Author: Victor T. Tumilba
Student no.:47-106801
Completion: February 2012

Principal Adviser: Associate Professor Yarime Masaru
Co-Adviser: Professor Onuki Motoharu
Graduate Program in Sustainability Science

Keywords: Resilience, panarchy, human-ecological systems and aquaculture

An ex-post perspective on human-ecological system resilience and dynamics: a case study of the Philippine brackish-water pond aquaculture

ABSTRACT

The “perfect storm” is said to be coming as global population is expected to grow by half from today to the middle of this century and simultaneously contend with soaring global temperatures due to climate change. This is only one of the countless sustainability challenges that humanity faces. It has long been realized that human and nature interrelationships are complex but it is only now that social-ecological dynamics is becoming one of the main foci in sustainability science for dealing with complex sustainability issues existing at multiple scales in multiple domains. This study attempts to contribute to such learning of system complexity by amalgamating forthcoming frameworks, approaches and methodologies to gauge system transformation and evolution. Three main stream sustainability science concepts are employed: system cycle of adaptive change; network analysis and resilience theory. The cycle of adaptive change is honed from observation of empirical studies of ecological cycles and is designed to capture system transformation categorized into four-phase successions. Although simple to comprehend the application has mainly been confined to qualitative narrative of system dynamics for it the intention is to simplify understanding of complex systems and

to recognize key elements of system evolution that is common to different systems. The purpose of applying network analysis in terms of the “value chain” is to give a concrete structure to the system which is essentially the foundation of quantitative description of the system in terms of material flux. Having the structure then caters for the requirements in applying quantification of resilience that is based on network-flow-structure and information theory. The measure of resilience is then reintegrated to the adaptive cycle (albeit qualitatively) to give a sense of quantitative system dynamics. The iterative process is applied to a case study which is a subsector in aquaculture that experience growth, development and disturbances to provide empirical evidence that such approach has merit in studying complex dynamics. One remarkable deduction on the results is that as the aquaculture sector, as a social-ecological system, cycles through growth and development there is a decrease in resilience that leads to an increase vulnerability to disturbances may it be from social, ecological, or economic origins. Prior to perturbations, low levels of system resilience are coupled with rapid increase in growth in terms of production volume. There are also instances that growth may be coupled with increase in resilience although increases in production volume are less progressive and at times stagnating. System efficiency is important in sustainable development of a sector but maintaining system resilience is equally important for system persistence. One could only hope that the result of this study is of value in understanding system complexity and its application is of benefit in navigating human-nature transformations.