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Regional Policy Paper for the Philippines

Integrating e-Sustainability and Resilience into Low-cost and School Building Develoment

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Regional Policy Paper for the Philippines

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Chapter 1 Introduction

1.1 Objective of Policy Paper

This regional policy paper, specifically focused on the Philippines, was prepared to target the integration of environmental sustainability and disaster resilience in school building development and its implication. This paper was developed in continuation of the efforts by the Environment and Development Division (EDD), ESCAP since 2008 in the area of eco-efficient urban infrastructure in the Asia-Pacific region.

The main objective of this paper is to develop guidelines that will enhance the capacity of the policy/decision makers involved in infrastructure design and planning, especially water and energy infrastructure at the central as well as local level. This effort aims to enable the application of the concept of eco-efficiency in water-energy infrastructure design and planning in the context of the green economy and sustainable urban development. The paper also focuses on the development and application of integrated building codes to address disaster resilience (DR) and environmental sustainability (ES) for low-cost buildings in general, and school buildings in particular.

This document also includes constructive feedback received during the National Workshop on Sustainable Urban Infrastructure Development in the Philippines organized by ESCAP and the Philippines' Department of Science and Technology on 10-11 September 2014 at Dusit Thani Hotel, Manila.

1.2 Scope of Policy Paper

Buildings constructed today are most likely to dictate city and town development and consumption patterns for the decades to come. An incremental investment trend has been seen in the low-cost building sector in many countries including Thailand, Brazil, Mexico, and Peru (Sushi, 2013). These are just a few of the many countries noted for embracing and promoting sustainable low-cost building solutions.

Currently, there are several international and national codes that govern the general buildings and large structures addressing various aspects of design and construction. These codes are often voluminous and sometimes complex, as they need to cover and address many types, sizes, configurations, usage, and varying materials involved. The application of building codes to low-cost buildings, which are often low-rise and of simpler configurations and material, and usually not designed and constructed by highly qualified professionals, is more difficult. This may lead to a lower level of adoption, enforcement, and may result in reduced DR and ES.

With respect to the trend and the need for sustainable low-cost buildings, it is important that the environmental and disaster resilient features are not compromised or neglected when these alternative buildings are designed and constructed. This can be facilitated and reinforced by having dedicated building codes for the low-cost buildings that take into account these aspects in an integrated, simplistic, and enforceable manner.

This policy paper specifically focuses on the need, development, and ways to implement a dedicated building code for low-cost buildings in general, and school buildings in particular, especially in the Philippines which is both vulnerable to disasters and has environmental constraints.

1.3 Disasters and Environmental Sustability

The linkage between environmental sustainability and disasters is inextricable. The continued strain on the environment and the impact of climate change will increase both the severity and the frequency of natural events.

The term disaster is generally viewed from the angle of the disruption caused to the human, economic, and environmental factors associated with a community. This view of disaster often overlooks the factors contributing to a disaster which include: Hazard, Exposure, and Vulnerability of the community and the natural environment. The criticality of the factors defines the severity of the consequences.

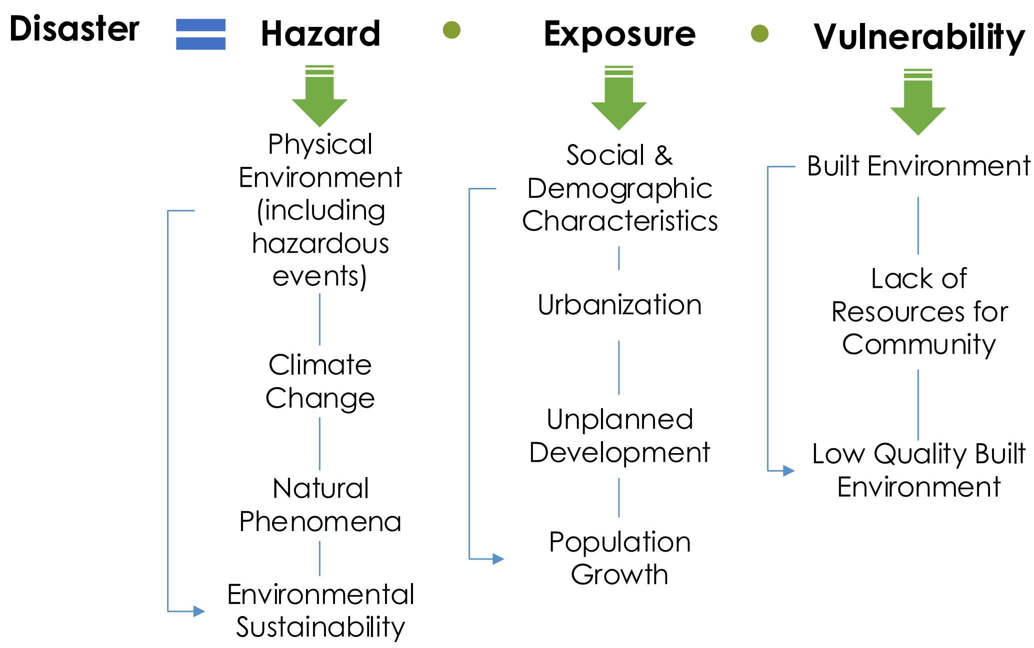

Figure 1-1 : Disaster, its sub-components and environmental correlation

Hazards: Rising temperature, variability in rainfall, rise in sea level, droughts, floods, and intensity and frequency of tropical storms are some of the forms in which the changing climate is being felt. The natural variation in climate system along with the degradation of eco-systems are some of the causes and consequences of climate change. The extent to which the environmental resources are exploited and the level to which remedial actions are taken can have a significant contribution to the many hazard level. However, some hazard such as earthquakes may not be directly linked to climate change.

Exposure: The projected increase in the demographic composition and distribution of the population means that the level of exposure is also increasing. The development of human settlements in areas where earthquakes and tropical storms occur frequently aggravates the exposure level. Also, in order to provide for developing human settlements, sometimes the natural barriers such as swamps or leveling of hillsides disrupt the natural runoff pattern and increases flood and landslide hazards.

Vulnerability: The factors of unplanned development and poor quality of construction and lower economic strength that contribute to increased vulnerability of community may also increase the environmental impact.

1.4 ES and DR in Built Environment

Built environment, as shown in the following figure, is a common factor between ES, DR, and climate change. The policies and actions that affect the planning and quality of built-environment have direct impact on ES and DR. Policies and actions need to be implemented at global, regional, national, and local level contexts. Integrated building codes can provide one vehicle to define and implement the policies and actions.

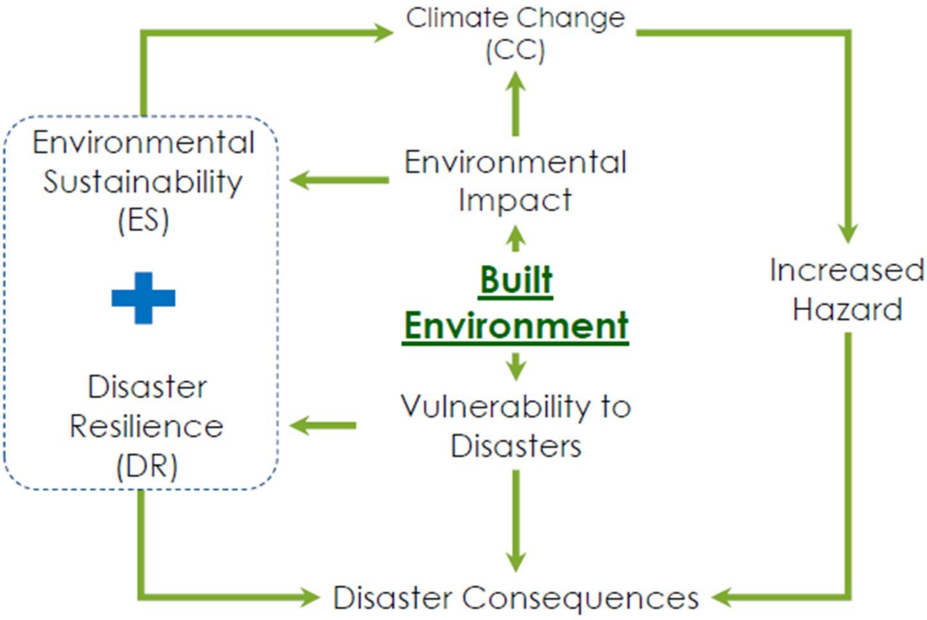

Figure 1-2 : ES and DR in built environment

One of the key considerations that needs to be kept in focus is the rate of urbanization, which has a direct impact on the built environment. Urbanization not only creates strain on the natural resources but also significantly contributes to the greenhouse gas (GHG) emission which in turn contributes to the climate change and resultant climate-related disasters.

The Asia and Pacific region is now home to more than two billion urban residents and it is estimated that by 2030 over half of the region's population will live in cities – a figure that will rise to 64 per cent in 2050. In this context, it is imperative to take into account of impacts both such rapid urbanization as it directly affects DR and ES considerations for a community, city, country, and the region.

Chapter 2 Overview of Existing Policies

2.1 Overview

For the development of the policies related to environmental sustainability and disaster resilience, it is important to realize that actions carried out by individuals contribute to the local, national, and eventually at the global level. For example, cutting of a tree in a house, or disposal of a toxic material in the waste, or use of polluting products by individuals can affect the entire chain of sustainable ecosystem. At the same time, the assessment created by global initiatives can filter through and can help evaluate individual for greener and sustainable living. Similarly, the policy frameworks developed at global scale can help to guide the national and local policies. The national regulations can shape the provincial and local regulations, and finally the enforcement of the policies and regulations can help to achieve the action needed at individual level, which in-turn can effect the sustainability cycle. This hierarchical context is represented in Figure 2-1, and is meant to highlight that various policy frameworks need to be developed with the appropriate linkage to various levels, to create the proper impact.

Some of the global, regional, and national policies and relevant frameworks are briefly reviewed in the following sections.

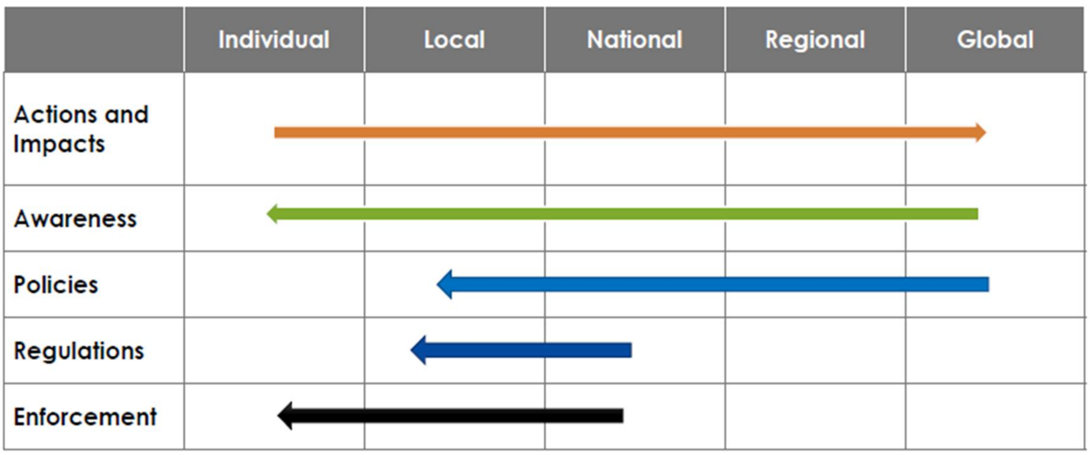

Figure 2-1 : ES and DR considerations and the flow of information in a typical hierarchal context

2.2 Existing Policies and Strategies

2.2.1 Policy Initiated by the United Nations

As per the 2014 revisions of the World's Urbanization Prospects issued by the United Nations:

- Governments will be in charge of implementing policies to ensure that the benefits of urban growth are shared equitably and sustainability

- Diversified policies to plan for and manage the spatial distribution of the population and internal migration are needed
- Policies should be aimed at a more balanced distribution of urban growth
- Provisions on accurate, consistent, and timely data on global trends in urbanization and city growth
- Successful sustainable urbanization

The document envisions the achievement of a successful sustainable urbanization for all UN member states. And to achieve a successful sustainable urbanization, the effective integration of ES and DR considerations is needed.

2.2.2 Hyogo Framework for Action

As laid out in Priority for Action (PFA) for Hyogo Framework for Action (HFA)[1]:

- **PFA 1:** Ensure disaster risk reduction (DRR) is a national and local priority with a strong institutional basis for implementation
- **PFA 2:** Identify, assess, and monitor disaster risks and enhance early warning
- **PFA 3:** Use knowledge, innovation, and education to build a culture of safety and resilience at all levels.
- **PFA 4:** Reduce the underlying risk factors
- **PFA 5:** Strengthen disaster preparedness for effective response at all levels

The PFA's clearly states the approach that need to be taken for disaster resiliency, especially building culture of safety and resilience and to reduce the underlying risk factors.

2.2.3 Policy Recommendation by ESCAP

In its November 2013 issue of Urbanizaiton Trends in Asia and the Pacific, ESCAP presented some of the policy recommendations for the region, which included [2]:

- Improve urban planning in cities and improve urban governance

[1] Priority for Action (PFA) for Hyogo Framework for Action (HFA) http://www.unisdr.org/we/coordinate/hfa

[2] Urbanizaiton Trends in Asia and the Pacific, ESCAP http://www.unescap.org/resources/urbanization-trends-asia-and-pacific

- Enhance urban infrastructure and services
- Establish economic policies that focus on the reduction of inequalities at the city level
- Promote more environmentally-friendly practices to ensure sustainable growth of Asian-Pacific cities

Chapter 3 Multi-aspect Integration

3.1 Overview

The aim of the multi-aspect integration should be to implement strategy that overcomes the human, economic, and environmental challenges associated with ES and DR considerations. The policy/strategy for multi-aspect integration needs to primarily keep the following in focus:

- Structural and non-structural aspects
- ES and DR integration

3.2 Structural and Non-structural Aspects

The various aspects that need to be considered when considering multi-aspect integration are:

Structural: Planning, design, construction, maintenance, rehabilitation, retrofitting, and rebuilding

Non-structural: Awareness, preparedness, management, lifestyle, regulations, and incentives

3.3 ES and DR Integration

For an effective integration, ES and DR features should be clearly identified prior to developing a full strategy. This integration may include the following aspects:

Environmental Sustainability: Water conservation, energy conservation, soil conservation, and resources conservation

Disaster Resilience: Typhoons, earthquakes, landslides, floods, volcanic eruptions, and wild fire

3.4 Interdependence and Conflicting Areas of DR Measures and ES Requirements

It is a widely held conception, which is not always true, that to make buildings more robust (less vulnerable) to natural hazards - they need to be stronger, hence requiring larger sizes of structural members and stronger materials. This apparently contradicts or conflicts with the need to conserve resources.

Figure 3-1 shows an indicative dependence matrix between the measures normally carried out for improving DR for various hazards and their possible negative impact on ES measures. According to this matrix, most of the hazards have a high to medium dependence on site location and corresponding environmental impacts of site selection. Many mitigation measures may also have impact on soil conservation, and most will have an impact on material conservation. It can also be seen that many ES considerations have low or no dependence on the measures needed for DR.

Some of the obvious conflicts may be in terms of providing roof overhangs, window sun shades for better energy conservation, and improved indoor environment, which may become vulnerable to hurricanes and strong winds. Similarly, the best size and locations of windows for cross-ventilation and lighting may create weaknesses during hurricanes, storms, and strong winds.

Disaster Resilience	Environmental Sustainability Considerations							
	Site	Soil Conv.	Water Conv.	Energy Conv.	Material Conv.	CO2/GHG	Air Pollution	Indoor Env.
Earthquakes	M	M	N	N	H	L	N	N
Volcano	H	N	N	N	N	N	N	N
Fire	N	N	L	M	M	L	N	N
Wild Fire	H	N	N	N	N	N	N	N
Wind	M	N	L	L	M	L	L	L
Hurricanes, Typhoons, Storms	M	M	L	L	H	L	L	L
Flooding	H	M	L	N	L	N	N	N
Landslides	H	H	N	N	L	N	N	N

H=High, M=Medium, L=Low, N=None

Figure 3-1 : Indicative interdependence of DR measures and ES requirements

3.5 Areas where ES and DR may have Complementing Requirements

By enhancing DR of buildings, their durability is automatically enhanced. If these buildings can sustain a natural hardness, do not need to be rebuilt, or require nominal or less rehabilitation after a disaster, then resources are automatically conserved. Durability and longer building life span can therefore benefit both ES and DR.

3.6 Areas where Various Multi-hazard DR Requirements may Conflict

The most obvious conflict is for measures needed is when providing high resistance to strong earthquakes and strong winds. The design for wind requires large stiffness, large mass, and greater strength. The design of earthquakes requires low mass and high ductility with often lower strength interaction between ductile and brittle failures. Similarly, seismic resistance of gable roof walls is less than flat roofs, whereas gable roofs may be more suitable for rain storms and provides better energy efficiency.

3.7 Key Features to be considered for Integration

This section, characterized by several considerations presented in the following tables will demonstrate why not much can be done at the low-cost building level for risk reduction for floods and specially landslides in an economically feasible manner.

While many ES considerations can be easily integrated in the basic percepts and construction of low-cost buildings, resilience to various types of natural hazards and disasters is often not considered. Oftentimes, the damage and corresponding causalities and disaster consequences are more pronounced in low-cost buildings. Examples of such include the consequences of the Haiti earthquake [3], Kashmir earthquake [4], and typhoons in the Philippines are well documented.

This is because low-cost buildings are planned, designed, constructed, and perceived as low quality and sometimes consequently unsafe. The notion that "strong" and resilient buildings require higher cost leads to either explicit or implicit exclusion of DR considerations during the design and construction of the structures. While there may be some cost impacts for making the buildings more disaster resilient, the consequence of not including DR considerations may often be much greater. The DR of a building can often be improved significantly by incorporating simple details and considerations in the design and construction practices. It often involves using the same materials in a different manner, or paying attention to certain construction methodologies and practices.

DR considerations does not necessarily mean incurring greater cost, therefore, it is important not to exclude DR considerations in low-cost buildings by default, but rather evaluate each relevant hazard risk and include the desired level of DR in the design, selection of materials, and construction details and practices, including.

3.7.1 Environmental Sustainability

Various considerations for ES can be included in an integrated manner at different steps of the design and construction as shown in the table below.

[3] According to the Disaster Emergency committee, almost 293,383 buildings were either severely damaged or destroyed by the Haiti Earthquake. http://www.dec.org.uk/haiti-earthquake-facts-and-figures.

[4] According to the Earthquake Engineering Research Institute (EERI) special earthquake report, February 2006, it was estimated that over 780,000 buildings were destroyed or severely damaged during the Kashmir earthquake on October 8, 2005. Among these, around 17,000 were school buildings.

Table 3-1: Various considerations for environmental sustainability

Primary Aspect of ES	Considerations to Cover the Primary Aspect	Design and Construction Process Step
Soil and Environment Conservation	Avoid to building site that is part of protected environmental zones, or covered by trees and vegetation that holds the soil together	Site selection
	Consider minimal damage to land around the construction site	Construction practices
	Design the building to follow the existing land profile to avoid excessive cut and fill	Architectural planning
	Avoid blocking or diverting any exiting natural water ways or building on ponds or water bodies	Site selection and architectural planning
	Include planning of grass, vegetation and trees, if possible, within or around the buildings	Architectural planning
Water Conservation, Harvesting and Recycling	Provide minimal water usage outlets, with just enough flow capacities, and water efficient fixtures wherever possible	Plumbing design
	Include rain water harvesting in design or roof	Architectural design
	Provide rain water collection and recycle system, either for each building or a group of buildings	Architectural planning and plumbing design
	Incorporate waste-water recycling wherever possible, each building or a group of buildings	Architectural planning and plumbing design
Energy Conservation, lower GHG, and Alternate Sources	Use proper orientation of the building, location and size of doors and windows, proviso of window shades to optimize the use of natural daylight, proper ventilation, natural cooling etc.	Architectural design
	Use energy efficient electrical system and light fixtures	Electrical design
	Provide proper insulation to the roof and walls to minimize heat gain (or loss for cooler areas)	Architectural design
	Of the available materials, select materials with higher insulation value to minimize heat gain or loss	Material selection, architectural design
	Consider incorporation waste to energy solutions for a group of buildings or a community	Architectural planning, plumbing and waste disposal, electrical design
	Choose local materials for construction as far as possible to reduce transportation efforts to reduce energy consumption	Architectural design and structural design
Material Conservation and Re-use	Use minimal material through efficient design	Architectural design, structural design
	Minimize material waste through modular design and use materials of standardized sizes, or design to match material sizes.	Architectural and structural design and material selection

Primary Aspect of ES	Considerations to Cover the Primary Aspect	Design and Construction Process Step
	Incorporate recycled materials into deign, wherever possible	Architectural and structural design and material selection
	Use proper construction practices, to reduce material waste and encourage proper waste recycle and disposal	Construction practices

3.7.2 Disaster Resilience

The disaster resilience for various hazards can be built through integrated consideration in different steps of the building design and construction process steps.

Table 3-2: Various considerations for disaster resilience

Primary Aspect of DR	Considerations to Cover the Primary Aspect	Design and Construction Process Step
Earthquakes	If possible, avoid sites and locations known to have soil liquefaction potential during earthquakes	Site selection
	Select simple plan and elevation layout, and follow basic guidelines for better seismic resistance	Architectural design, structural design
	Select materials with of appropriate stiffness and ductility for walls, and primary framing members	Architectural design, structural design, material selection
	Provide proper connection details to tie-up various component of the building to provide integrity during design	Structural design, Architectural design
	Provide sufficient strength and ductility in main structural system to withstand major earthquakes without collapse or danger to life	Structural design
	Connect and support non-structural parts to main structural members properly to avoid "falling object" hazard during earthquake	Architectural design
	Provide proper exit and evacuation paths and doors during earthquake, especially for public buildings, such as schools etc.	Architectural design
Cyclones, Hurricanes, Storms, Wind	If possible, avoid sites and locations in the direct path of known, regular cyclones, hurricanes and storms	Site selection
	Avoid design or roof elements, or verandah areas susceptible to wind uplift	Architectural design
	Tie and connect all roof element to main structural members, and hold-down foundations	Structural design, architectural design

Primary Aspect of DR	Considerations to Cover the Primary Aspect	Design and Construction Process Step
	Use wall and enclosure materials and forms to resist out-of plane wind pressure	Architectural design, structural design, material selection
	Use materials that have water proof and water resistant qualities	Architectural design, material selection
	Provide windows and doors of material and form that can withstand high wind and water pressure, and provide proper connection with walls and locking system	Architectural design
	Provide sufficient strength in main structural system to withstand forces induced by high wind pressures	Structural design
	Consider the possibility of falling trees, power-lines, flying debris and its impact on the building	Site selection, architectural design, structural design
Floods	If possible, avoid sites and locations in the known, regular flood areas, and near overflowing water ways, or flash floods	Site selection
	If the building is to be located in known flood hazard, consider in basic design, by raising sleeping areas above flood level, or consider multistory living	Architectural design
	Consider flood mitigation at community and locality level through diversion, storage, protection etc.	Site and Architectural planning
	Use materials that have water proof and water resistant qualities	Material selection
Landslide	If possible, avoid sites and locations in the known, regular land slide prone areas	Site selection
	Take land-slide mitigation measure for the site/ location at community/ regional level through vegetation, slope protection, geo textiles, micro piping, and other means	Locality and regional planning and infrastructure

Chapter 4 Low-cost School Buildings as the Focus

4.1 Why Start with Schools?

School buildings and premises present particularly high risks due to the large number of students, in relatively small, and often inappropriately designed and constructed buildings. These risks pose the possibility of a large scale of human, economic, and education facilities loss after a strong event.

School buildings are often designated in many communities as the emergency and disaster shelters, and need to have appropriate resilience for various hazards. Schools, which are centers for early education and development of children's minds can serve as awareness building for disaster resilience as well as environmental sustainability.

These factors emphasize that schools require special attention due to potentially high consequences in case of disasters. Putting initiatives in place that address DR and ES can have long-term and far-reaching effects.

4.2 What are Low-cost Buildings?

The low-cost building concept deals with budgeting to reduce the overall construction cost by improved management, appropriate utilization of local knowledge and resources, and technology while maintaining the efficiency and durability of the building (Tiwari et al.,1999).

Cost considerations for low-cost buildings are given higher weightage and priority in the design and construction, compared with other construction details. Lower cost is typically achieved through:

- Using relatively lower space requirements (such as smaller room size, public spaces)
- Using minimalistic approach in terms of non-essential building components and finishes
- Using material of "just sufficient" specifications and relatively lower cost amongst available alternatives; and using the locally available instead of imported options
- Using low-cost construction techniques and technologies, often relying on local labor and practices

Lower cost can also be achieved through:

- Economy of scale by using mass production, standardization, modularization of components and systems; and constructing large number of building at the same time

- Mechanized construction techniques, use of pre-cast, pre-fabricated components, improved logistics, reducing wastage, and reducing construction time and labor inputs
- Improved and optimized designs, especially developed low-cost materials, use of re-cycled materials, or use of waste and by-products from other processes as construction materials.

Low-cost buildings are often low-rise with simple configurations and smaller spans and heights, using typical and standardized layout plans and details. These types of low-rise and low-cost buildings also have simpler plumbing systems. They typically do not utilize Heating Ventilation and Air-Conditioning (HVAC), or employ elaborate firefighting measures, complex electrical or mechanical systems, and do not have elevators. This makes many of the requirements for general building construction irrelevant for low-cost buildings. In addition, in low-cost buildings, it may not be necessary to carry out a separate or explicit structural and building services design, and may be integrated into the basic architectural layout and design of the enclosure. This is due to the simplicity of the plans, smaller sizes of spaces, and use of simpler systems.

4.3 Why Focus on Low-cost Buildings?

Low-cost buildings provide multi-benefits for residents including durability, disaster resiliency, environmental sustainability, energy conservation, poverty alleviation, and reduced greenhouse emissions on a wider scale. Low-cost buildings must be adopted and encouraged to achieve sustainability from the local and regional climatic and natural hazards and utilize the local materials and technology (UNHABITAT, 2011).

Due to their relatively small size and low-cost, these buildings often do not get sufficient attention and commercial interest from highly qualified and competent architects and engineers, which may lead to a lower quality of basic design for ES and DR compared to highly funded projects. In the same way, the construction is often carried out by the less qualified contractors and most times by local laborers, leading to a lower quality of construction thereby reducing resilience to disasters. Cases have shown that low-cost buildings may not receive attention from the building officials. There may also not be enough officials available to visit/inspect all buildings, and especially those built in the informal sectors.

The largest application of the low-cost building is in the public housing for low income groups and for public buildings such as schools, hospitals/health units in the rural and suburban areas. Recently, low-cost buildings are also being used in social housing projects and programs initiated by the development agencies, NGOs, and corporate entities as part of corporate social responsibility (CSR) initiatives. In the Philippines and other countries with similarities, private developers of high-end commercial housing projects are often required to also provide a certain number of low-cost/social housing units.

4.4 Low-cost Buildings and Disaster Resiliency

Usually, low cost buildings are planned, designed, constructed, and perceived as low quality and sometimes consequently unsafe, and hence most of the times the physical, structural, and human losses are more pronounced in low-cost buildings. Also, the general perception of higher cost factor associated with the resilient structures oftentimes leads to an oversight or minimal inclusion of DR considerations during design and contruciton phases which may lead to compromising on the safety of the structure.

There may be associated costs in constructing or making a building disaster resilient, but the consequence of not including the DR considerations may often be much higher. Most of the times the resiliency of a building to disasters can be significantly enhanced by incorporating simple details and considerations in the design and construction practices. It often involves using the same materials in a different manner, or paying attention to certain construction methodologies and practices.

Rather than excluding the DR considerations in low-cost buildings, it is important that each relevant hazrd risk should be evaluated and the resultant degree of DR should be also included in the design, selection of materials, and construction details and practices. Appropriate building codes and guidelines can greatly help to achieve these efforts.

4.5 Low-cost Buildings and Environmental Sustainability

Many of the basic percepts of low-cost housing can lead to sustainable construction and development when implemented appropriately. Lower cost is often achieved by minimizing waste and doing-away with frivolous and superfluous design components and construction practices.

Environmental sustainability in a building could be achieved at a lower cost by improvising on design and utilizing technology and resources available at local levels. Some common practices [5] which could enhance environmental sustainability are as follows:

a) Utilizing natural daylight to reduce the consumption of artificial light and conserving the total energy usage.

b) Utilizing cross-ventilation through windows to conserve energy required to ventilate rooms.

[5] The strategies are adopted from the global green organisation's twenty strategies for Global Green Initiative in the United States.

c) Installation of central heating or cooling system for the entire building could be applied to reduce the air conditioning cost and preserve energy.

d) Usage of energy star appliances to curtail the energy consumption by appliances such as refrigerators.

e) Installation of water efficient restrooms/toilets for conserving water.

f) Utilizing no Volatile Organic Compounds (VOC) paints to improve the indoor air quality.

The environmental sustainability of low-cost buildings can be further improved by incorporating specific requirements and details for these considerations in water conservation and re-use, alternate energy usage, improved use of day light, and better ventilation. Such requirements can be part of the relevant building codes and guidelines.

4.6 Key Issues with Low-cost Buildings

Some of the key issues pertaining to the concept and construction of low-cost buildings are:

- Most of the time, low-cost buildings do not get the desired attention and commercial interest from highly qualified and competent architects and engineers.
- Low quality basic design are common for low-cost building ES and DR compared to the ES and DR to well-funded projects.
- Construction by less qualified contractors and local laborers leads to lower quality of implementation and thereby reducing resilience to disasters.
- Lack of required attention from building officials and not enough officials available to conduct inspection.

4.7 Special Challenges for Schools

Some of the key challenges that have been identified in Hyogo Framework are:

- Increased vulnerability due to urbanization, increased enrollments, and establishment of private schools with less controls
- Schools have received less attention from hydro-meteorological and other natural disasters
- Limited early warning systems and inadequate access to proper hazard maps
- Limited emphasis on reducing underlying risk through vulnerability reduction, and lack of substantive studies on vulnerability

Reducing damages due to disasters to housing, educational, and health facilities are one of the three global targets identified for the first ten years of Hyogo Framework for Action 2[6].

4.8 Key Policy Suggestions

Some of the key policy suggestions that can be considered in relation to low-cost buildings, specifically for schools, are:

- Integration of ES and DR in various initiatives
- Development of policy and frameworks for low-cost Buildings
- Assignment and identification of schools to determine highest priority for DR and ES
- Use of school DR and ES as means of awareness and education of these aspects
- Use of schools as "safe" and "sustainable" models for the community
- Preparation of schools as temporary "safe houses" for communities during disasters

[6] Consideration on the post 2015 framework for disaster risk reduction, Third UN World Conference on Disaster Risk Reduction – 16 June 2014

Chapter 5 Building Codes

5.1 Overview of International and Regional Building Codes

Although there is great awareness among the various stakeholders involved in the planning, design, construction, and operations of the buildings and facilities for both DR and sustainability aspects, these aspects are often covered by separate and independent codes and guidelines, developed (and sometimes enforced) by different agencies or organizations. For example, this is demonstrated by the code organization for buildings for California, United States and Singapore (Figure 5-1 and Figure 5-2).

Figure 5-1: Building codes and regulations in California, United States

These figures show that building codes in developed countries intend to cover many aspects of buildings and are comprised of several documents. Based on these representative codes, DR considerations are covered in structural design codes, whereas ES considerations are distributed across many codes. There are sometimes special (and often voluntary) codes for green buildings, covering ES aspects in greater detail, and often with higher standards.

A comprehensive analysis and comparison of the building codes in some developed and some developing countries was presented in a previous report developed.[7] Based on this report by UNESCAP and AIT, it can be

[7] Integrating Environmental Sustainability and Disaster Resilience in Building Codes, UNESCAP and AIT, 2012

inferred that the integration of the DR and ES considerations in various building codes varies significantly. While almost all codes do consider the main DR for wind and earthquakes, not all consider other hazards such as landslide and flooding. ES considerations were also found to vary considerably, from codes with very comprehensive coverage and integration to those with barely any specific considerations.

A B C D E

Figure 5-2: Building codes and regulations in Singapore

5.2 Development of Low-cost Building Codes

Low-cost buildings, particularly when used for school buildings as is the primary focus in this concept paper, provide an opportunity to explore the possibility of developing specific, yet integrated code documents and accompanying guidelines that combine all of the required provisions for basic planning, DR, and ES. Such documents can be targeted for the current qualifications and skill levels of the stakeholders typically involved in the planning, application, and enforcement these codes in the low-cost building sector.

In the case of ES, the main focus is on the conservation of resources and generation of alternate resources, whereas DR focuses on hazard mitigation, vulnerability reduction, and post-disaster management.

5.3 Overall Framework

To develop an integrated code for the low-cost buildings, it is suggested to take a "project-oriented" approach, rather than a discipline or trade-oriented approach by following general buildings codes. Based on the discussion in Chapter 2, it can be predicted that the design and construction of these buildings will often be carried with limited input from many professionals. It is unlikely that an architect, structural engineer, plumbing or building services engineer, and electrical engineer will be engaged to solely design a small low-cost building. It is also unlikely that a qualified contractor and project manager or construction engineer will be engaged during construction process. Similarly, there will probably be little formal evaluations and approvals, and not many visits by the building officials for inspection or enforcement of the code requirements.

It is therefore important that the code document will be developed in such a way that it can be understood and applied by a single professional, such as an architect, associate architect, or a qualified technical staff.

The integration framework for developing a typical regional low-cost building code is shown below.

Figure 5-3: Proposed structure for integrated code for low-cost buildings

The proposed framework addresses the various aspects of the environmental sustianability considerations such as water conservation, energy conservation, soil conservation and material conservation, together with disaster resilience to earthquake, hurricanes, floods, and landslides into the appropriate steps and aspects of the design and construction.

Table 5-1: Key characteristics of the items included in integrated framework

Integrated Framework Items		Key Characteristics
1	Site Selection	• Avoiding sites known to have soil liquefaction, landslide prone areas, regular flood areas, and sites in the direct path of known, regular typhoons • Consideration to the possibility of debris (falling trees, power-lines, etc.) • Avoiding contruction in environmental zones, or areas with vegetation holding the soil together. • Avoid blocking or diverting any exiting natural water ways or building on ponds or water bodies
2	Architectural Planning	• Selection of simple plan and elevation layout. • Selection of materials with appropriate stiffness and ductility for walls, and primary framing members. • Connect nd support non-structural parts to main structural members properly. • Providing proper exit and evacuation paths. • Provide windows and doors of material and form that can withstand high wind and water pressure, and provide proper connection with walls and locking system • Consider flood mitigation at community and locality level through diversion, storage, protection etc. • If the building is to be located in known flood hazard, consider in basic design, by raising sleeping areas above flood level, or consider multistory living. • Consider incorporation waste to energy solutions for a group of buildings or a community. • Choose local materials for construction as far as possible to reduce transportation efforts to reduce energy consumption. • Provide proper insulation to the roof and walls to minimize heat gain (or loss for cooler areas). • Design the building to follow the existing land profile to avoid excessive cut and fill
3	Structural Design	• Follow basic guidelines for better seismic resistance. • Provide proper connection details to tie-up various component of the building to provide integrity during design.

		• Provide sufficient strength and ductility in main structural system to withstand major earthquakes without collapse or danger to life. • Tie and connect all roof element to main structural members, and hold-down foundations. • Providing sufficient strength in main structural system to withstand forces induced by high wind pressures.
4	Material Selection	• Use of wall and enclosure materials and forms to resist out-of plane wind pressure. • Use of materials that have water proof and water resistant qualities. • Of the available materials, select materials with higher insulation value to minimize heat gain or loss. • Minimal material waste through modular design and use materials of standardized sizes, or design to match material sizes. • Incorporation of recycled materials into deign, wherever possible.
5	Plumbing	• Provision of minimal water usage outlets, with just enough flow capacities, and water efficient fixtures wherever possible
6	Electrical Design	• Use of energy efficient electrical system and light fixtures
7	Construction Practices	• Use of proper construction practices, to reduce material waste and encourage proper waste recycle and disposal

5.4 Nature of the Code

With the ever increasing development in urban and rural areas coupled with an increase in the frequency of disasters and environmental constraints, it has become important to have a comprehensive, integrated, and targeted building code specifically addressing the low-cost building sector needs to be developed.

However, in developing a building code for low-cost buildings, it is necessary to look into the limitations that may need to be addressed for enforcement, as listed below:

- Capability and capacity of available resources
- Stakeholder participation and coordination
- Addressing local needs rather than one policy for everyone

To address the limitations, a strategy that could be considered is to have a code that is perceived by users as simplistic, prescriptive or illustrative, and serves as a guideline.

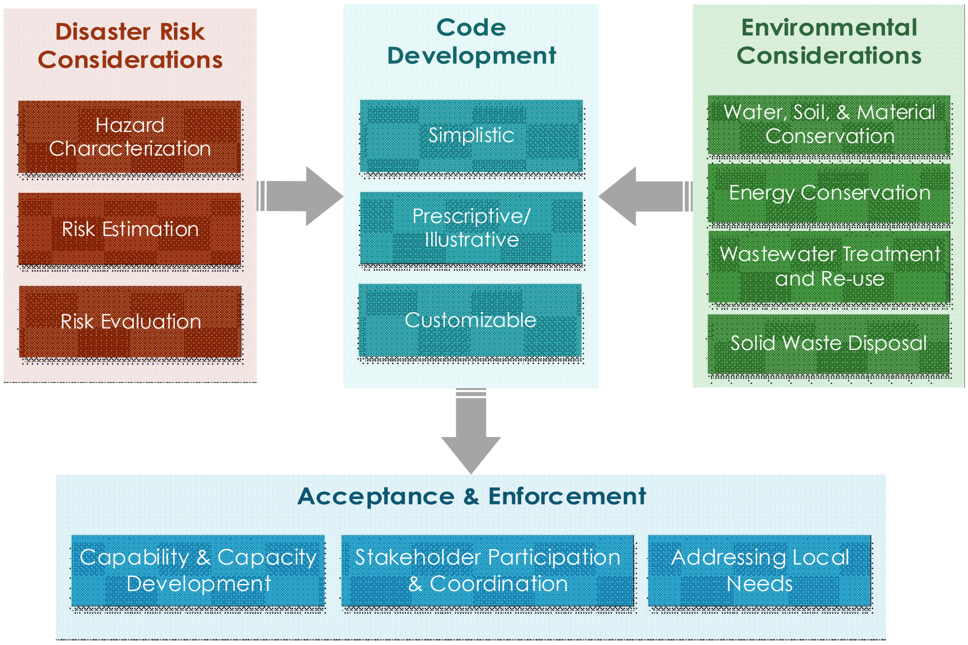

Figure 5-4: Conceptual framework for the development, acceptance, and enforcement of building code for low-cost buildings

5.5 Customizable Codes

One building code cannot address the different needs of the various regions of the Philippines. Environmental impacts and risks from a given disaster may differ from region to region and thus must be reflected in customizable codes.

It is not only vulnerability to the environmental events and disasters that must be considered, the capability and the capacity of the local bodies of the region must also be assessed. It may be possible that a particular community or region already has some innovative practices that can actually complement the overall code for the low-cost building. So, this effort may require the following:

- Optimizing available local resources
- Due consideration for local techniques, skills, and innovative models
- Simplistic codes for easier adoption of the practices by the community.

5.6 Enforcement Considerations

While considering the enforcement of the building codes, some key aspects include the following:

- Not all the building codes incorporate elements of environmental sustainability and disaster resiliency
- Not all codes are enforced strongly in the region, which also applies to the Philippines
- There is a need to identify practices that increase the rate of implementation of the codes

To overcome the challenges and enable the effective enforcement of the building codes, some key features could be considered:

- Simplicity of the codes
- Awareness level among the community
- Provision of certain incentives

Chapter 6 Relevance to the Philippines

6.1 Key Considerations

6.1.1 Frequent and Multiple Natural Disasters

The Philippines, by virtue of its geographical location, is exposed to a variety of hazards that includes typhoons, floods, earthquakes, volcanic eruptions, and landslides. The frequency and magnitude of natural events affecting the Philippines have increased in the past few years, which have resulted in significant increase in the social and economic damages[8].

Every year natural disasters result in significant developmental, infrastructural, human, and economic losses. The Philippines' experiences many annual natural hazards and is affected by major economic impacts, though on the basis on the intensity and frequency, typhoons and flooding are major hazards that occur every year (Benson, 1997). The landslides triggered by typhoons and flooding also cause considerable losses. These hazards re-occur every year although the severity and frequency of occurrence varies. These natural disasters hamper the development process and have an adverse impact on growth and poverty alleviation initiatives causing a long term impact on the economy. However, their overall impact on the national economy is difficult to analyze due to their annual occurrences and confinement to relatively smaller geographical areas.

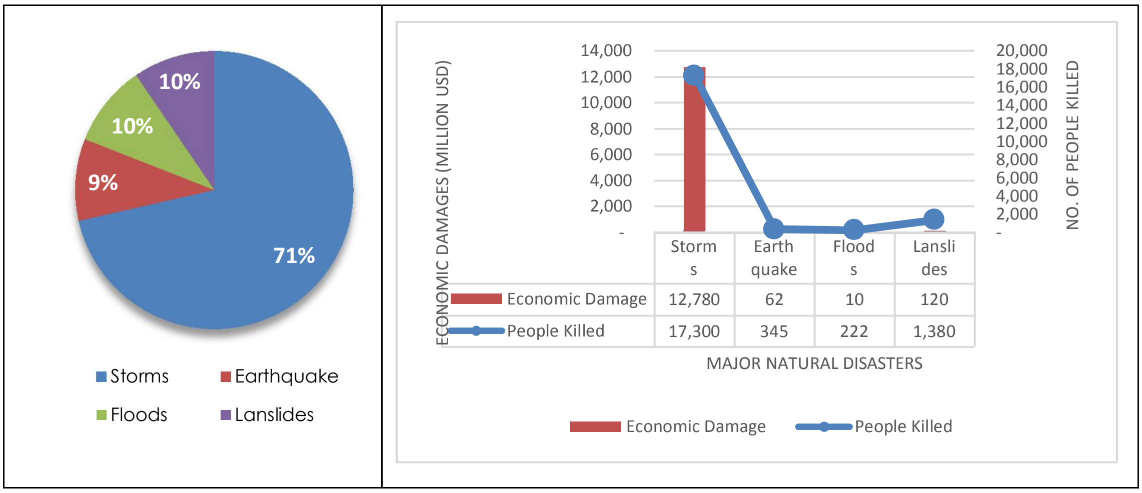

Figure 6-1: Percentage distribution of major natural disasters and the resultant human and economic damages (2000 – 2013)[9]

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[8] Several studies signify that Philippines is one of the most disaster affected country in the world (Delica, 1994).

[9] The International Disaster Database

6.1.2 Population Growth and Urbanization

With a population of approximately 100 million, the Philippines has high population density of 328 people per sqm. The Philippines also has a population growth rate of 2.04%, one of the highest in Asia.

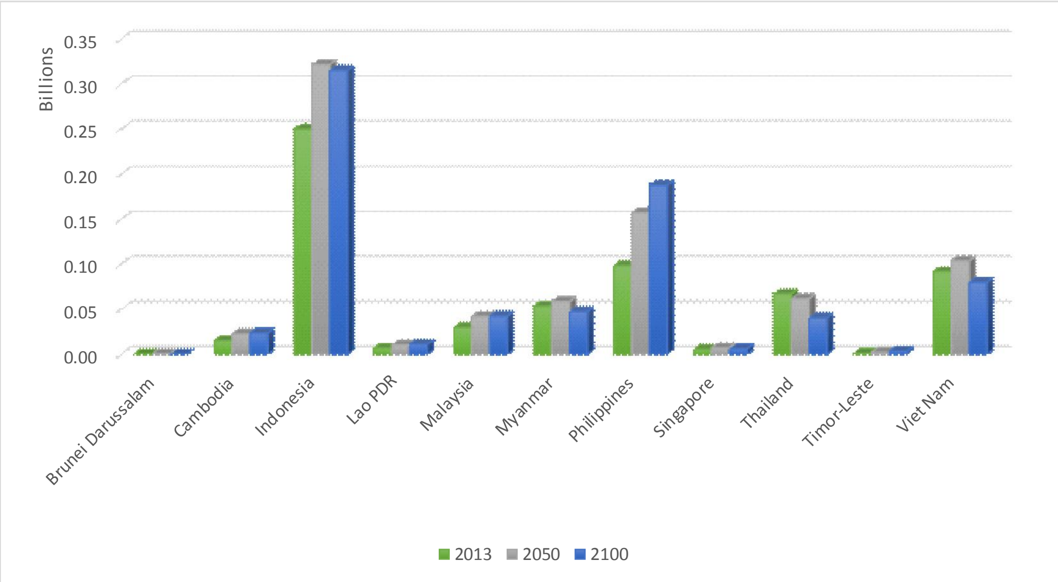

Figure 6-2: ASEAN population growth projection[10]

The increase in population growth has the resultant effect on the rate of urbanization in the Philippines. As of 2011 the urban population comprised 48% of the total population11. Urbanization has its consequences, which can be seen through the strain caused by existing infrastructure, eco-systems, and the delivery of basic services (schools and medical facilities)[12].

6.1.3 Quality of Built Environment

As with most of the countries in the developing world, the Philippines also faces the challenge of developing infrastructure and housing amenities that are at par with the minimum requirement of DR and ES considerations. One of the major constraints for a developing country is to manage the ever increasing demand for built spaces together with the investment required to build and maintain those built spaces. The quality of built environments becomes all the more important, keeping in view the frequency of the natural disasters in the Philippines. It is important to build

[10] United Nations Population Division, World's Population Prospects 2012

[11] CIA World Factbook- https://www.cia.gov/library/publications/the-world-factbook/fields/2212.html

[12] Urbanization Dynamics and Policy Frameworks in Developing East Asia, East Asia Infrastructure Department, The World Bank

infrastructure and housing facilities that can withstand natural events and require minimal investment after a natural event.

As per the country's National Statistic Office, the type of material that is mostly used for construction of housing units in the Philippines are galvanized iron/aluminum, and nipa/cogon/anahaw.

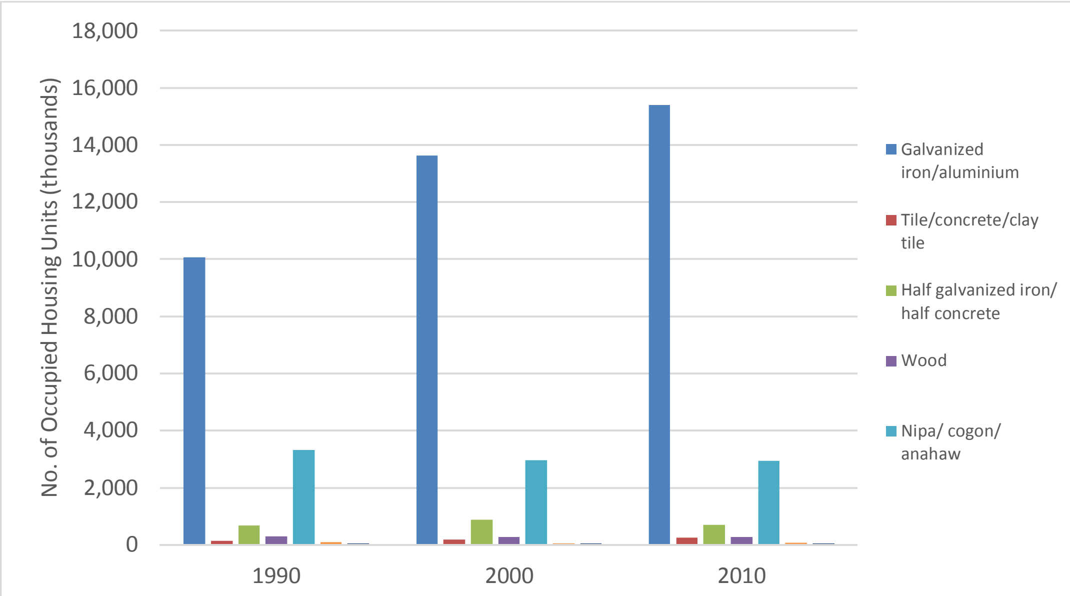

Figure 6-3: Number of occupied housing units by type of construction materials of outer walls and roof [13]

6.1.4 Student Density in Schools

According to the country's Research and Statistic Division, Office of Planning Service, there were approximately 38,000 public elementary schools with approximately 13 million students enrolled as of 2013. In comparison, approximately 7,500 public secondary schools with approximately 5.5 million students were enrolled nationwide. These figures provide only one aspect of the story, whereas the need to verify student density per school and the number of students that were actually exposed to disasters by way of vulnerable school buildings.

[13] Philippines in Figures 2014 – National Statistic Office, Philippines

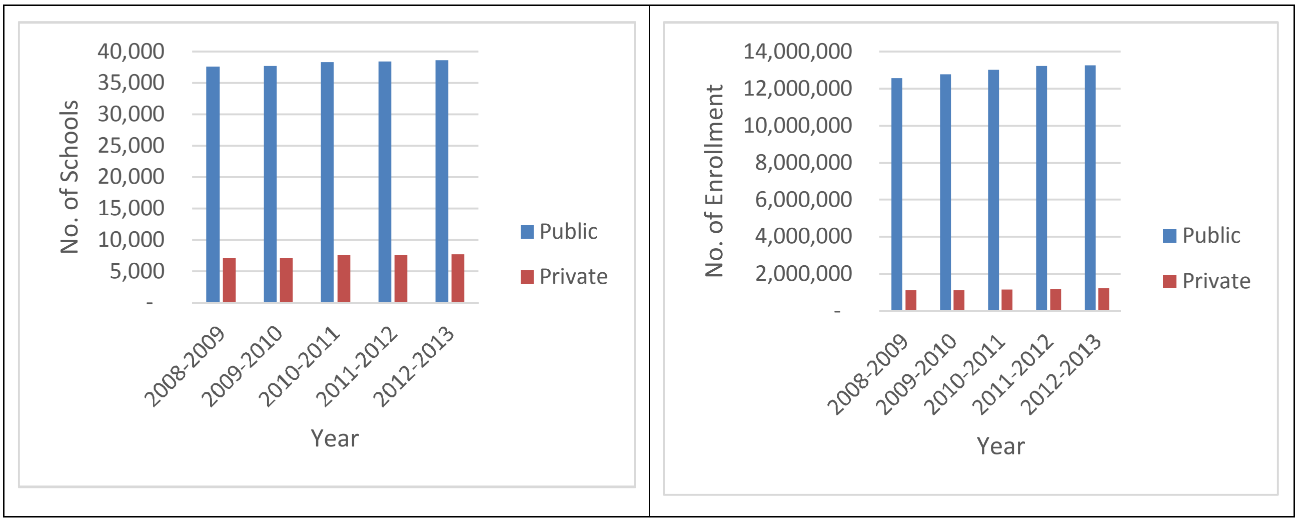

Figure 6-4 : No. of elementary schools and students enrollments (2008 – 2013)[14]

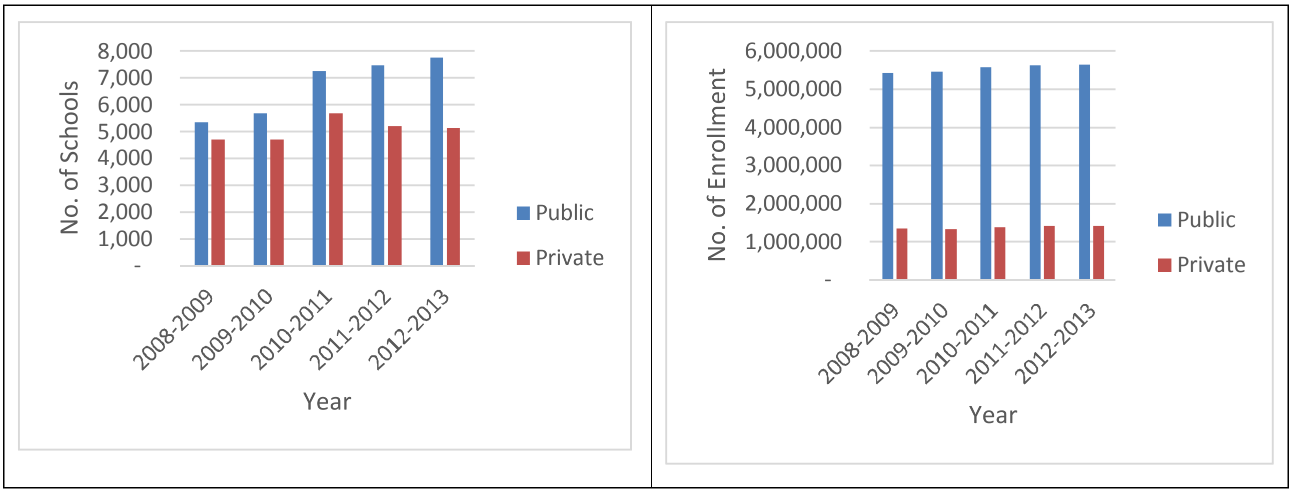

Figure 6-5 : No. of secondary schools and students enrollments (2008 – 2013)[15]

6.2 Environmental Sustainability in the Philippines

The occurrence and severity of natural disasters are directly related to the prevailing environmental systems. The Climate Change Commission (CCC) through the National Strategic Framework on Climate Change (2010-2022), has laid down the Philippine vision of a climate-risk resilient country with healthy, safe, prosperous, and self-reliant communities with thriving and productive ecosystems (Global Footprint Network, 2012) [16]. To achieve the

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[14] Factsheet (September 2013), Research and Statistics Division, Office of Planning Service, Department of Education, Philippines

[15] Factsheet (September 2013), Research and Statistics Division, Office of Planning Service, Department of Education, Philippines

[16] http://www.footprintnetwork.org/de/index.php/blog/year/2012/

vision as laid out by CCC, the National Climate Change Action Plan was formulated with one of the objectives indicating increased resilience of vulnerable sectors and natural ecosystems.

The seven strategic priorities laid out by the CCC [17] includes sustainable energy, water sufficiency ecosystem and environmental stability, climate smart industries and services, food security, human security, sustainable energy, and center to all is the knowledge and capacity development.

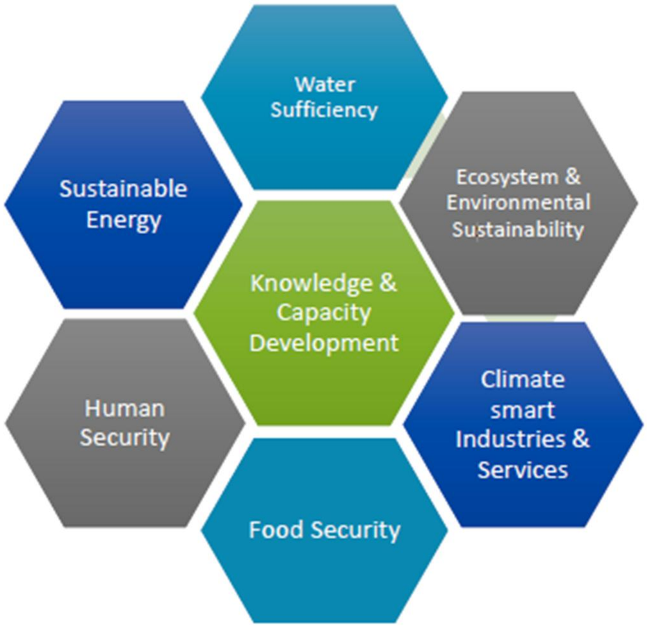

Figure 6-6 : Seven strategic priorities by Climate Control Commission (CCC)

With the ever increasing strain on natural resources and resultant impact in the form of climate change, carrying out development using the old assumptions cannot be relied upon. The tools of the past are no longer sufficient to meet the needs of the present and future.

Built environments are one of the main contributors to the strain on the environment. Buildings, as part of the built environments, contribute to greenhouse gases (GHG) during its lifecycle. As per the country's National Framework Strategy on Climate Change (2010-2022), the major producers of GHG emissions are residential and commercial sectors. The residential and commercial sectors combined consumes 50% of primary electric energy, of which 27% is consumed by households while 23% is consumed by the business sector. The framework document also states that the buildings contribute to 33% of the CO_2 emission from human settlements.

[17] Seven Strategic Priorities by the Climate Change Commission (CCC) are described in the Philippines' National Climate Change Action Plan http://adaptationmarketplace.org/data/library-documents/NCCAP_TechDoc.pdf

The framework is carried out through the objective "Reduce carbon footprint through energy-efficient design and materials for public infrastructure and settlements" and defines the scope for the development and emphasis on climate resilient infrastructure technologies.

ES takes into account material conservation and resource efficiency, including energy and water resources efficiency and water conservation, soil conservation, solid waste reduction, and air pollution control.

6.3 Building Codes in the Philippines

The National Building Code of the Philippines (NCP) covers several general aspects of building design and construction, and refers to other codes for detailed considerations. The National Structural Code of the Philippines (NSCP 2012) covers most of the aspects related to earthquake and wind hazards. Other specific codes referred to include the National Plumbing Code, Philippine Electrical Code, and the Philippine Mechanical Code. It is interesting to note that provisions of the NCP and other referred codes do not explicitly address ES considerations. Even though floods and landslides are major hazards and responsible for significant damages and casualties, these are not adequately addressed in the code documents.

A number of chapters of the National Building Code of the Philippines[18] refer to the National Structural Code of Buildings which integrates DR aspects such as resistance to seismic and wind loads. However, neither the NCP nor the NSCP 2012 integrate flood loading resistance. The NCP also specifies one specific minimum requirement related to wind load resistance for certain residential buildings within the chapter on "Classification and General Requirement of All Buildings by Use of Occupancy". The code also addresses fire resistant construction materials within the chapter on "Fire-Resistive Requirements in Construction".

[18] The National Building Code of the Philippines was adopted by Presidential Decree in 1977 and was revised in 2004.

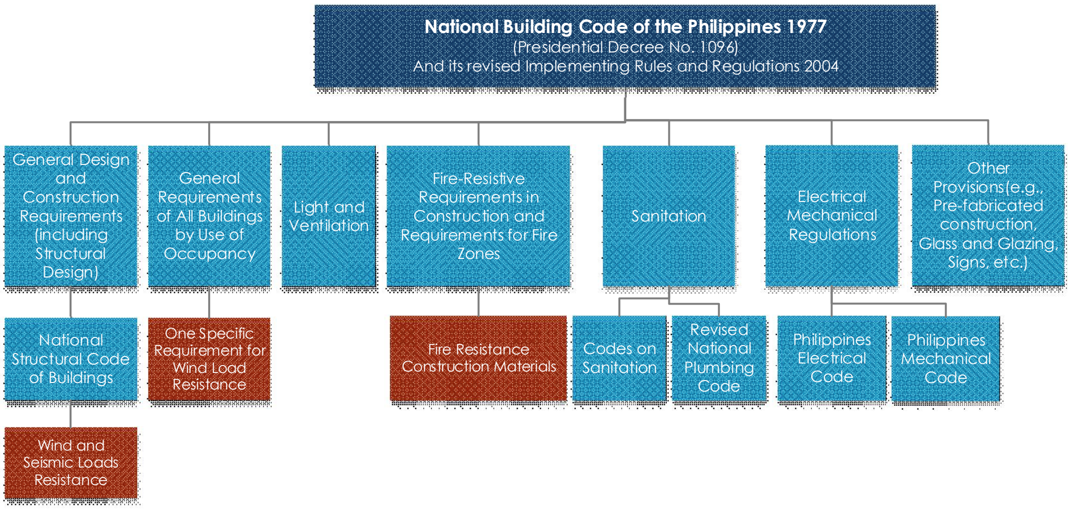

Figure 6-7 : The building codes and regulations in the Philippines

6.4 Integrated Framework for Low-cost Building Codes

The overall code framework is indicated below which is based on the proposed framework in Figure 5-3. This is organized considering the steps involved in the design and construction of a typical low-cost building project. For each of these code provisions, only relevant aspects to low-cost buildings were included.

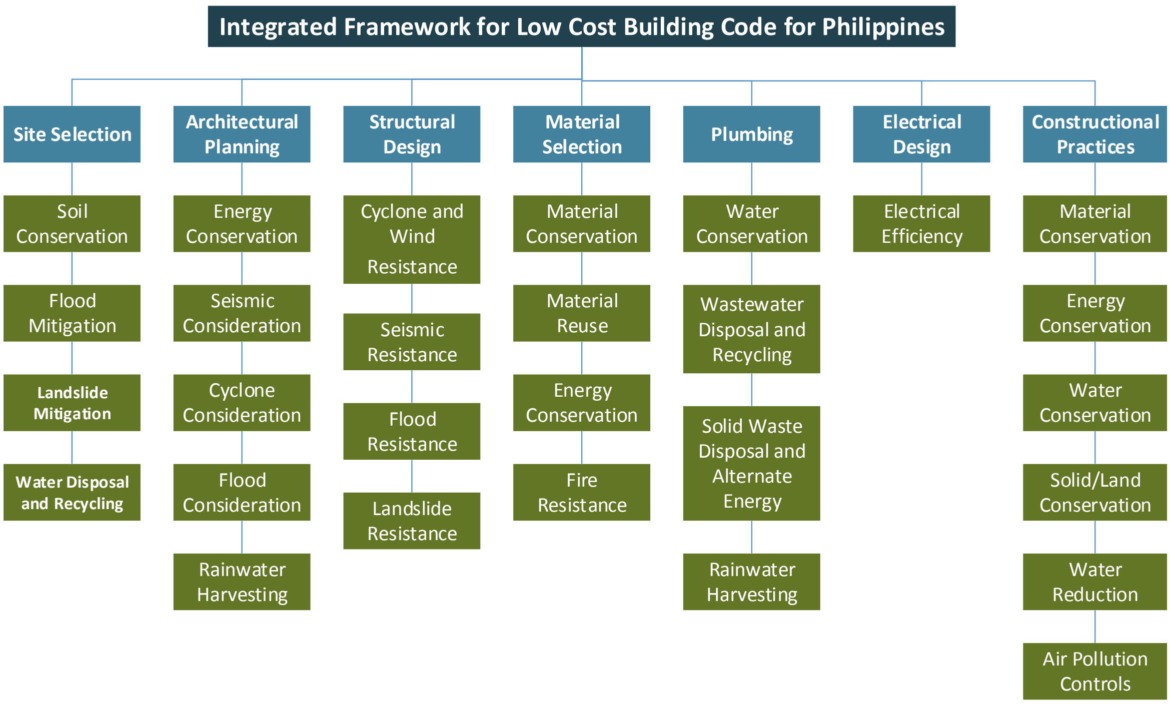

Figure 6-8 : Integration framework for low-cost building codes

As discussed in Chapter 5, the proposed framework addresses the various aspects of the environmental sustianability considerations such as water conservation, energy conservation, soil conservation and material conservation, together with disaster resilience to earthquake, hurricanes, floods, and landslides into the appropriate steps and aspects of the design and construction.

In relation to ensuring the safety of school properties particularly of school sites and buildings, facilities, equipment, fixtures, and other properties, Department of Education, Philippines (DepED) in its Disaster Risk Reduction Resource Manual has issued guidelines[19] to ensure that these properties are safe and secured. The guidelines from DepED are primarly intended to complement the accepted architectural and engineering principles, and the provisions of the National Building Code of the Philippines, and other relevant rules, regulations and ordinances issued by the national and local agencies. Moreover, the National Housing Authority, Philippines is commited in the development of affordable and resilient housing facilities.

The proposed framework when coupled with the existing policies and guidelines can be used as the basis for the development of special building codes/guidelines for low cost housing with specific provisions for the school buildings. These documents can then be adopted by the general building code, and specialized by the each provincial departments, with reference to the relevant hazards, building material and construction practices.

[19] Disaster Risk Reduction Resource Manual (Safer Schools Resource Manual)-2008, Department of Education, Philippines

Appendix A

Review of Good Practices

Appendix A: Review of Good Practices - Nepal

This case study specifically focuses on the resiliency to earthquakes. There are several fault lines running through the country, which makes Nepal one of the most seismic active regions in the world. Approximately 25 earthquakes of 4 or higher on the Richter scale (National Seismological Center Nepal) were recorded in 2011. The strongest earthquake to hit Nepal in 20th century was the Nepal-Bihar earthquake of 1934 which killed approximately 9,000 people and damaged more than 200,000 buildings (UNCRD 2009, EM-DAT 2008). If the event occurs again, the damage and destruction could be at much higher scale. Though people understand the need to have earthquake resilient structures, the capacity and capability of the local builders are one of the limitations.

To overcome the limitations and prevalence of self-built housing tradition in Nepal, the Government of Nepal decided to implement not one but four building codes. The four codes, presented below, were developed for different types of buildings.

The categorization of the four building code in practice in Nepal:

Category 1: Code for the state of the art buildings

This code focuses on buildings that have six or more floors. As per this category, the buildings should follow the codes of India or the United Kingdom and follow the minimum standards set by Nepal.

Category 2: Code for professionally engineered structures

This code focuses on buildings with three to six floors and covers major structures such as hospitals, multi-story buildings, and large residential buildings. In this code a detailed prescription for seismic design, fire safety, and sanitary and electrical engineering is provided.

Category 3: Code for non-engineered buildings (Mandatory rules of thumb)

This code focuses on small buildings that do not exceed certain criteria to height, number of apartments, and gross floor area. Since most of the buildings are not designed by professional staff, the rules are simple and guidelines are easily made available.

Category 4: Guidelines for rural buildings

This category of code focuses on the small buildings erected in villages designed by the owners or local technical advisors. The guidelines are explained with pictures and focuses on changes required to improve seismic resistance.

Appendix B

Workshop Pictures

Appendix B: Some Pictures-National Workshop on Sustainable Urban Infrastructure Development in the Philippines, Manila, 10-11 Sept 2014

Appendix C

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Appendix C: References

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