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Dissertation title: "Risk-Benefit analyses to balance flood risk, livelihoods and ecosystem services "

Traditional measures for flood risk reduction such as runoff and flood control structures, zoning and land use restrictions are often based on the principle of *keeping people away from floods*. Despite its effectiveness at reducing flood risk, the exclusion of direct human uses from flood-prone lands is not always possible. In many developing countries, for instance, local people may practice strategies to cope with floods and benefit from the use of frequently inundated areas. In such contexts, benefits provided by floods and use of flood-prone land are essential, particularly where livelihoods and ecosystem services are tied to natural hydrologic cycles. Measures aimed at managing flood risk, however, are usually based on the assessment of potential damages and often overlook the role of coping capacity and socio-ecological benefits from river-floodplain systems.

The original contribution of this study is a framework in which livelihood benefits of direct floodplain use are distinguished from those supplied through ecosystem services. Management of flood risk while procuring multiple benefits from flood-prone land may be realized through enhanced coping capacity. Decision-makers may thus apply this framework where flood risk, ecosystem, and livelihood objectives must be balanced. To support this conceptual approach, I present an integrated assessment of flood risk and probabilistic benefits in Candaba municipality, Philippines. I evaluate flood damages and the potential to accrue benefits from floodplain use by combining hydrological modelling, remote sensing techniques, and information on livelihoods and coping capacity collected from field surveys. Flood risk and probabilistic benefit trade-offs are analyzed according to current use of flood-prone land in the area (seasonal agriculture/wild fish capture). For this analysis, however, alternative scenarios of floodplain use are also considered on the basis of potential policies that may support, for instance, livelihood practices compatible with "low risk" direct human use (dry season agriculture/wild fisheries) or "flood storage/nature conservation" use (wild fisheries only).

Findings reveal that flood benefits related to ecosystem services and livelihoods from direct use of flood-prone land are vital to communities in Candaba. Though current "risky" use of flood-prone land is associated with potential damages to agriculture, for all investigated magnitudes of flood events with different frequencies, probabilistic benefits exceed risks by a large margin (US $ 58 million). In addition, probabilistic livelihood benefits associated to direct human uses (current "risky" and policy-driven "low risk" scenarios) far exceed benefits provided by the alternative "flood storage/conservation" scenario (difference of US $ 85-87 million). In Candaba, some communities cope with seasonal inundation, for instance, by adapting crop planting periods to the flood pulse or using land alternately for agriculture and wild catch fisheries during dry and wet seasons, respectively. The analysis of an additional scenario, which entails land use configurations associated to such practices, indicates that individual coping capacities may execute dual functions of reducing flood risk and facilitating greater benefit capture (US $ 125 million) in the area. Evidence from Candaba therefore suggests that acknowledging local capacity to live with and benefit from the use of flood-prone lands may lead to a better characterization of flood risk. Joint risk-benefit assessments may also provide essential information to support decision-making, which can result in more sustainable measures for integrated management of floods, livelihoods, and ecosystems.

Keywords: Risk-Benefit Assessment, livelihood benefits, ecosystem services, coping capacities, floodplain use, Philippines