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SmartLessons

real experiences, real development

An Innovative and Cost-Effective Solution for Livestock Waste Management in China, Thailand and Vietnam

The East Asia region is home to more than half the world's stock of pigs (see Figure 1) and more than one-third of the world's poultry — a population that is expected to grow rapidly over the next decades. As a result, about 26 percent of the total area in East Asia suffers from significant nutrient surpluses, mainly from agricultural sources. For instance, the region has a 47 percent surplus of phosphorus and a 16 percent surplus of nitrogen, both from animal manure. This contributes significantly to the degradation of regional water quality. To address this issue, the Global Environment Facility (GEF) funded the Livestock Waste Management in East Asia (LWMEA) Project. This SmartLesson discusses major challenges faced and key lessons learned from implementing that regional project.

Background

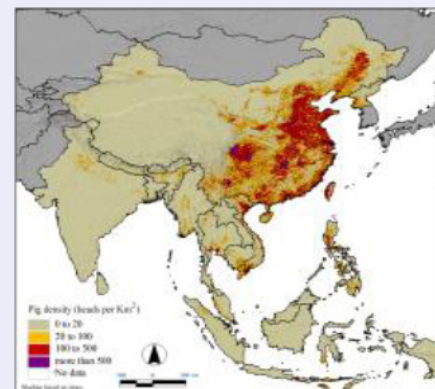
Despite an array of programs, projects, and technologies to address the negative impacts of livestock waste on the environment and human health in the East Asia region, progress has been slow, costly, and ineffective. Reasons include lack of 1) local capacity to design, construct, and service technologies; 2) financial mechanisms and effective policies; and 3) ability to select appropriate technologies that are affordable and simple to construct and operate.

To introduce an innovative and cost-effective solution, the World Bank, acting as an implementing agency of the GEF, launched the regional LWMEA Project in 2006. The project's development objective was to reduce the major negative environmental and health impacts of rapidly increasing concentrated livestock production on water bodies and thus on the people of East Asia. Its global environment objective is to reduce livestock-induced, land-based pollution and environmental degradation of the South China Sea.¹

The project supported China, Thailand, and Vietnam — the three most important livestock-production countries in the region — with a grant of \$7 million: \$2 million each to the three countries and \$1 million to the Food and

¹ For the project, "South China Sea" includes the Gulf of Thailand.

Figure 1: Pig Density in East Asia



Agriculture Organization (FAO) of the United Nations for technical assistance and regional coordination activities. Project implementation was completed in China by December 31, 2010, in Vietnam and by the FAO by June 30, 2011, and in Thailand by December 31, 2011.

This is the first GEF project in the region to address the livestock waste management issue from both policy and technical standpoints, and with a regional collaboration approach. The project was designed with replicability in mind,

making its results relevant to other livestock-production areas in the world. It supported activities under four components:

- Livestock waste management technology demonstration;
- Policy and replication strategy development;
- Project management and monitoring; and
- Regional support services.

In addition to the common understanding that, if not managed appropriately, livestock waste is a known pollutant, a human health threat, and a source of anthropogenic greenhouse gas (GHG) emissions, the preproject assessment study identified three key challenges:

- **Lack of technical solutions:** In all three countries, limited government support for basic livestock waste management investments addressed only the immediate effects of the problem as perceived at the local level and did not even begin to address the nutrient imbalance. Without new initiatives and technical solutions, alternative practices would be too weak to overcome the incentives driving concentrated livestock production. Consequently, the imbalance between the level of nutrient inputs and the absorptive capacity of the land would worsen progressively with rapidly growing industrial livestock production.
- **Lack of policy instruments and replication strategy:** All three countries had national-level environmental policies with supporting standards but no replication strategy for livestock waste management. Policy components dealing with industrial livestock production and waste management are either missing or are very recent and too general, with little effective enforcement. Agencies charged with enforcement generally were not coordinated and lacked sufficient resources to monitor and enforce the regulations.

- **Lack of capacity, awareness, and collaboration:** Though livestock waste management does receive priority, there are challenges of poor capacity and inadequate collaboration among key government agencies — such as agricultural, environmental, and public health — which sometimes have incompatible interests and priorities and are not accustomed to working together. Complicating the situation is a lack of awareness and participation of local populations and civil society, plus weak partnership with and support from the private sector.

Lessons Learned

Lesson 1: Look for strong commitments.

To ensure project ownership, sustainability, and success, strong commitments are needed — from the government (for compliance, enforcement, and provision of incentives) and from the key stakeholders (for full involvement in project preparation and implementation). The project succeeded in gaining strong commitments through the following:

- Integration with the governments' mainstream programs;
- Implementation based on existing institutional mechanisms; and
- Involvement of key stakeholders, such as village committees and the women's federation in China, pig cooperatives in Vietnam, and local administrations, communities, and nongovernmental organizations in Thailand.

Lesson 2: Select the right technologies.

Waste management technologies should be simple to operate and compatible with the waste-handling practices found across various scales of livestock farms; cost-effective and offer financial returns; and able to be locally developed and serviced. A number of livestock waste management technologies exist, ranging from simple to complex, with various cost implications from moderate to high. For example:



Anaerobic digesters, designed to recover and combust biogas, are recognized as the only waste management technology that can increase farm profits through use of biogas — carbon and renewable energy.

Photo Credit: Weiguo Zhou

- **Composting** is the least-cost option suitable for farms that handle solid waste, with very low carbon-reduction potential.
- **Aeration** processes are effective only when adequate retention time and a series of processes are ensured. They require land availability and are suitable for farms that handle dilute wastes, where emissions can be high.
- **Anaerobic digestion (AD)** is an anaerobic (without oxygen) biological process that stabilizes — reduces biochemical oxygen demand (BOD) — waste material and produces biogas, a mixture of roughly 65 percent methane, 35 percent carbon dioxide, and trace amounts of hydrogen sulfide. Biogas is combustible and when recovered can be used in renewable energy applications such as electrical generation, heating, cooking fuel, and lighting, among others.

A number of commercially proven ADs are appropriate for farms of various sizes, and they cover a range of operational complexity and cost. Selecting appropriate AD technologies is an art and depends on availability of local equipment; local capacity to design, build, and operate; and local affordability. Often, innovative materials and methods of construction are used to reduce costs at smaller scales. As a result, all participating countries desire gas-recovery technologies and selected the AD technology.

Lesson 3: Provide essential financial incentives.

Costs of livestock waste management can be affordable for medium and large industrial pig farms — the target under this project.² In the demonstration phase, providing a fairly high level of financial incentive helps overcome the natural resistance of farmers to increased costs, builds their confidence against uncertainties, and induces initial investment.

Livestock waste management practices must yield tangible benefits for key stakeholders, specifically farmers and local communities, to ensure adoption and replicability. Although AD technologies are effective, the initial cost is often a barrier to adoption, even though the financial pro forma is favorable. Some form of subsidy or other payment is necessary to overcome this market barrier. Financial incentives for improved livestock waste management in each of the three participating countries have mostly been for installation of digesters, exposure ponds, and drying beds to treat livestock waste as well as to conserve energy (biogas).

Another possible financial incentive is to sell carbon credits that could be generated during a livestock waste management process. Since AD technologies result in reduced GHG emissions, two CDM (clean development mechanism) projects were developed in Thailand in conjunction with the LWMEA Project. Despite the fact that the CDM regulatory process is often slow and complicated,³

² Smaller farms can also afford the technologies, provided they are successful in partially defraying costs through treated-manure sales, fish production, or chemical fertilizer and household energy savings (using biogas).

³ Payment for carbon credits occurs only upon delivery, which could take significant time because of the lengthy and complex procedure. Also, the selection of technologies can be limited, since the CDM requires projects to use approved methodologies under the UN Framework Convention on Climate Change for their calculation of carbon credits and monitoring.

registered CDM projects can receive a steady stream of additional revenue for 10 years or more, though the first payment is yet to be made.

Under the project, finance included a 25 percent grant from GEF, a 25 percent grant from the government, and a 50 percent investment from the farm. GMI⁴ (Global Methane Initiative) provided additional support — power generator, gas flare, and training — to all three countries. One significant finding of the LWMEA Project was that about 50 percent cost sharing is required to help farm owners overcome the initial cost hurdle.



The project demonstrates pollution-control technologies to help reduce nutrient discharge from livestock production (pig farms in particular) into the South China Sea.

Photo Credit: Weiguo Zhou

Lesson 4: Take a comprehensive approach.

The LWMEA Project integrates technological solutions, policy development and enforcement, capacity building, and regional coordination and dissemination. In all three countries, regulatory action on livestock waste management has had limited impact on actual farm behavior. So the project had a policy component to improve the policy framework and strengthen policy enforcement. Each participating country has developed at least one Code of Practice and a country-specific Replication Strategy focusing on 1) setting up an effective policy and regulatory framework for environmentally sustainable livestock production and waste management; 2) adopting improved manure management practices at local and national levels; 3) increasing awareness among line agencies, the general public, and livestock producers; and 4) strengthening institutional capacity and providing incentives for policy compliance and enforcement of demonstrated livestock waste management practices.

Lesson 5: Improve awareness through wide dissemination.

About 15 percent of the total project budget has gone toward awareness raising and capacity building. The

⁴ GMI was developed in October 2010 to reduce global methane emissions from agriculture, coal mines, landfills, and oil and natural gas systems, while enhancing and expanding these efforts and encouraging new resource commitments from country partners with its Steering Committee and Administrative Support Group located in Washington, D.C.

project's regional approach, working through annual Regional Coordination Group meetings and regional conferences, ensured:

- Involvement of the region's three most important (in terms of livestock production and waste pollution) countries;
- Emphasis on their common interest in protecting the ecosystems of the South China Sea;
- Promotion of important cross-country synergies; and
- Replication of experience from the project demonstration throughout the region.

Regional dissemination activities primarily targeted the three participating countries. But they eventually included other countries that drain into the South China Sea, thus permitting collaboration, comparison of results and experiences on waste management and policy elements, exchange and transfer of technology and approaches, and environmental awareness raising among farmers and government staff who could benefit from the knowledge and experience gained under the project. The project also provides valuable experiences beyond the East Asia region.



Awareness raising and capacity building account for about 15 percent of the total LWMEA Project budget.

Photo by Weiguo Zhou

Lesson 6: Focus on results.

Measuring wastewater processes is difficult. Obtaining country consensus on measurement methods, processes, and parameters may be more difficult. Yet, credible measurement methods are necessary to support claims and quantify project impacts. The project selected a wide range of measurable indicators, including process indicators and stress-reduction indicators for monitoring the

following areas: 1) implementation progress; 2) livestock waste management system; 3) environmental management; and 4) project impact. The actual monitoring assignments were contracted to professional firms or institutions. Key performance indicators were set in the legal agreements.

Monitoring results show that at the end of project implementation, the project achieved tangible nutrient reductions in all three countries through investment activities financed by the project as well as through replication of demonstrated waste management interventions by other farms. It is estimated that in 2010 a total of about 57,000 tons of COD (chemical oxygen demand), 25,000 tons of biochemical oxygen demand, 3,200 tons of nitrogen, and 1,600 tons of phosphorus were reduced from project farms.

Conclusion

Project implementation yielded positive and encouraging initial results, including: 1) pollution reduction on all participating farms, meeting national standards for discharge; 2) a much larger number of farms showing interest in participating in the project; 3) wide adoption of a comprehensive project approach by the participating countries; and 4) achievement of integration with the governments' mainstream programs and other programs supported by various sources. The project experience is significant, because it provides:

- Clear evidence that the project's development and GEF's global environment objectives are very likely to be achieved;
- Feasible solutions that could also serve multiple purposes for reducing GHG emissions and capturing methane;
- Evidence of improved and ensured long-term sustainability (social, economic, environmental) of livestock waste management; and
- A successful model for scaling up the livestock waste management practices in the three participating countries — and beyond.

On that last point, an IBRD lending project is currently under preparation in Guangdong province of China, two carbon-financed livestock waste management programs are under implementation in Thailand, and more pig farms will follow the practices in Vietnam. Moreover, 12 additional countries expressed interest in and willingness to follow the demonstrated practices.



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