Minimising agricultural pollution to enhance water quality in Laguna de Bay (Philippines) and the Mt Lofty Ranges (Australia)

CSIRO Land and Water  A Joint Project between LLDA, UPLB and CSIRO (Australia)

Off-site transport of contaminants in the form of nutrients, sediment and pesticides from agricultural practices is of concern in the Philippines and Australia. This project aimed to identify the major sources and quantify loads of contaminants in the Pagsanjan-Lumban catchment, Philippines and the Mt Lofty Ranges, Australia. This work was funded by the Australian Centre for International Agricultural Research (ACIAR).

Background

**Philippines** Laguna de Bay
- Largest freshwater lake in Philippines supporting some 28000 fishing families (Figure 1).
- The lake consists of 3 bays, the western bay being heavily polluted by wastewater discharge (Figure 2). The eastern bay is somewhat cleaner and receives drainage from predominantly agricultural sources.
- The Pagsanjan River (in Pagsanjan-Lumban sub-catchment) discharges to the eastern bay and supplies about 35% of the lake’s total fresh water inflow (Figure 3).
- Water will increasingly be extracted from the Lake to augment water supply for customers south of Metro Manila.
- The impact of agricultural pollution on the water quality of Laguna de Bay needs to be minimised.

**Australia** Mt Lofty Ranges (MLR) – South Australia
- Inflows (110 GL) provide approximately half of Adelaide’s current water requirements in an average rainfall year, but this is dependent upon rainfall.

Figure 1. Aquaculture in Laguna de Bay

Figure 2. Map of Laguna de Bay showing the 3 bays

Figure 3. Map of Pagsanjan-Lumban sub-catchment in Philippines

Figure 4. Map of Mt. Lofty Ranges, South Australia
• Decline in inflows to reservoirs in the Mt Lofty Ranges is expected due to climate change (Figure 4). Increasing temperatures and decreasing inflows may concentrate contaminants in surface drainage water.
• The impact of agricultural production systems on water quality needs to be minimised.

Main objectives (Australia and Philippines)
• Collate and compile biophysical information about the Pagsanjan –Lumban sub-catchment and identify the main land-uses in the sub-catchment.
• Model the water balance and sediment transport in the sub-catchment.
• Quantify the contribution made by the main land-uses in the sub-catchment to loads of sediment, nutrients and pesticides entering rivers.

Establishment of study sites (Australia and Philippines)
• Sites were identified as representative of the major land-uses in the sub-catchment (4 in Philippines and 3 in Australia).
• All sites were instrumented with an automatic water sampler and a water level logger to monitor water depth and flow volumes (Figures 5 and 6).

Capability development
• Mr Emil Hernandez (LLDA) received training on sediment transport modelling from CSIRO in Australia.
• Dr Pearl Sanchez (UPLB) worked with the CSIRO team in Australia to carry out data analysis and prepared data for publications.
• UPLB and LLDA staff were trained in use of data loggers, auto-samplers and other hydrologic measurements (Figure 7).

Key finding on sources of pollution
Philippines
Nutrients and total suspended solids (TSS)
• Were found to be highest in stream in Majayjay followed by (in a decreasing order) Salasad, Lucban and Cavinti.
• In Majayjay the mean concentrations TSS, TN and TP concentrations (mg/L) in 2008 were 1377, 71 and 0.7 respectively.

Pesticides
• A small number of pesticides were detected in streams sampled from Lucban (vegetable production system) and Salasad (rice production system).
• Mean concentration of Malathion detected at Lucban was 1.49 µg/L Jan-mid March 2008 and 0.91 µg/L June-Nov 2008.
• Profenofos detected at Salasad (mean conc 5.08 µg/L) during Jan – March 2008.

Rain stations were established in nine schools in the catchment. Students were trained to record rainfall data for sending to project team by SMS (Figure 8).
• Student resource books were provided to encourage utilisation of meteorological data and enhance awareness about the water cycle and water quality issues.
• Reference charts were prepared for horticulturists in the Mount Lofty Ranges to make informed choices of safer pesticides on their farms.
Australia

Nutrients and total suspended solids (TSS)
• In drainage from farms, the total nitrogen concentrations frequently exceeded Australian environmental trigger value for protecting 95% of species (1.0 mg/L), total phosphorus concentrations frequently exceeded Australian environmental trigger value for protecting 95% of species (0.1 mg/L). The highest TSS concentrations were detected at the apples and grapes site.

Pesticides
• Fenarimol (a fungicide) detections from apples site exceeded Australian drinking water guideline (1 µg/L) quite regularly.
• Chlorpyrifos (an insecticide) detected for long periods (3-4 months) in all years.
• Chlorpyrifos concentrations exceeded Australian environmental trigger value (0.01 µg/L) in 94% of 2007 samples and in 54% of 2008 samples.
• No pesticides detected from grapes site.

Recommendations.

More work is needed to gain a complete picture, but some recommendations based on project findings so far are as follows:

Philippines
• The piggeries at Majayjay are a major point source of pollution in waterways in the Pagsanjan-Lumban catchment. The local industry should be engaged to discuss the options to minimise pollution (Figure 9).

• Profenofos is a very toxic pesticide that has been detected in waterways in the catchment. A safer alternative should be considered.
• Sediment load in Salasad creek is significant and should be reduced.
• The instrumentation of sites with data loggers and auto-samplers is a significant facility, which has been functioning well, must be maintained.

Australia
• In Australia, the runoff of pesticides such as fenarimol and chlorpyrifos should be minimised through improved on-farm management.
• Efficacy of a range of mitigation strategies need to be investigated for both soluble and particulate-bound contaminants

General
• Results of this project should be peer reviewed and published in an international journal.
• Popular articles should be prepared at the end of the project to enhance awareness about the pollution and water quality issue in the Pagsanjan Lumban sub-watershed.

The study should be continued for at least 2 more years to gain best value out of current sites and instrumentation and the momentum generated by the project.

Figure 9. Water draining from Majayjay piggeries into the river system contains very high total suspended sediment, total phosphorus and nitrogen concentrations.

Ronilo Samiano demonstrating the water flow meter.
More information
http://www.llida.gov.ph/program.htm

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