環境省
Ministry of the Environment
Government of Japan

IGES
Institute for Global Environmental Strategies

LCS-RNet

Making land-use climate-sensitive

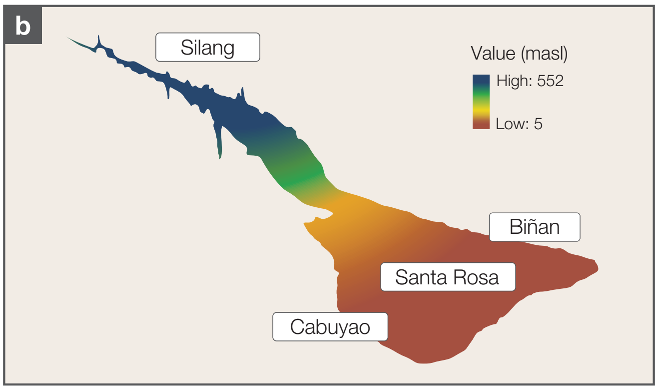
A pilot to integrate climate change adaptation and mitigation

Introduction

While synergies among climate change adaptation and mitigation (CCA&M) policies clearly exist [1–3], little common understanding has been established on how to introduce CCA&M policies in an integrated manner [3-7]. A holistic approach to land-use planning and management at the local level can help meet this challenge [8,9]. To test this idea, with support from the Ministry of the Environment, Japan, the Institute for Global Environmental Strategies and the University of the Philippines at Los Baños launched a pilot project with local governments in the Philippines in 2014. This project aims to examine the necessary conditions for integrating climate change measures – adaptation and mitigation – by improving land-use planning at the river basin level. The project spans several cities in one watershed in the Philippines and engages municipalities and government agencies.

Study area

The study area is the Silang-Santa Rosa subwatershed, which is located about 40 km south of Manila, the national capital, and adjacent to Lake Laguna, the largest lake in the country (Fig. 1 (a)). The subwatershed, one of 24 subwatersheds surrounding the lake, has a basin area of about 120 km^2 and accounts for 4.1% of the entire watershed of the lake [10]. Four local governments manage the Silang-Santa Rosa subwatershed, which holds a total population of about 570,000 people: the Municipality of Silang, Cavite (upriver) and the Cities of Biñan, Santa Rosa, and Cabuyao, Laguna (downriver) [11] (Fig. 1(b)).



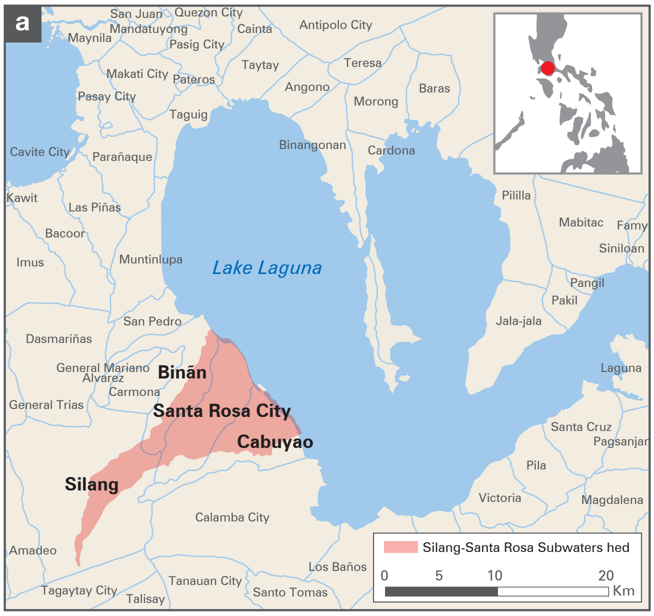


Fig. 1. Study area: (a) Silang-Santa Rosa subwatershed, Philippines (Source: Project); (b) Topography with municipalities located in the subwatershed (Source: Project)

Weather-related natural disaster and local responses

Because of rapid urbanization and industrialization, a vast area of land in the subwatershed, especially the cities of Santa Rosa and Biñan, has been converted for industrial use in the past two decades[12]. Population growth, land-use change and climate change have altered the water resources in the river basin in ways that have negatively impacted the availability of drinking water, public health, and food security, and are also associated with large weather-related natural disasters such as floods and landslides[11] (Fig. 2). This situation is expected to worsen with development upriver in Silang and climate change likely to exacerbate flooding downriver.

In these circumstances, local governments understand the need to manage land and other natural resources holistically[10]. Local governments in the Silang-Santa Rosa subwatershed have been revising their Comprehensive Land-use Plans (CLUPs), paying attention to both climate change and disaster risk prevention and reduction. Understanding that a coordinated response across the watershed is required, local governments have established the Integrated Watershed Management Council (IWMC) for the Silang-Santa Rosa subwatershed in December 2014. This is the first such council in a subwatershed of Lake Laguna.

Fig. 2. Floods in the Silang-Santa Rosa subwatershed from Typhoon Milenyo, September 2006 (courtesy of E.C. Creencia)

Results

In the scenario and risk analyses, the pilot project has identified the area and population likely to be affected by flooding and examined plausible impacts as further development and climate change are materialized. Fig. 4 (a) shows land-use of the Silang-Santa Rosa subwatershed in 2014 and indicates flood-prone zones. Most of the upriver area is either agricultural land or green space, while downstream areas are mostly developed but do hold some agricultural and unused land. In stark contrast, as Fig. 4 (b) illustrates, about 80-90% of the land in the subwatershed will have been converted for residential and commercial use by 2025. Farmland and forests will only remain in midstream and downstream areas. It is expected that flood damage – observed already in approximately half of the subwatershed (the area surrounded by the red line in Fig. 4(a)) and affecting about 100,000 people – will be aggravated by planned massive land conversion, which will increase the runoff coefficient (i.e. the percentage of rainfall that appears as stormwater run-off from a surface) (Fig. 5). The number of disaster victims and the economic damage that they suffer will increase as a result of increased flooding in terms of area, frequency, depth, and/or duration.

With support of the pilot project, under step three (CCA&M measure development), local governments have devised a set of priority measures for CCA&M (Table 1). Firstly, improving zoning ordinances aims to ease and/or evade flood risks by, for example, regulating development in high-risk areas. Runoff

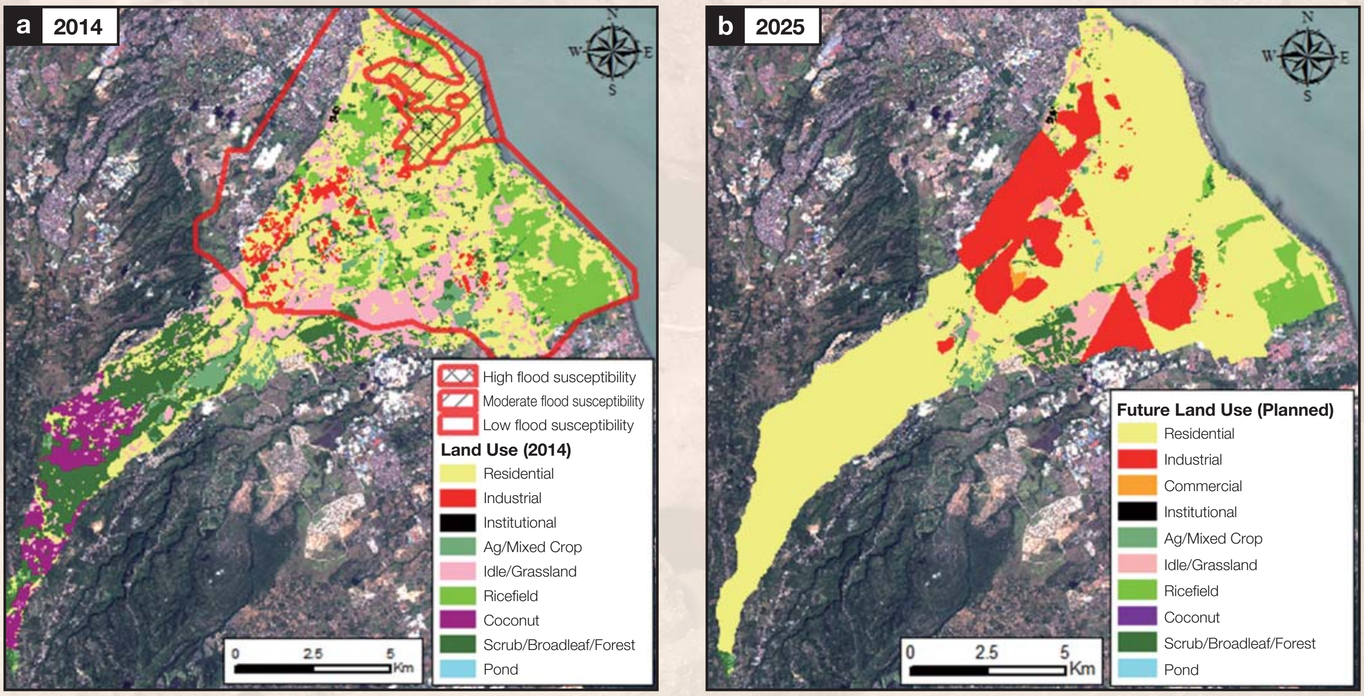


Fig. 4. Land-use in the Silang-Santa Rosa subwatershed: As of (a) 2014; (b) 2025 (Source: Project).

Methodology

The methodology of the pilot project consisted of the following four steps: (i) scenario analysis, (ii) risk assessment, (iii) CCA&M measure development, and (iv) land-use plan improvement (Fig. 3). The first step, ***scenario analysis***, aimed at understanding the problems that the local governments faced in addressing natural disasters and other impacts of climate change, and also the future development and land-use that the local governments planed. Participatory rapid appraisal activities, specifically the key informant and focus group discussions and the participatory mapping, were conducted with representatives from the four local governments. About 30 officials participated in the discussions, who were in charge of urban planning, agriculture, environment, and disaster risk reduction and management. The officials were asked to draw a future land-use map as of 2025 on tracing papers overlaid on the current land-use map as of 2014. The second step, ***risk assessment***, aimed to quantify the damage arising from floods due to typhoons and long periods of rain by identifying the areas, population, and structures such as infrastructure, buildings, and facilities, exposed to flood risks. Geographical information system (GIS) and remote sensing techniques were applied, and to estimate the population vulnerable to flooding in the subwatershed, a Landsat satellite image, national census population data, and a flood susceptibility map were used. The future land-use, obtained from Step one, was processed as GIS data. Step three, ***CCA&M measure development***, aimed to devise possible climate actions for both adaptation and mitigation in consultation with the local governments and prioritize these actions according to their feasibility and urgency. Another focus group discussion session where a set of possible countermeasures were presented requested the officials to identify measures based on the needs of each local government. Further consultation then led to the identification of priority measures. Step four, ***land-use plan improvement,*** aimed to support local governments to strengthen their land-use and related development plans through dialogue on the recommendations generated from the previous three steps.

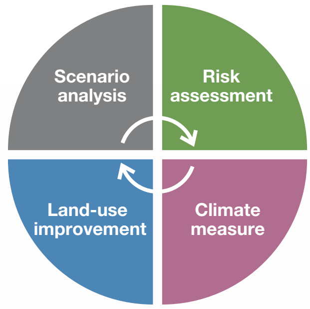


Fig. 3. Methodology

mitigation measures are mandated when forest or agricultural land is converted to built-up types of land use (e.g., residential developments, industrial facilities, shopping malls). Secondly, water course management actions including riverbank re-enforcement and reforestation are proposed to reduce surface runoff and erosion as well as speed the flow of water in rivers (to reduce flooding). Depending on the geographic location (e.g., up-, mid-, or down-stream), different actions are to be taken. Lastly, training activities are to be implemented to strengthen the capacity of local government staff to undertake these actions. This includes an assessment of training needs followed by the development of training materials. While most of these measures address mainly adaptation, some measures such as afforestation and reforestation could provide mitigation benefits as well as non-climate benefits of livelihood creation and improved health.

As part of the implementation of CCA&M measures (Step 4), immediate actions were proposed according to the needs of each local government. To alleviate flood risks, it was suggested that the building codes in high-risk areas in Santa Rosa be strengthened by mandating measures such as the construction of floodwalls and the introduction of elevated flooring, and that administrative guidelines be prepared in Silang to implement runoff mitigation measures where forest and/or agricultural land is converted to built-up land use types. Watercourse management measures in the downstream basin, including Biñan and Cabuyao, were also recommended to maintain and improve the watershed protection functions (i.e., flood alleviation, water retention ability) of the ecosystem. Additionally, activities for strengthening the capacity of IWMC were included in the proposal.

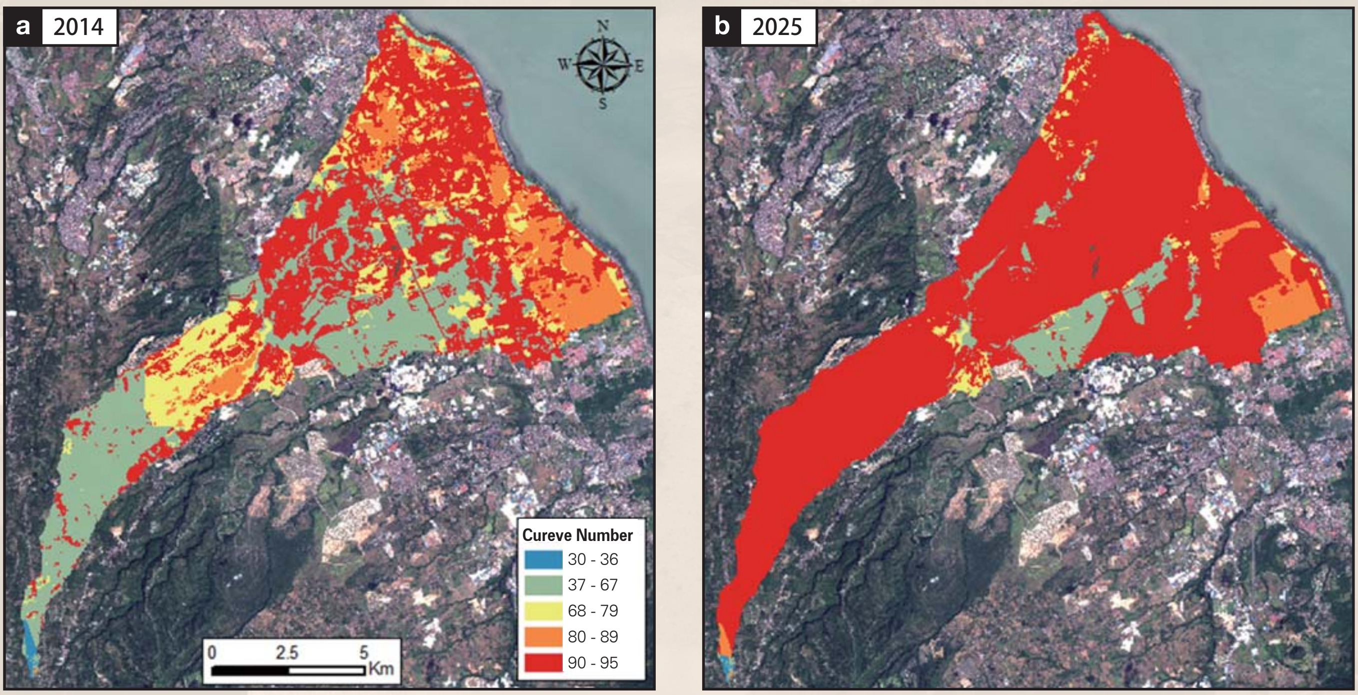


Fig. 5. Run-off coefficient of the Silang-Santa Rosa subwatershed: As of (a) 2014; (b) 2025 (Source: Project).

Table 1. Priority measures for climate change mitigation (CCM) and adaptation (CCA)

1 **Zoning enhancement** To avoid and alleviate climate impact, and to sequestrate carbon dioxide	*2* **River rehabilitation** To increase water retaining capacity (e.g., reforestation, river cleanup, dredging, and riverbank reinforcement)	*3* **Capacity development** To build and strengthen the ability of local government to design and implement climate actions
• Enforce development controls in areas highly susceptible to flooding, which prevent settlement construction and maintain as much vegetation as possible. • Strengthen building codes in high-risk areas to mandate measures such as the construction of floodwalls and the introduction of elevated flooring to protect buildings and infrastructures against flooding. • Devise a relocation plan for informal settlers who reside in flood-prone areas. • Where forest and/or agricultural land is converted to residential or commercial areas, mandate runoff mitigation measures such as tree planting, green parking design, water-permeable paving, and vegetated roofs. • Take actions for the strict enforcement of zoning ordinances. • Harmonize land-use among the local governments to manage the river basin as a whole to address climate-related disasters such as flooding downstream by collective planning of the development upstream.	• All areas > Regular river cleanup • Upstream area > Protection and improvement through replanting of endemic and indigenous plant species • Midstream area > Proper zoning and land use planning/implementation > Rehabilitation of easement and riverbanks > Construction of slope protection along riverbanks • Downstream area > Control encroachment of settlements in easement areas > Dredging of sediments > Solid and liquid waste management > Planting of endemic and indigenous plant species > Improvement of drainage	• Needs assessments (NA) on climate change adaptation and mitigation (CCA&M) and disaster preparedness and management: Develop survey/assessment instrument to determine the needs for training and public awareness activities; Conduct the NA. • Development of campaign materials and training modules for CCA&M and disaster preparedness and management • Conduct of trainings and events to increase awareness and preparedness

Conclusions

This pilot project is developing and testing an approach to integrate CCA&M at the local level, especially in land-use planning and management, by analyzing risks and setting out countermeasures, including utilizing ecosystem services, in a river basin context. The pilot project emphasizes the need for a holistic approach to land-use planning and management by local governments in the Philippines that incorporates climate change mitigation and adaptation strategies. Collaboration among local government agencies at the river basin / watershed level is critical to an effective response to weather-related disasters, especially flooding, which are expected to become more pronounced with climate change.

Acknowledgement

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