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Developing Social-ecological Resilience Indicators of Organic Rice Production through Integrating Resilience Theories with Social Sciences' Disciplines

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Abstract The term "resilience" seems to permeate discourses of sustainable development since it has been defined as a practical ability to overcome challenges of all kinds. However, understanding and building resilience must begin with developing a specific set of indicators to monitor a specific system. In this paper, 53 organic farmers in four Districts of Chiang Mai Province were selected as informants by snowball sampling. They were iteratively interviewed and observed with reference to the guidelines of social-ecological resilience in agro-ecosystems and technography, respectively to identify components to deal with the dynamic change of organic rice production. Data obtained from the collection process were coded into concrete indicators by qualitative data analysis, supported by insights from grounded theory (GT). The result shows that all indicators built by that way possess three attributes of precision, reliability, and specificity. These qualities are far from questionable since the informants' important factors such as perspectives, indigenous knowledge, and infrastructure have been taken into consideration. Therefore, the indicators are not only used for the quantification purposes, but also provided apparent practices and skills which should be implemented against changes.

Keywords: Developing indicator; Social-ecological resilience; Organic rice production; Grounded theory; Technography

Introduction

Resilience has always been praised as a key property of sustainable development since its concept was defined as systems' ability to absorb changes of state variables, driving variables and parameters, and still persist (Darnhofer *et al.*, 2010). This definition is important to stakeholders as it provides an efficient framework to understand the complicated relationships between humans and the environment, and to offer a necessary set of practices

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against the dynamic change of social-ecological systems (SESs) (Dixon and Stringer, 2015). However, monitoring systems' resilience is complicated because the concept of resilience is rather metaphoric, and the system's operation also takes place in multi-dimensional domains involving ecological, technological and physical aspects as well as social and political contexts (Carpenter *et al.*, 2001).

Scientists have endeavored to combine methodologies, bridging natural and social disciplines to establish a holistic approach for assessing resilience. Bennett *et al*. (2005) suggested that the sustainable livelihoods could be applied in the process since this framework deals with necessary abilities and assets that form a means of living. Nonetheless, such application of the framework is often criticized as the sustainable livelihoods without stakeholders' power relations. Cabell and Oelofse (2012) translated resilience's abstract ideas into apparent actions, presenting thirteen indicators called "behavior-based indicators," which were collected from critical attributes needed for sustaining agro-ecosystems, and most often cited in literatures as relevant to SESs' resilience. Nonetheless, the behavior-based indicators could not be a golden standard of all resilience assessments as it was built without oriented to assessing resilience of a specific system even though the nature of resilience is significantly dependent on interactions of the spatial and temporal contexts (Berkes *et al.*, 2003).

The researchers do not argue that the behavior-based indicators are not practical. Its underlying ideas contribute to the resilience study in the sense that either presence or absence of those indicators can predict whether or not the system is potentially capable of resisting changes. Therefore, integrating the behavior-based indicators with appropriate disciplines will allow stakeholders to understand farmers' insights into how they can interact with necessary factors within their system.

There are two remarkable disciplines recommended to help in integrating the behavior-based indicators with suitable disciplines, studying about sustainable development of agricultural systems. Consequently, a set of efficient indicators of assessing resilience as the indicators will be built by appropriate sciences and the empirically contextual evidence (Adger *et al.*, 2005). Firstly, grounded theory (GT) is suitable for facilitating the integration of natural and social sciences with theoretical perspectives (Glaser and Strauss, 1967). It allows researchers to overcome conjecture and preconception to the precisely underlying processes through in-depth interviews and observational approaches, of which the outcome can be developed as a theory relevant to that study area (Quinlan *et al.*, 2015). Another is technography that provides additional hypotheses emerged from interactions between human, technology, and that social-ecological contexts (Jansen and Vellema, 2011). The outcome is

a description to acknowledge how technologies are adopted and adapted by human (Richard, 2009).

The goal of this paper is to present how to develop resilience indicators of organic rice production. Because building resilience in any systems cannot happen overnight, but requires a series of well-planned processes (Uday and Marais, 2014), which has to begin as the first step by developing appropriate indicators for monitoring (Ciftcioglu, 2017).

Materials and Methods

Study area and sample size

The study was carried out during June 2015 to May 2016, and conducted in four Districts of Chiang Mai Province namely Mae Rim, Mae Taeng, Sun Sai and Phroa, where organic rice production is predominant (DOAE, 2013). Fifty-three organic farmers were selected by snowball sampling to provide the data. This technique ensures that all informants share the following characteristics: (1) small semi-subsistence farmers who are representative of most Thai farmers (McConnell and Dillon, 1997); (2) the farmers are recognized knowledgeable that is helpful to develop indicators through participatory processes (Babbie, 2001).

Preparation

Forasmuch most data were collected by semi-structured interview, the researchers began the process by reviewing literatures about the four districts' bio-physical and social-ecological information, and wider range of related contexts such as opportunities and constraints of organic agriculture production in Chiang Mai (Pattanapant and Shivakoti, 2009), and innovation and marketing mechanism that contribute to organic agriculture (Limnirankul and Gypmantasiri, 2011). Agro-ecosystems analysis (AEA) was then conducted to gather the richness of configurations at the locally agricultural zones (NAFRI, 2006). Also, key informants, from institutions/agencies responsible for or involved in promoting organic rice development in the province, were interviewed to acquire additional information.

Data collection

The meaning of resilience has been considered difficult for ordinary people's perception due to its association with scientific meaning. In this study, based on the consideration in popularly cited literatures (Carpenter *et al.*, 2001;

Berkes *et al.*, 2003; Milestad, 2003), we used the term "the adaptive capacity" with the extension: *"the capacity of the farm to cope with negatively dynamic changes in both sudden events and long-term events, and to adapt to the changes in an active way"* during the interviews with the farmers. In addition, to make them understand resilience better, they were informed of the details about resilience concepts, and the expected outcomes.

The semi-structured interviews began with asking the farmers to indicate a desirable version of organic rice farm considered having the capability of resisting and adapting to dynamic changes. Then the pleasant format must be coupled simultaneously with the components, and in-depth descriptions which can help the farm sustaining its identity, functions and structures.

To capture more components especially relevant to adaptations which are always cited as a key property of all resilience systems (Kummer *et al.*, 2012), the behavior based indicators in agro-ecosystems (Cabell and Oelofse, 2012), and scenario analysis based on plausible disturbances (Enfors *et al*., 2008) were applied to formulate strategic questions. The farmers were requested to impart the history of their farms, and to offer a vision about the implementation of adaptations in case their farm was affected by the indeterminate future simulation, for examples, *"Why do you do organic rice production?"*, *"Do you have more plans to be done in order to achieve a state of the desirable farm?,""As you could remember, which social-ecological factors caused change to the farm?"* and then *"Which strategies were adapted to enable the farm undergoing those changes?"* These questions and responses can be developed as social-ecological resilience indicators. Because the practices operated and adapted on farm are in theoretically dynamic progress established from interactions between social and natural forces, and assumed linking with knowledge about organic rice production to cope with changes (Darnhofer, 2010).

Lastly, to ensure that components about the interactions between farmers and technological usage do not slip through the net, technography (Jansen and Vellema, 2011), was simultaneously conducted during the interviews. All fieldwork data collections were recorded and taken note. This process was the series of iterative process done with the farmers individually, and normally lasted approximately two hours per time until the empirical saturation of the result has been achieved.

Data analysis

Data obtained from the interviews and the observations were transcribed as descriptive data and reflective data. Next, it was converted into useful

meaning of units by three procedures of qualitative data analysis: (1) data reduction; (2) data display; and (3) conclusion drawing (Miles and Huberman, 1994). Based on the first two processes, the data were synthesized line by line in detail, and assigned into the initial sets of codes showing the attributes relevant to the resilience properties in agro-ecosystems. Then the code sets were analyzed to sort out the complicated data, and were aggregated into the classified codes of the same qualifications. After that, those were categorized in the same groups; others considered irrelevant were discarded. In the third procedure, the groups of the classified codes were verified and classified around the four critical properties of resilience (Folke *et al*., 2003).

In this study, the outcomes of the collected data were called social-ecological indicators (SERIs). Though the SERIs were all built by the participation at the farm level, some are occasionally not ready-made indicators due to its high degree of abstract, which is difficult to use for quantitative purposes. To make such indicators available in practice based on the real situations of organic rice production, insights advocated by GT (Strauss and Corbin, 1998) and technography (Jansen and Vellema, 2011) were taken into account.

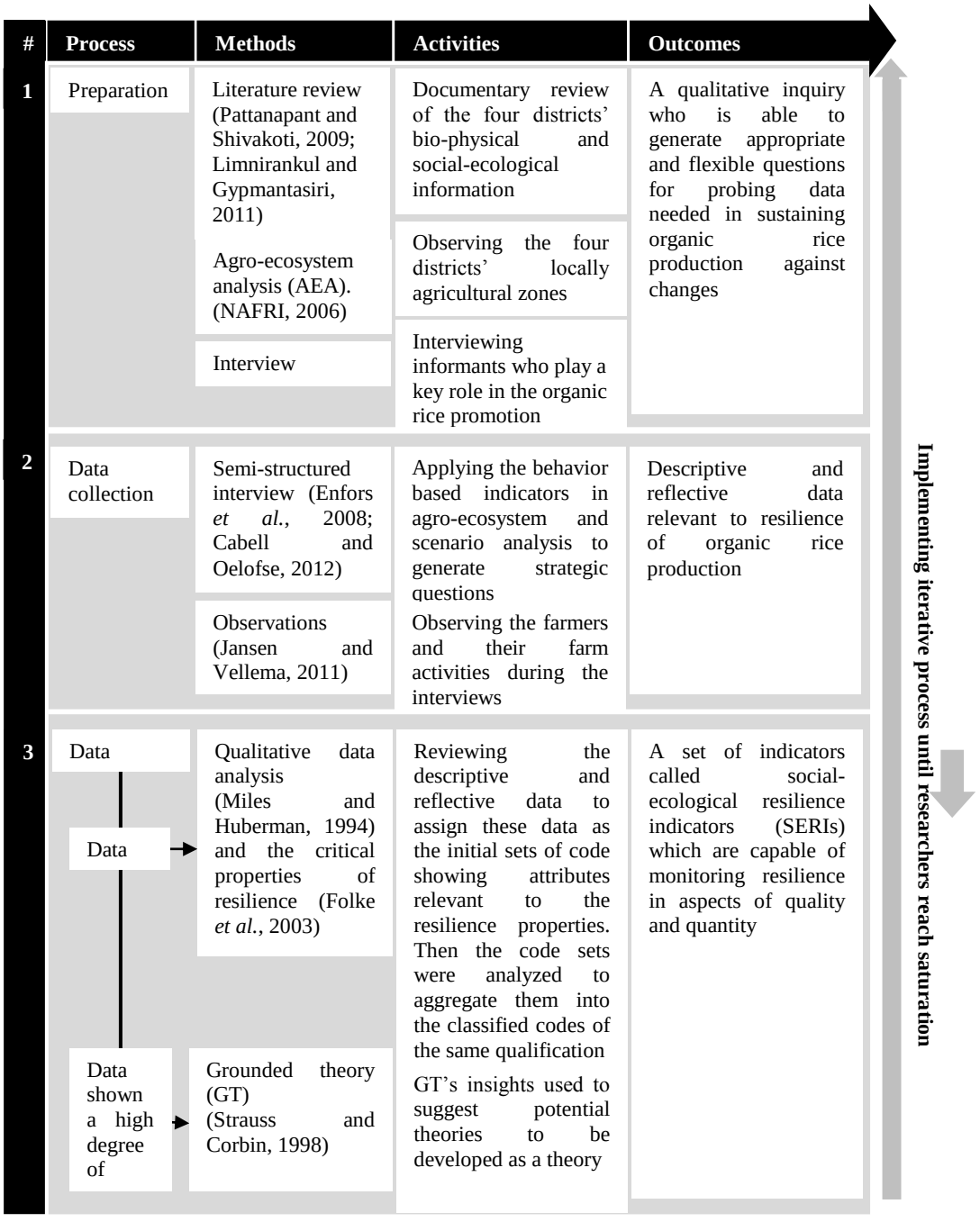

Figure 1 Overview of the methodological steps taken in this study

Results

We developed a set of indicators to build and monitor resilience capacity of organic rice production against changes. To achieve the goal, semi-structured interview and observation designed by resilience concepts and technography respectively, were applied. However, these disciplines' information were often paired with GT to provide greater information for developing indicators, and translating some collected abstract data into practical indicators. The finding is the methodology which is effective to acquire precise, specific and reliable indicators as well as for suggesting farmers with required practices and skills against changes. This qualification has been occurred because the farmers' necessary components for sustaining the farm such as their agricultural perspectives and adaptations, indigenous knowledge, local cultural and traditions, and infrastructure and policies, were taken into consideration throughout the data collection.

An example to present the SERIs possessing the three qualities of precision, specificity and reliability, is the importance of marital status which has been addressed to be an indicator of the SERIs. A starting point of it arose when a preliminary phenomenon of having spouse was ignited by the farmers, citing farm activities may be difficult to perform in case they do not get support from their spouses. After we acquired a possible theory regarding social life sprung during the data collection, our next step was developing a logic paradigm to explain the relationship between the marital status and resilience abilities. The finding from moving in and out of the data collection and the data analysis states that such a relationship is substantive. Like ordinary people, the farmers look for an intimate relationship to fulfill their life and to act as the inspiration for creating new things. In this case, it seems this indicator is not pertinent for building resilience, but its attribute pragmatic contributes to both farm and psychological resilience.

As mentioned earlier that some SERIs were built by technography. To demonstrate its contribution is a situation in Mae Taeng District where we found a farmer was growing system of rice intensification (SRI) on the commercial plots and cultivating direct broadcasting rice on the household consumption plot. He stated that such agricultural platforms did not take place just for this year, but at least had consecutively been in place for four years. After the question of the platform difference arose, we conducted technography to explore the dissimilarity of practical-technical configurations determined by either personal factors or others driven by the agro-ecosystem where he belongs to. The result indicates that he has always realized that SRI is capable of improving qualitative and quantitative rice yields, and is suitable for commercial production. However, the disadvantage of SRI is requiring labor-

intensive, which is impossible to him who has a limitation of the household labors. In addition, the amount of rice yields produced by direct broadcasting has satisfied him and his family. They have accepted to consume uncommon shape and size of rice grains affected by crop-weed competition as long as this method can provide them the sufficient amount of rice yields.

Regarding the case above, neglecting SRI is not determined by skills and experience, but has been forced from his personal attitude and unavailability of the household labors. Presumably, he will grow SRI on both plots in case his household labors are abundant. This assumption is not a metaphysical notion initiated by our opinion. It was proposed by technographical observation which helped us develop that assumption to be the substantial one. In addition, such a relationship between SRI and the availability of farm resources can be logically described by the theories of the labor importance to farmers' strategic adoption choices (Glover, 2011; Ciani *et al.*, 2014).

Discussion

Seemingly our methodologies are simple, interviews are a kind of conservations, and conservations are just ordinarily reciprocal exchanges. Practically at the field work level, such a method requires the quality of being qualitative inquiry for formulating brief, but salutary questions for time and cost effective control. Similar to the observation conducted by either AEA or technography, our method requires researchers' quality about understanding phenomenon of interest settings to accurately decide where the observation will take place, at what time, who is next participant, in what circumstances. Most importantly, all verbal and experiential data acquired from participants and their social-ecological contexts must be decoded into the quantifiable indicators. Therefore, the key point recommended is as follows.

Importance of Pilot Studies

To describe why the pilot study is necessary is simple; developing indicators similarly to our methodology greatly demands researchers' understanding of spatial and theoretical contexts in which the data collection takes place. This understanding must be excellently strengthened to enhance researchers in the contextual data analysis.

Prior to the beginning of full-scale study in Chiang Mai, we carried out two days of pilot study in Nan during April of 2015. Nan is located in the North of Thailand, and shares many agro-ecological contexts similar to Chiang Mai. The participants were twelve organic farmers who greatly appreciated organic

farm performance. Apart from that, they have a good term of personal connections with us from the previous study which focused implementing local wisdoms to strengthen sustainable development (Puangchaey and Panpakdee, 2012). The pilot study was held to evaluate the methodology's efficacy. Unfortunately, the consequence did not at all go as expected as the prepared questions listed from literatures could solely unlock the farmers' preliminary data. We became aware of that problem when we witnessed that most farmers had none of difficulty to identify the desirable system. Yet such a harmony situation did not occur during the process of generating components to develop the constitutive part of that system. Assumedly, the terminology of resilience itself is troublesome for acknowledging particular people who are less associated with scientific fields. In addition, we might not well-prepared for asking questions which were possibly comprehensible to the farmers.

Although we failed, the pilot study was still remunerative. The two parties' communicational barriers were not found during the interviews. It presumably occurred from the previously personal familiarity which can be counted as a handicap of qualitative study (Cooper *et al.*, 2012). Therefore, the participatory process's duties such as questioning and interpreting were not solely contributed by us. Most farmers were enthusiastic to express additional ideas about organic rice production, and that enthusiasm went so far to the politic topics which are often considered a taboo in Thai custom. Most importantly, the farmers also indicated that there are factors which have not been specified in resilience literatures, but considerably necessary for maintaining the farm against change, for examples, the marital status, and local dialect and cultures.

It is difficult to conclude that the pilot study provided new findings, but it was gainful in terms of pointing out which issues and topics, and what possible interview questions will be explored in the Chiang Mai study. The Nan farmers revealed that the best knowledge of organic rice production could not be found in literatures, but among them who interact with it on a day-to-day basis. The pilot study also taught us that delivering appropriate and flexible questions to meet farmers' perception, researchers must understand farmers-activity systems at the beginning. To avoid the aforementioned negative situation experienced at the Nan workshop, the full-scale study therefore began with conducting AEA and interviewing key informants within the province to incorporate kinds of relevant data for supplementing and analyzing the data collection that follows.

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References

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R. and Rockström, J. (2005). Social-ecological Resilience to Coastal Disasters. Science 309:1036-1039.

Babbie, E. (2001). The practice of social research,9th ed. Wadsworth Thomson, Belmont, CA.

Bennett, E. M., Cumming, G. S. and Peterson, G. D. (2005). A systems model approach to determining resilience surrogates for case studies. Ecosystems 8:945-957.

Berkes, F., Colding, J. and Folke, C. (2003). Navigating Social-ecological Systems: Building Resilience for Complexity and Change. Cambridge University Press, Cambridge.

Cabell, J. F. and Oelofse, M. (2012). An Indicator Framework for Assessing Agroecosystem Resilience. Ecology and Society 17:18.

Carpenter, S., Walker, B., Anderies, J. M. and Abel, N. (2001). From Metaphor to Measurement: Resilience of What to What? Ecosystems 4:765-781.

Ciani, F., Huggard, J. and Zervas, T. (2014). The Resilience of Bergamot Farmers in the Reggio Calabria Province of Southern Italy Working Paper Economics, No. 25. Universitadegli Studi di Firenze, Firenze.

Ciftcioglu, G. C. (2017). Assessment of the Resilience of Socio-ecological Production Landscapes and Seascapes: A Case Study from Lefke Region of North Cyprus. Ecological Indicators 73:128-138.

Cooper, R., Fleischer, A. and Cotton, F. A. (2012). Building Connections: An Interpretative Phenomenological Analysis of Qualitative Research Students' Learning Experiences. The Qualitative Report 17:1-16.

Darnhofer, I. (2010). Strategies of Family Farms to Strengthen their Resilience. Environment Policy and Governance 20:212-222.

Darnhofer, I., Fairweather, J. and Moller, H. (2010). Assessing a Farm's Sustainability: Insights from Resilience Thinking. International Journal of Agricultural Sustainability 8:186-198.

Dixon, J. L. and Stringer, L. C. (2015). Towards a Theoretical Groundings of Climate Resilience Assessment for Smallholder Farming Systems in Sub-Saharan Africa. Resources 4:128-154.

DOAE. (2013). Basic Agricultural Information of Chiang Mai Province 2012. DOAE, Chiang Mai.

Enfors, E. I., Gordon, L. J., Peterson, D. and Bossio, D. (2008). Making Investment in Dryland Development Work: Participatory Scenario Planning in the Makanya Catchment, Tanzania. Ecology and Society 13:42.

Folke, C., Colding, J. and Berkes, F. (2003). Building Resilience and Adaptive Capacity in Social-ecological Systems. *In* Berkes, F., Colding, J. and Folke, C. (2003). Navigating Social-ecological Systems. Cambridge University Press, Cambridge.

Glaser, B. G. and Strauss, A. (1967). The Discovery of Grounded Theory: Strategies for Qualitative Research. Aldine Publishing, Chicago.

Glover, D. (2011). The System of Rice Intensification: Time for an Empirical Turn. Wageningen. Journal of Life Sciences 57:217-224.

Jansen, K. and Vellema, S. (2011). What is Technography? Wageningen Journal of Life Sciences 57:169-171.

Kummer, S., Milestad, R., Leitgeb, F. and Vogl, C. R. (2012). Building Resilience through Farmers' Experiments in Organic Agriculture: Examples from Eastern Austria. Sustainable Agricultural Research 1:308-318.

Limnirankul, B. and Gypmantasiri, P. (2011). Agricultural Innovation in Supporting Organic Rice Production System of Smallholder Farmers in Northern Thailand. National Science and Technology Development Agency, Bangkok.

McConnell, D. J. and Dillon, J. L. (1997). Farm Management for Asia: A Systems Approach. Food and Agriculture Organization of the United Nations, Rome.

Miles, M. B. and Huberman, A. M. (1994). Qualitative Data Analysis. Sage Publishing, Thousand Oaks.

Milestad, R. (2003). Building Farm Resilience: Challenges and Prospects for Organic Farming. A thesis submitted in partial fulfillment of the degree of Philosophy of Sciences (Agricultural Sciences), at Swedish University, Uppsala.

NAFRI. (2006). Handbook on Agro-ecosystems Analysis and Agro-ecological Zoning: A Tool for District Land Use Planning. National Agriculture and Forestry Research Institute, Laos.

Pattanapant, A. and Shivakoti, G. P. (2009). Opportunities and Constraints of Organic Agriculture in Chiang Mai Province, Thailand. Asia-Pacific Development 16:115-147.

Puangchaey, H. and Panpakdee, C. (2012). Practical Knowledge of Local Wisdom at the Sobsai Basin, Nan Province. Sor Chareon Press.

Quinlan, A. E., Blázquez, B. M., Haider, J. and Peterson, G. D. (2015). Measuring and Assessing Resilience: Broadening Understanding through Multiple Disciplinary Perspectives. Journal of Applied Ecology 53:677-687.

Richard, P. (2009). Dressed to Kill: Clothing as Technology of the Body in the Civil War in Sierra Leone. Material Culture 14:495-512.

Strauss, A. L. and Corbin, J. (1998). Basics of Qualitative Research, 2nd ed. Sage Publishing, Thousand Oaks.

Uday, P. and Marais, K. B. (2014). Resilience-based System Importance Measures for System-of-Systems. Computer Science 28:257-264.

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