

**AGROECOSYSTEM ANALYSIS OF BARANGAY CAPAS, UMINGAN,
PANGASINAN, PHILIPPINES**

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AGRO-ECOSYSTEM ANALYSIS OF BARANAGAY CAPAS, UMINGAN, PANGASINAN, PHILIPPINES¹

EUNICE C. ELEGADO

ABSTRACT

Background: The sustainability of the agroecosystem in Barangay Capas, Umingan, Pangasinan was assessed using productivity, economic viability and ecological soundness as indicators. **Methods:** Representative farmers were interviewed for socio-demographic profile, Land Utilization Type (LUT) description and soil sampling was done per LUT for the determination of the major nutrients N, P, and K, soil pH as well as the soil texture and color. **Results:** Majority of the farmers do farming for subsistence. The yield obtained per LUT was 40-60% lower than the potential yield of the rice variety used. For the farmers with vegetables and corn as second crop, the yield obtained was 50-60% lower than the normal average yield. **Conclusion:** The productivity, economic viability, and ecological soundness of the existing agroecosystem were low. This was attributed to the regular use of chemical fertilizers and pesticides.

Keywords: Agro-ecosystem, Barangay Capas, Sustainability, Farmers.

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LITERATURE CITED

- Adeboye, M. K. A. (2011). Assessment of soil quality using soil organic carbon and total nitrogen and microbial properties in tropical agroecosystems. *Agricultural Sciences*, 2(1), 34–40. doi:10.4236/as.2011.21006.
- Anaya-Romero, M., Pino, R., Moreira, J. M., Muñoz-Rojas, M., & De la Rosa, D. (2011). Analysis of soil capability versus land use change by using corine land cover and microleis. *International Agrophysics*, 4(2), 395-398.
- Areola, Cynthia C. (2012). *Assessment of agroecosystem management practices in Central Luzon*. Unpublished master's thesis, Central Luzon State University, Science City of Munoz Nueva Ecija, Phillipines.
- Bank, T. I., & Bank, T. W. (2008). Agriculture Development. *Agriculture*, 2(6), 1–6. doi:10.1596/978-0-8213-7233-3.
- Belcher, K. W., Boehm, M. M., & Fulton, M. E. (2004). Agroecosystem sustainability: a system simulation model approach. *Agricultural Systems*, 79(2), 225-241. doi:10.1016/S0308-521X(03)00072-6.
- Beare, M. H., Giller, K. E., Izac, A. M., Lavelle, P., & Swift, M. J. (1997). Agricultural intensification, soil biodiversity and agroecosystem function. *Applied Soil Ecology*, 25(6), 3-16.
- Bureau of Soils and Water Management (BSWM). (1986). *Soil Analysis and Fertilizer Usage*. Manila, Philippines: Author.
- Cabell, J., & Oelofse, M. (2012). An indicator framework for assessing agroecosystem resilience. *Ecology and Society*, 17(1), 7-10. doi:10.5751/ES-04666-170118.
- Carpio, Rodelio T. (2003). *Assessment of Strategic Agriculture and Fisheries Development Zones of the Science City of Munoz*. Unpublished undergraduate thesis, Central Luzon State University, Science City of Munoz Nueva Ecija, Philippines.
- Conway, G. R. (1986). *Agroecosystem Analysis for Research and Development*. Bangkok, Thailand: Winrock International Institute for Agricultural Development.
- Dumanski, J., & Pieri, C. (2000). Land quality indicators: research plan. *Agriculture, Ecosystems & Environment*, 81(2), 93-102.
- FAO, Food and Agriculture Organization. (1997). *Guidelines for Land Evaluation*. FAO Soil Bulletin #75, Rome, Italy: Author.

- Floresca, J. P., Alcantara, A. J., Lamug, C. B., Rapera, C. L., & Adalla, C. B. (2009). Assessment of ecosystem services of lowland rice agroecosystems in Echague, Isabela, Philippines. *Journal of Environmental Science and Management*, 12(1).
- Fragoso, C., Brown, G. G., Patron, J. C., Blanchart, E., Lavelle, P., Pashanasi, B. & Kumar, T. (1997). Agricultural intensification, soil biodiversity and agroecosystem function in the tropics: the role of earthworms. *Applied Soil Ecology*, 6(1), 17-35. doi:10.1016/S0929-1393(96)00154-0.
- Garbach, K., Milder, J. C., Montenegro, M., Karp, D. S., & DeClerck, F. A. J. (2014). Biodiversity and ecosystem services in agroecosystems. *Agroecosystems. Encyclopedia of Agriculture and Food Systems*, 2(6), 21-40. doi:10.1016/B978-0-444-52512-3.00013-9
- Guy, P. (2002). *Agroecosystem Analysis and Rapid Rural Appraisal of Selected Sites in the Central Cordillera, Ifugao, Philippines*. Nova Scotia, Canada: Dalhousie University
- Jarvis, D. I., Khaka, E., Pert, P. L., Thiombiano, L., & Boelee, E. (2013). Managing water and agroecosystems for food security-Comprehensive assessment of water management in agriculture series. *Managing agroecosystem services*, 10(7), 124-141. doi:10.1079/9781780640884.0124.
- Klein, A. M., Kravess, A., Steffen_Dewentrn, I., Thies, C., & Tschardtke, T. (2005). Landscape perspectives on agricultural intensification biodiversity ecosystem service management. *Ecology Letters*, 36(2), 57-74. doi: 10.1111/j.1461-0248.2005.00782.X
- Mina-Roguel, Soledad S. (2003). *Hybrid Rice Seed Production Training Manual*. Philippine Rice Research Institute, Maligaya, Science City of Munoz Nueva Ecija, Philippines.
- Moonen, A. C., & Barberi, P. (2008). Functional biodiversity: an agroecosystem approach. *Agriculture, Ecosystems & Environment*, 127(1), 7-21. doi:10.1016/j.agee.2008.02.013
- Mohammeda, U., Wayayoka, A., Amin, M., Sooma, M., & Abdana, K. (2015). Performance of Umar-srimat on soil water conservation and weed control in system of rice of rice intensification. *Journal of Technology* 76(15), 83-88.
- Municipal Planning and Development Office (MPDO). (2014). *Comprehensive Land Use Plan of Umingan, Pangasinan, Philippines*. Umingan, Pangasinan Philippines: Author.

- Organic Agriculture Act, R.A. 10068. P.H. (2010). Retrieved May 29, 2016, from https://www.senate.gov.ph/republic_acts/ra%2010068.pdf
- Perez, F.O. (2002). *Soil Pollutant Susceptibility Rating For Rice Agroecosystems*. Unpublished Ph.D. Dissertation, University of the Philippines at Los Baños, Los Banos, Laguna, Philippines.
- Rasul, G., & Thap G. (2003) Sustainability analysis of ecological and conventional agriculture system in Bangladesh. *Ecology*, 31(10), 21-41. Doi: 10.1016/S0305-750X(03)00137-2.
- Sands, M. H., & Podmore, T. H. (2000). A general environmental sustainability index for agricultural system. *Agricultural System and Environment*, 15(4), 29-41.
- Smit, B., & Smithers, J. (1992). Adoption of soil conservation practices: an empirical analysis in Ontario, Canada. *Land Degradation & Development*, 3(1), 1-14.
- United States Department of Agriculture. (1995). *Land Capability Classification*. Southwest, WA: Department of Agriculture, Soil Conservation Service.
- United Nations Development Program. (2015, October). *Human Development Report 2015* (Issue Brief No. 978-98-1-126398-5). New York: Author. Retrived April 25, 2016, from http://hdr.undp.org/sites/default/files/2015_human_development_report.pdf
- Urdal, Henrick. (2005). People vs. Malthes: population pressure environmental degradation and armed conflict revisited. *Journal of Peace Research*, 42(7), 17-19. doi: 10.1177/0022343302024089.
- Villamor, Jayson O. (2009). *Rice Agroecosystem Sustainability of Urbanized Areas in Nueva Ecija, Philippines*. Unpublished master's thesis, Central Luzon State University, Science City of Munoz Nueva, Ecija, Philippines.
- Wood, S., Sebastian, K., & Sara, J. (2001). *Pilot Analysis of Global Ecosystems: Agroecosystems*. Washington, DC: International Food Policy Research Institute and World Resources Institute.
- Young, K.,R.,. (1994) Roads and the environmental degradation of tropical montane forests. *Geography*, 2(7) 2-5.
- Zhu, W., Wang, S., & Caldwell, C. D. (2012). Pathways of assessing agroecosystem health and agroecosystem management. *Acta Ecologica Sinica*, 32(1), 9-17. doi:10.1016/j.chnaes.2011.11.001