabato, Zamboanga Del Norte, North Cotabato, Sultan Kudarat, Siquijor, Tawi-tawi, Negros Oriental, Camiguin, Misamis Oriental and Bukidnon (Fig 3).

Misamis Oriental is also one of the top provinces to be affected by the projected increase in temperature identified by the Manila Observatory and the DENR. Other areas affected are: Sulu, Basilan, Lanao Del Sur, Maguindanao, Lanao Del Norte, Davao Del Sur, Zamboanga Del Sur, Tawi-tawi, Misamis Occidental, Camiguin, Siquijor, Cebu, Agusan Del Norte, Zamboanga Del Norte, Albay, Sarangani, Negros Oriental, Negros Occidental and Ifugao (Fig 4).

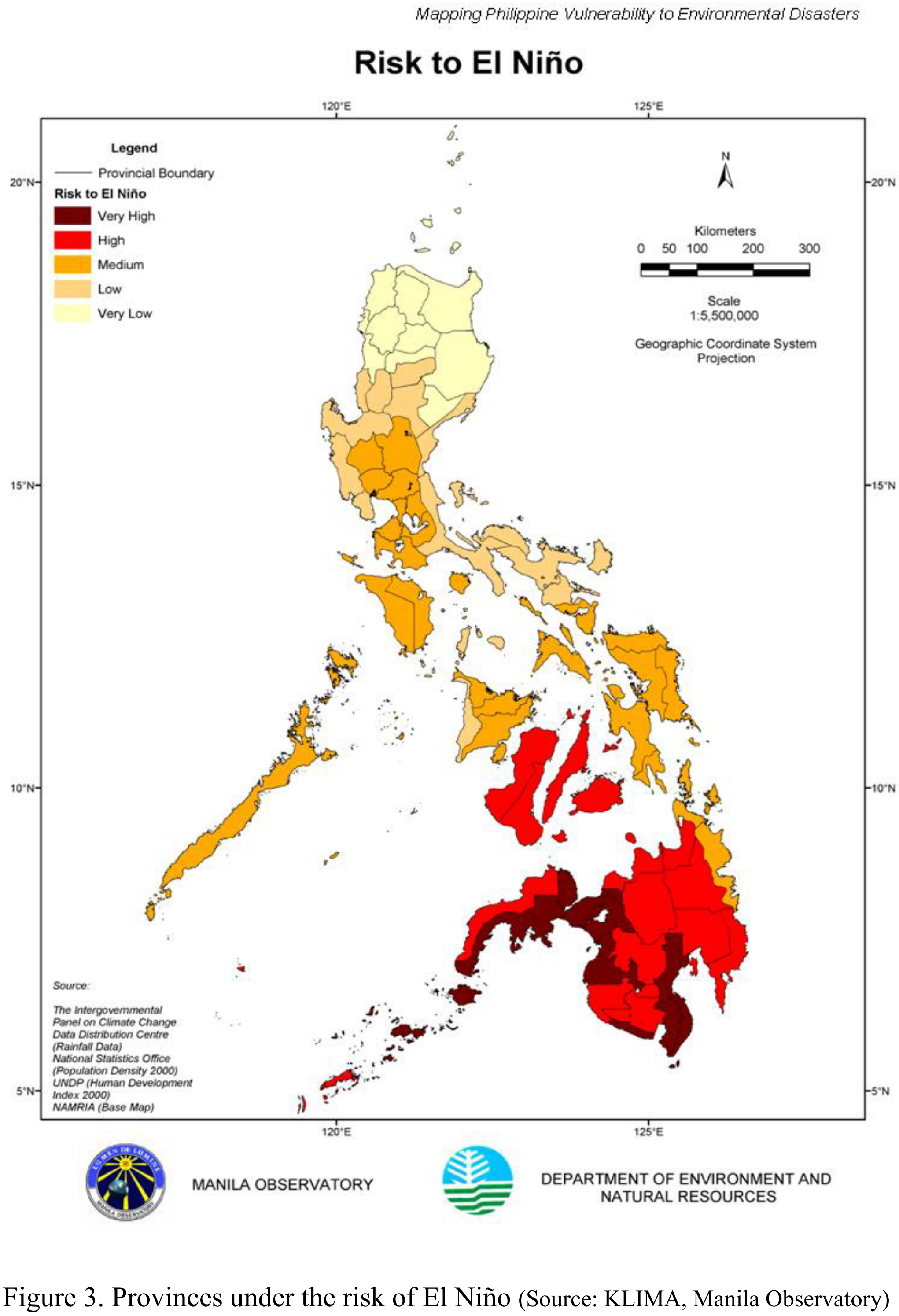
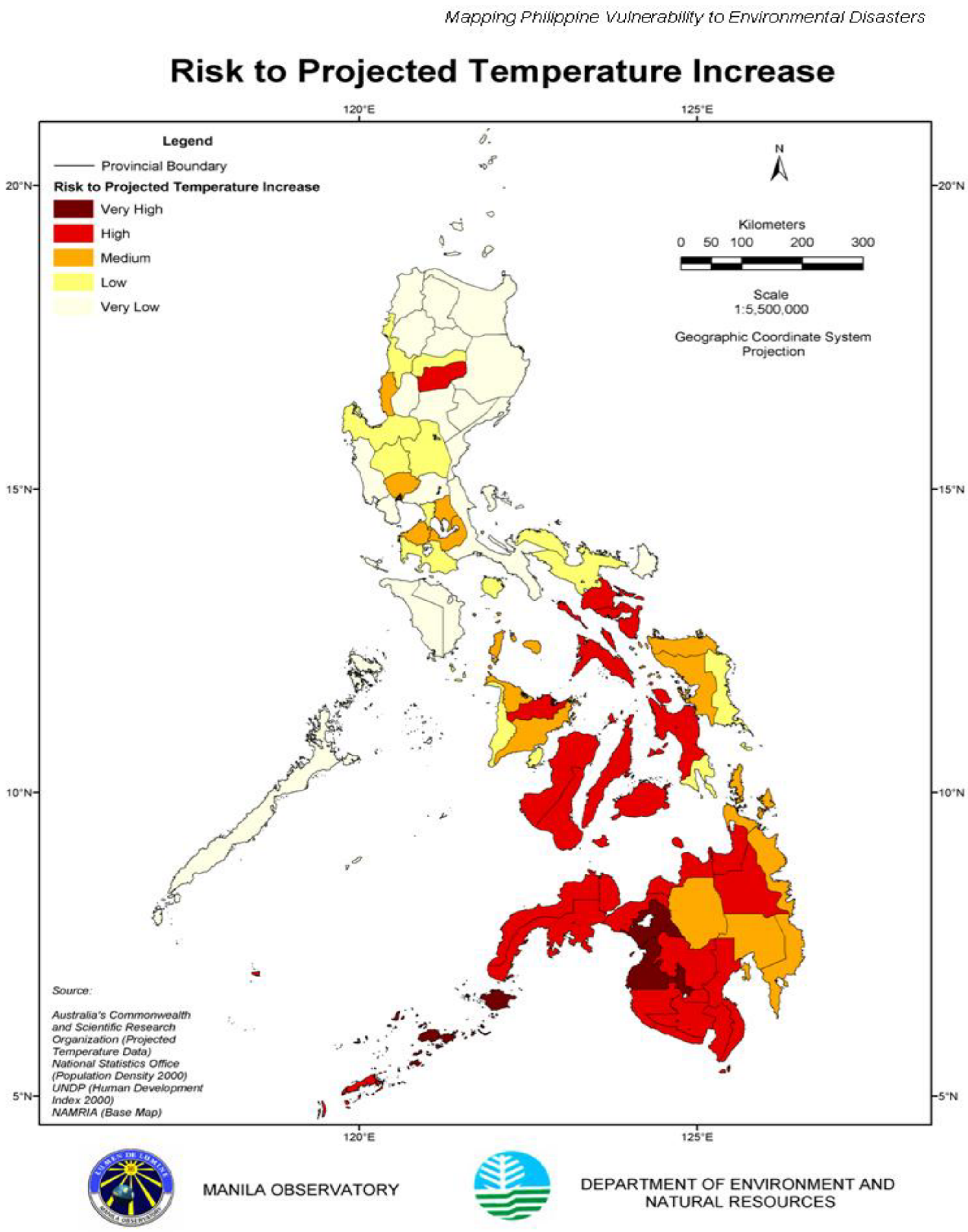


Figure 3. Provinces under the risk of El Niño (Source: KLIMA, Manila Observatory)



(Source: KLIMA,Manila Observatory)

The Bureau of Soil and Water Management (BSWM) generated the same findings. BSWM identified Misamis Oriental as one of the province that has El Niño as climate variability a threat. Other areas include: Iloilo, Albay, Davao Oriental, Western part of Cagayan Valley, Southern part of Batangas, part of Masbate, Southern part of Zamboanga del Sur, Earstern Part or Zamboanga del Norte, Central Part of Bukidnon Cagayan de Oro City, Isabela, Eastern part of Bulacan, Eastern part of Nueva Ecija, Bohol, Northern Cebu, Davao del Sur, South Cotabato and Lanao del Norte (Table 2).

The impacts of El Niño- in the Philippines as a phenomenon is related to drought events, and water shortages. The agricultural sector would experience crop production damages and soil degradation. Water quality could suffer and forest could encounter fires. This phenomenon affects the social lives as well. There could be interferences on the normal activities such as migration, health problems due to biophysical problems. On the other hand, during La Niña floodwaters could be expected (http://iri.columbia.edu/climate/ENSO/societal/example/ Jose.html, .March 2006).

Vulnerability

There is no universally agreed upon definition of vulnerability. Various scholars define vulnerability in different ways. Vulnerability is a bound measure of the susceptibility to suffer loss or damage (Buckle 2000). Kasperson (2002) defines it as the degree to which an exposure unit is susceptible to harm due to exposure to perturbation or stress, and the ability (or lack thereof) of the exposed unit to cope, recover, or fundamentally adapt (become a new system or become extinct). Downing (2003) prefers to use "sensitivity" not vulnerability for natural ecosystems. Vulnerability is registered not by exposure to hazards (perturbations and stresses) alone but also in the sensitivity and resilience of the system experiencing such hazard. This is the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either perturbation or stress/stressor (Turner II, et. al. 2003). The relationships of hazard and vulnerability to risk is illustrated by the function:

$$\textbf{Risk} \cong \textbf{Hazard x Vulnerability}$$

Importance of vulnerability assessment

Several adverse impacts on climate variability have been identified. These are accompanied by hazards. The adaptation policy framework defines hazard as the interaction of climate hazards (e.g. drought, windstorm, or extreme rainfall event) with the properties of an exposed system- its sensitivity or socially constructed vulnerability.

Vulnerability is represented by socio-economic, political and environmental variables that represent the sensitivity and exposure of national populations to climate hazards. Brook et. al. (2004) identified key indicators of vulnerability:

1. population with access to sanitation
2. literacy rate, 15-24 years old,
3. maternal mortality,
4. literacy rate, over 15 years,
5. Calorie intake,
6. voice and accountability,
7. civil liberties,
8. political rights,
9. government effectiveness,
10. literacy ratio (female to male),
11. life expectancy at birth.

Further divided into three broad categories: health status, governance and education. The health status is given by the calorific intake and sanitation, life expectancy and maternal mortality. Literacy rates consider the access to non-manual employment and to information. While for the governance it sees the ability of citizens to participate in the political process. Vulnerability depends critically on context, and the factors that make a system vulnerable to a hazard will depend on the nature of the system and the type of hazard in question. Assessment of vulnerability can tell how equipped a country is to cope with and adapt to climate hazards.

Vulnerability analysis for Lovkvist-Andersen et. al (2004), focuses both on consequnces for the object itself and on primary and secondary consequences for the surrounding environment. The concern is also with the possibilities of reducing such consequences and improving the capacity to manage future incidents.

Downing (1992) identified three fundamental difficulties arising from assessing the risk of climate changes to future livelihoods. First, rapid socioeconomic changes can be expected at the same time as projected global warming. Second, studies of local effects must be embedded in a global context of environmental, social, and economic processes, impacts, and responses. Third, the complexity of linkages among economic sectors, and feedback processes in general, confounds the analysis.

Adaptation is the action of responding to experienced or expected impacts of changing climatic conditions to reduce impacts or to take advantage of new circumstances. It is not about returning to some prior state, since all social and natural systems evolve and in some sense co-evolve with each other over time (Tompkins et al 2003). For IPCC, adaptation refers to the adjustments in natural or a human system in response to actual or expected climate stimuli, or their effect, which moderates, harm, or exploits beneficial opportunities (McCarthy et al. 2001). It includes adaptation to present climate.

Adaptation for Adger et. al (2003) refers to the action of responding to experienced or expected impacts of changing climatic conditions to reduce impacts or to take advantage of new circumstances.

The objectives of an adaptation strategy could be any or a combination of the following (Niang-Diop and Bosch, 2003; Adger et al 2003):

1) Increasing robustness of infrastructure designs and long term investments (nursery, fire lines, etc);
2) Increasing the flexibility of vulnerable managed systems (Agroforestry farms);
3) Enhancing the adaptability of vulnerable natural systems (choice of species in reforestation that adapts to new climate;
4) Reversing the trends that increase vulnerability (encroachment in forest areas, shifting cultivation) and
5) Improving societal awareness and preparedness (NPC/NIA, DENR, local communities).

Adaptation as defined by Robledo et. al. (2005)is any adjustment by a system in response to climate. This includes measures to reduce the impacts on the social, economic and environmental systems. Adaptation capacity in the other hand measures the degree capacity of the system to generate adjustments. Two types of adaptation have been identified:

1. Autonomous adaptation which is the automatic response of the system to certain stimulus. This is showed in the function:

Vulnerability = Potential Impacts – Adaptation Capacity

2. Planned adaptation is the set of strategies and conscious actions to minimize impacts. This is s dynamic process that includes adaptive capacity of a system. This is given by the function:

Vulnerability = Impacts – Autonomous Adaptation Capacity – Planned Adaptation.

The stress and hazards brought about by climate variability compels the necessity for adaptation in order to survive. Adaptation measures could be of the broad categories: One is the prevention of loss that is adoption of measures to reduce vulnerability to climate change. Second is tolerating the loss, where no action is involved to reduce vulnerability and losses are absorbed. Third is spreading or sharing the loss, this does not reduce vulnerability but rather spread the burden of losses across different systems or populations. Fourth is changing the activity. This stops the activities that are not sustainable under changed climate and substitutes with other activities. Last is changing the location that is moving the activity or system to another place (www.climatechangesask.ca/html/learnmore/ Impact_adaptation/Adap_Measure_Links/index.cfm 2006).

Assessing Adaptation and Vulnerability

The International Panel for Climate Change (2001) guidelines describe the seven steps necessary to evaluate impacts and adaptation needs (Fig 5). There steps are necessary to be followed. First is the problem identification, this will help in focusing the target adaptation strategies. Second would be method selection, necessary to have for the appropriate approaches in tackling the evaluation. Third should be the test method/ sensitivity analysis, the methods identified should be checked and assessed using different type of factors of variables. Forth is to select and apply scenarios, after the test method it will bring into play on different situations and circumstances within the systems. Fifth should be appraising the biophysical and socio-economic stakeholders, assessment should be made on what the outcome would be and what other concerns would the stakeholders ask for. Then appraising the autonomous adaptation, assessment should be done as well for self-sufficiency of the adaptation strategies. And lastly is assessing the adaptation strategies, after considering the preliminary steps it there would be essential and sufficient rationalization in assessing the adaptation strategies.

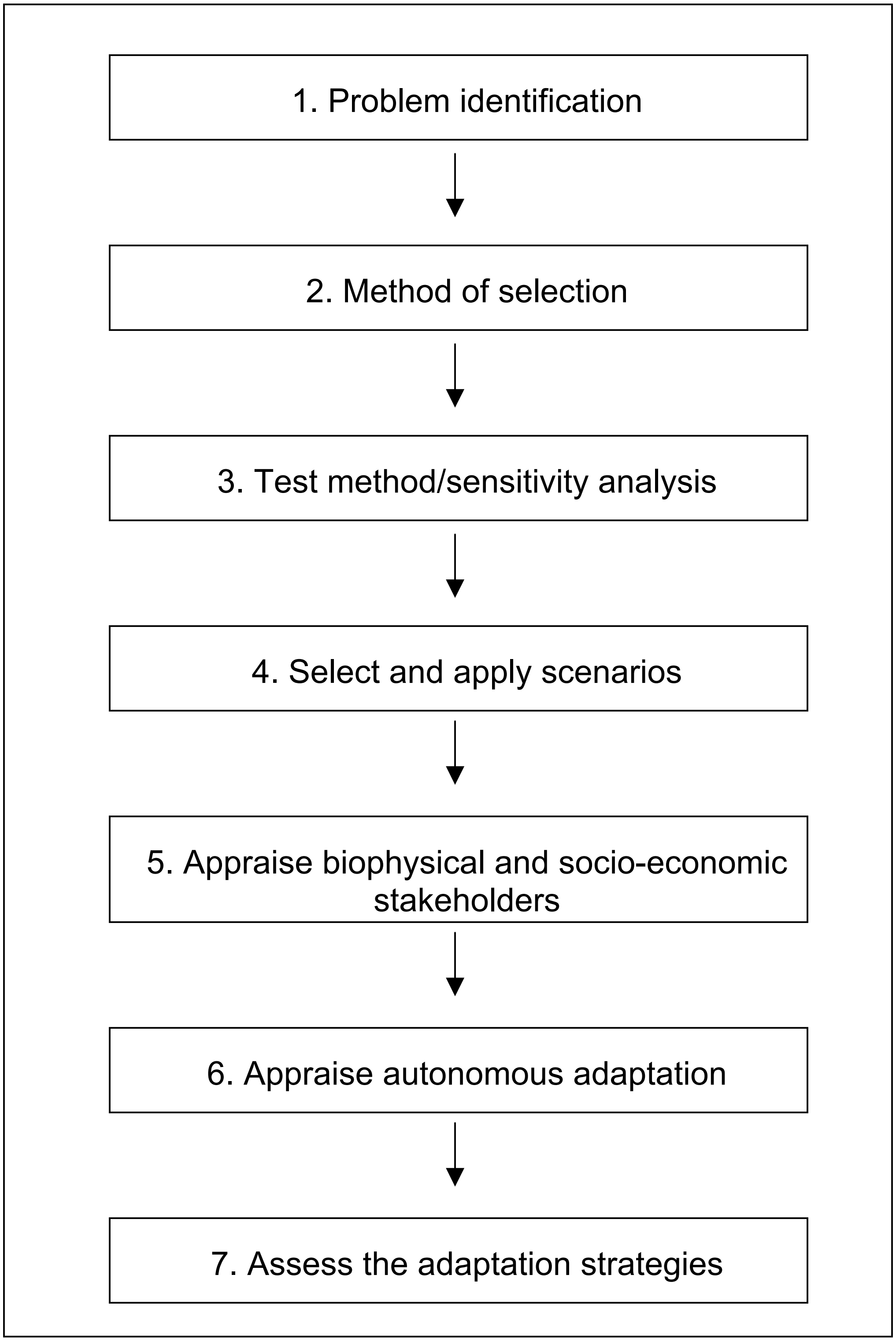


Figure 5. IPCC seven steps to assess impacts

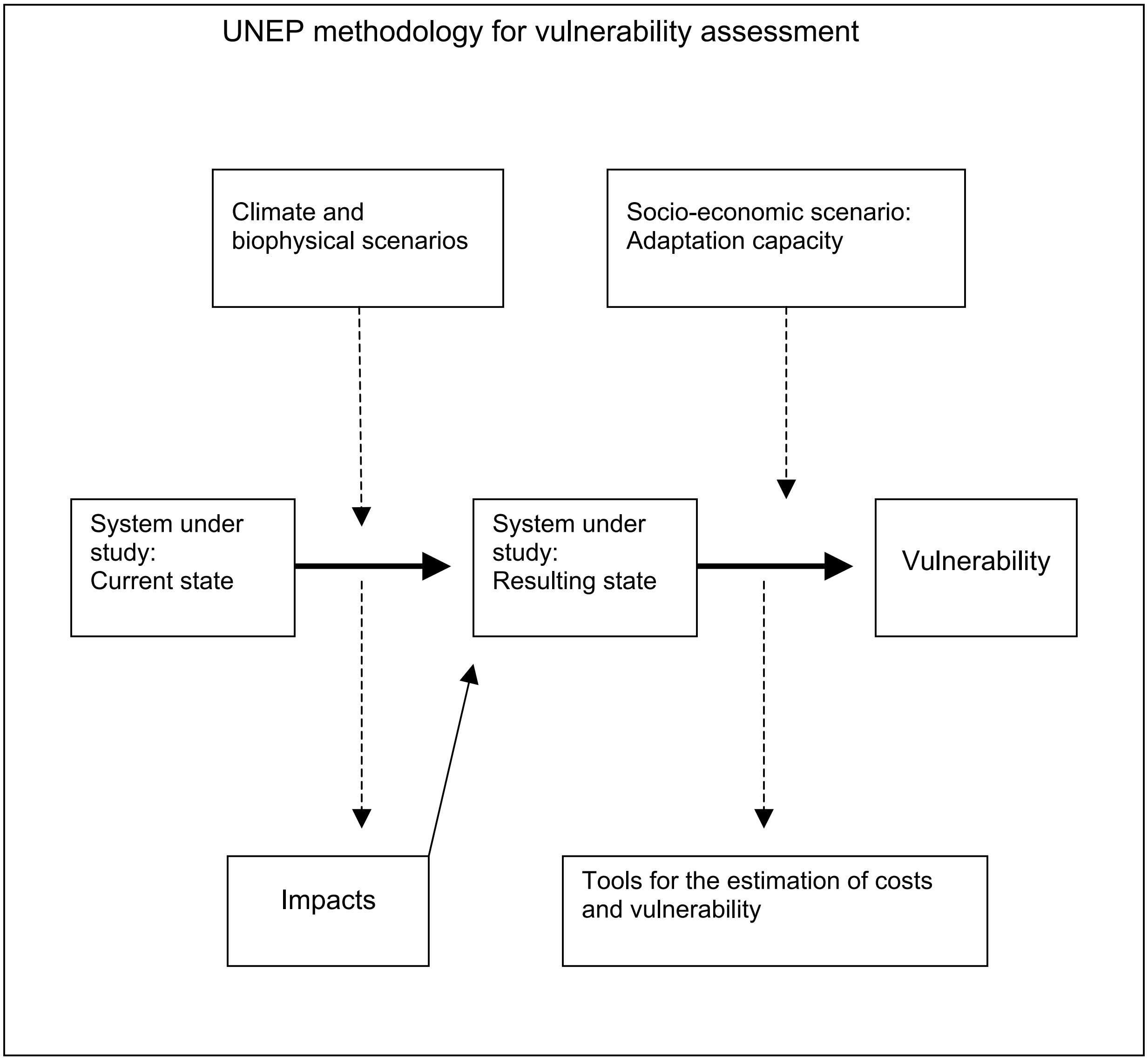


Figure 6. UNEP methodology for vulnerability assessment
Source: Robledo et. al. 2005

The UNEP (Robledo et. al. 2005) has formulated a diagram in assessing adaptation to cope up with the vulnerability problem (Fig 6). This type of assessment requires three main types of scenarios:

1. The Climate Scenario: This is the basis for the impacts of climate change. It has three types: incremental which includes trend changes; analogous or those that have been applied in other similar systems and models.

2. The Socio-economic factors. These have two functions: to illustrate future conditions that determine Green House Gas emissions and to determine the sensitivity, adaptation capacity and vulnerability of social groups.

3. The Biophysical and environmental scenarios. Then includes the physical and the environmental variables.

Adaptive Capacity

The relationship between adaptive capacity and vulnerability depends crucially on time scales and hazards. The vulnerability, or potential vulnerability, of a system to climate change that is associated with anticipated hazards in the medium-to long-term will depend on that systems' ability to adapt appropriately in anticipation of those hazards (Brooks et. al 2004).

Adaptive capacity refers to the potential or capability of a system to adjust, via changes in its characteristics or behavior to cope better with existing climate variability or with changes in variability and mean climatic conditions (Adger et al., 2003). The purpose of assessment is to prepare and identify feasible, efficient and equitable adaptation options. Adaptive capacity is a function of resources available for adaptation, the ability of those who need to adapt to deploy these resources effectively and their willingness to do so. This is an aspect of resilience that reflects learning flexibility to experiment and adopt novel solutions, and develop generalized responses to broad classes of challenges.

Sussman (2004) defined adaptive capacity as "the skill to take the initiatives in making adjustments for improved performance, relevance and impact. Fundamentally, it is the ability to respond to and instigate change. The importance of this aptitude for change grows as organizations appreciate the breadth, complexity and dynamism of their organizational ambitions and operating environment. Adaptive capacity includes the ability to generate or initiate change, challenging the organization's external circumstances'.

Similarly, the Millenium Ecosystem Assessment (2000) defined adaptive capacity as "the general ability of institutions, systems, and individuals to adjust to potential damage, to take advantage of opportunities, or to cope with the consequences".

Resiliency

In a certain society sustainability is necessary and an important consideration for many. Sustainability pinpoints the maintenance of the functionality of system when it is perturbed, or of the elements needed to renew or organize if a large perturbation radically alters structure and function. Having this could also means resilience (Walker 2000).

Resilience is the capacity of a group or organization to withstand loss or damage or to recover from the impact of an emergency or disaster. (Buckle 2000) The emerging insights from adaptive ecosystem management and new institutional economics suggest that building resilience into both human and ecological systems is optical way to deal with future surprises, or unknowable risks (Thompkins et. al 2003).

Holling (1973 as cited by Walker) gave three characteristics of resilience: (1) the amount of a change a system can undergo (amount of stress it can sustain) and still retain the same controls on function and structure; (2) the degree to which the system is capable of self-organization; and (3) the degree to which the systems expresses capacity for learning and adaptation.

Building resilience involves the ability of a system (social and ecological) to withstand shocks and surprises and to revitalize itself if damaged, offering the prospect of a sustainable response. The elements involve decision-making, networks, and institution process (Adger et. al 2003).

Holling (1973) stated that resilience should not always be desirable. Building resilience can sometimes be subjective of a desired system configuration that requires enhancing the structures and processes (social, ecological and economic) that enable it to recognize following a disturbance.

In analyzing resilience in social-ecological systems, four steps are important (Walker 2000). First is the development of a conceptual model of the stakeholder-led system. This includes the historical profile and preliminary assessment of the drivers, and sources of key ecosystem goods and services. Second is the identification of the range of unpredictable and uncontrollable drivers, the stakeholders' visions for the future' and contrasting possible future policies. Third is the use of the outputs from the first and second steps in an iterative way. Fourth is the stakeholder evaluation of the process and outcomes in terms of policy and management implications

Relationship of Vulnerability to Resiliency

The higher the resilience, the less likely damage may be, and the faster and more effective recovery is likely to be. Conversely, the higher the vulnerability, the higher in the exposure to loss and damage (Buckle 2000).

Landcare

"Landcare is a movement of farmer-led organizations supported by the local government that share knowledge about sustainable and profitable agriculture on sloping lands while conserving natural resources. The Landcare approach has developed into a dynamic voluntary movement called the Landcare movement" (Mercado et. al 2000).

Landcare as an approach provides (Metcalf 2004):

1. A way for interested farmers to learn, adapt and share new technologies that can earn more money and conserve natural resources;
2. a forum in which the community can respond to issues that it sees as important;
3. a mechanism that local government can support; and
4. a network for ensuring ideas and initiatives are shared and disseminated

Objectives of Landcare

The study area's slope, topography and soil characteristics render Claveria unfavorable for the communities to farm. Landcare attempted to address these difficulties. Catacutan (2004) in her documentation of the history of Landcare in Claveria. noted that the objective of Landcare was to solve soil erosion and acidity. Landcare aimed to develop farming techniques, help maintain livelihood for the farmers, enhance farming approaches and explore other technologies that are appropriate in the uplands.

History of Landcare

The International Rice Research Institute (IRRI) started the project in 1984. In 1987, with the Department of Agriculture (DA), it began the farmer-to-farmer training programs in Claveria to enhance the adoption of the Sloping Agricultural Land Technology (SALT). SALT aimed to solve the soil problems. However the adoption has not been widespread and several constraints were identified such as (Mercado et. al. 2000):

1. high labor requirements to establish and maintain the hedgerows,
2. limited value-added to the farm income,
3. unanticipated problems in soil fertility due to hedgerow competition,
4. irregular width of the alley,
5. too dense hedgerows in moderately to steeply sloping farms,
6. poor species adaptation and lack of planting materials, and
7. insecure land tenure.

In 1992, operation of the project was transferred to the International Centre for Research in Agroforestry, now known as the World Agroforestry Centre. ICRAF in 1993 took over the site in Claveria and started carrying out field trials. (It was in 1996 when the natural vegetative filter strips (NVS) has been widely promoted.) Extension teams known as the Contour Hedgerow Extension Team (CHET) where organized to conduct the training sessions in the mid 1990s. The demand of farmers to ICRAF(service of ICRAF or CHET) started on 1995. The farmers were looking for an alternative to their old practice of slash-and-burn to maintain sustainability. Some of the farmers who were in close contact with ICRAF asked the ICRAF researchers to help them (Cramb et. al 2003; Metcalf 2005).

Mercado et. al (2000) found that the NVS gives simple solution to the technical constraints of soil conservation on slopes by serving as buffer strips (Plate 7). Normally, NVS is applied on the contours for the natural vegetation to re-grow which then serves as protective cover. NVS was developed through experience and helped farmers to have the foundation to explore other different agroforestry systems involving fruit and timber trees. The discovery of a cheap contour technology, the application of the natural vegetative strips (NVS) to lessen the soil erosion problem was further tested and developed by ICRAF. In 1996, the farmer leaders under ICRAF's facilitation decided to form a farmer organization to promote NVS contour hedgerow system within the Claveria community Claveria Landcare Association (CLCA) thereafter became a municipal-wide organization (Cramb et. al 2003).

Activities of Landcare

These are the five types of Landcare groups facilitated in Claveria (Metcalf 2004):

1. On farms – with farmers and land-owners
2. In schools – with elementary and high school students; integrated in the Technology and Home Economics subject as part of their curriculum
3. In forest margins – with indigenous people and migrants
4. In church – part of church activities for caring for both physical and spiritual needs of members
5. For out-of-school youth – who need some focus to their activities

Landcare Technologies

Landcare has been widely known for its natural vegetative strips (NVS) technology. From NVS it evolved to enrich NVS incorporating other crops and perennials like banana. Other technologies promoted by ICRAF are the contour plowing and hedgerows. The ultimate goal of NVS was to pave the way for the development of agroforestry system on the farm. In contour plowing the furrows are plowed to make it perpendicular to the slope. Both A-frame and cow'sback method are used to establish NVS. The A – frame uses a wood or bamboo stick with a string and a stone hanging at the center. The frame helps to obtain the next contour position. In the cow's back method, the top back of the cow serves as the guide to estimate the curves of the slope. The cow's back go along the contour of the land. Planting hedgerows on the strips helps to catch the soil minimizing soil erosion. The old practice was planting leguminous trees on the contour lines. The hedgerows create terraces. Hedgerow provides barriers to soil erosion and at the same time additional income for the farmers (Agustin 2002).

The Triadic Approach

Landcare as an approach is composed of three key actors: the Claveria Landcare Association (CLCA), World Agroforestry Centre (ICRAF) and the LGU, hence the triadic approach. These actors work for the promotion on the adoption of the Natural Vegetative Filter Strips (NVS). The key activities which are considered as the "cornerstones" of the landcare approach were: (1) promotion of appropriate technologies;

(2) institution building through formation of landcare groups; and (3) building partnerships amongst landcare groups, LGU officials, ICRAF and other agencies.

Each actor in this “triadic approach” has different roles. ICRAF serves as the facilitator of the process. For ICRAF, Landcare is an approach being tested to learn how the promotion of Landcare technologies can still be enhanced. The LGU on the other hand serves as the channels for the activities of the Landcare groups. The contact persons are the barangay captains and the committees on agriculture. The *kagawads* are the coordinators, which in a normal sense are automatically appointed as the landcare presidents of the groups. The most important role of the municipal government is the implementation of local policies. The Landcare groups and the Claveria Landcare Association (CLCA) provide the resources such as time, labour and some low-cost materials. CLCA is the representative of a municipal wide association of Landcare chapters. Officers assist the implementation of trainings, sessions and slide shows, and advocated financial and policy support from the LGU (Catacutan 2004).

Landcare Coverage and Dissemination

The Contour Hedgerow Team (CHET) was at first composed of five members. The Team started the activities by giving trainings and teaching the farmers. The adoption rate at first was so slow. ICRAF had the vision to widely disseminate the technologies, and to do this, CHET formed separate training groups and subgroups. Consequently, the Claveria Landcare Association (CLCA) composing at first of 20 groups was formed (Arcenas 2002). CLCA brought the rapid formation of Landcare groups in the whole Claveria municipality to reach even the sitios.

The technology was either taught to the farmers or was taught by the farmers themselves to their neighbors, friends and fellows. This led to the extensive technology adoption of the farmers in the whole Claveria. There have been 62 village-based landcare groups, involving more than 2000 farmers. More than 1500 conservation farms had been established and more than 200 community and household nurseries (Mercado et. al 2000). The dissemination reached the neighboring municipalities like Malitbog. Then on 1997, the visit of the local government officials of Lantapan, Bukidnon to the farm sites further encouraged the up scaling of Landcare (Metcalf 2004). At present, Landcare is found in Misamis Oriental, parts of Bukidnon, Cotabato, Bohol and Leyte (Fig 7).

Hypothesis

The hypotheses tested were as follows:

- Landcare as a community-based organization enhances the adaptive capacity of upland communities to climate variability
- Landcare membership enhances adaptive capacity.
- Adoption of Landcare technologies promotes resilience.

Landcare Activies

Plate 1. One of the IEC activities – Slide showing
Source: ICRAF - Claveria database

Plate 2. Cross visit
Source: ICRAF - Claveria database

Plate 3. NVS establishment
Source: ICRAF - Claveria database

Plate 4. Establishment of Communal nursery (a) and Seed sowing (b)
Source: ICRAF - Claveria database

Plate 5. Demonstration on Asexual propagation
Source: ICRAF - Claveria database

Landcare in school

Plate 6. Landcare in School
Source: ICRAF - Claveria database

Landcare Technologies

Plate 7. Natural Vegetative filter Strips (NVS)
Photo source: ICRAF-Claveria Database

Plate 8. Enriched NVS
Photo source: ICRAF-Claveria Database and MR Banaticla April 2006