論文題目　The Diffusion of Agricultural Information in Real and Virtual Communities:
Evidence from Shrimp Farmers in Developing Countries
（現実コミュニティと仮想コミュニティにおける農業情報の普及：
開発途上国のエビ養殖業者の事例から）

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The diffusion of information on good farming practices plays a key role in improving agricultural productivity and promoting rural welfare in developing countries. Traditionally, the main channel to disseminate information to farmers has been the governments of developing countries via their extension officers. Nevertheless, the lack of information remains to be one of the reasons for farmers to adopt wrong or inefficient practices. Moreover, the problem of spreading inaccurate information also persists (WB, 2008).

　　To overcome such problems, recent literature has focused on the role of farmers' social network on obtaining information. The studies find that the Social Network Targeting (henceforth, SNT) is a way to increase farmers' adoption of new technology (Banerjee et al., 2013; Beaman et al., 2015; Kim et al., 2015). However, it is still unclear that the targeting method is useful in disseminating information in terms of delivering accurate information. Moreover, they do not reveal the reason why people share information to others. Literature on psychology or social network have studied the communication among the Community of Practices (CoPs), i.e., groups which consist of individuals who are engaged in the same industry or related to the work, and found that direct reciprocity is one of the reasons why people share information (Lave, 1991; Lave & Wenger, 1991; Wasko, 2005; Wenger, 1998). Others show indirect reciprocity, which is the feeling of obligation to help others if she is helped by someone, also plays a role (Nowak and Sigmund, 2005). However, most of these studies rely on self-report recall data of personal communications and consequently the data points are limited. Further, examples are drawn from developed-country settings, and thus

the applicability of these findings to developing-country agriculture is not guaranteed.

This dissertation takes a case of shrimp farmers in Vietnam and Thailand to answer the remaining questions. While shrimp farming is a profitable business for smallholders in developing countries, it is also difficult, and farmers frequently experience crop failures due to shrimp viral diseases (UNIDO, 2013). Thus, it is critical for farmers to receive appropriate information on farming. To reduce the risk of shrimp diseases, veterinary drugs are used by shrimp producers, but these often contain substances harmful to the human body such as chloramphenicol, enrofloxacin, and ciprofloxacin. Thus, there have been attempts by the governments of developing countries and international communities to disseminate good aquaculture practices. Better Management Practices (BMPs) is one of them. According to NACA (2016), well-designed and -implemented BMPs support smallholder shrimp aquaculture to increase productivity by reducing the risk of shrimp disease outbreaks. I also investigated whether the BMPs reduce the use of harmful substances in shrimp farming, taking a case of Vietnam. Using the laboratory-tested objective data on the use of prohibited substances, I found that receiving BMPs training and having trust on extension officers have significant and positive effects on reducing the use of these drugs. This finding suggests the importance of considering effective ways to spread the information of BMPs among farmers.

Regarding one of remaining questions mentioned in the second paragraph, this dissertation compares the SNT with other targeting methods to verify whether the SNT is useful in delivering the BMPs accurately. I conducted a workshop on BMPs to 36 shrimp farmers in December 2016. The participants are selected using three targeting methods and divided into three groups based on the methods. The treatment group 1 includes farmers selected by Simple Random Sampling (SRS) while the treatment group 2 includes individuals chosen by Systematically Unaligned Random Sampling (SURS) using individual location information, and the treatment group 3 is selected using the SNT. In August 2017, I conducted a follow-up survey to investigate how well farmers' knowledge of BMPs improved compared to the status before my treatment.

Using the individual-level data, I examined which targeting method (1) improves the knowledge of good practices of the treated the most; (2) enhances information sharing with their neighbors the most, and (3) improves the farming knowledge of those who receive information from the treated. As a result, I found that the SRS targeting method shows the greatest increase in the average knowledge of BMPs in the village than other treatment. Secondly, the SURS targeting

method shows lower improvement in BMPs knowledge than the SRS. On the other hand, unlike other groups, the treated farmers in the SURS increase their neighbors' scores. Thirdly, the SNT targeting method increases information sharing between villagers in the village, but farmers, who receive information from treated farmers of the SNT group, have lower improvement score in their BMPs knowledge.

Furthermore, to reveal the motivation of information exchanges between shrimp farmers in a virtual community, this dissertation takes a case of one Facebook group, which share a common farming crop and the majority of the members are shrimp farmers. Facebook groups are considered as Virtual Community of Practices (VCoPs), which is similar to CoPs but members of VCoPs tend to be distributed throughout a country or the globe, and many of them may not meet face to face with other members (Wasko, 2005). While these Social Network Service (SNS) communities are considered to be an advanced form of agricultural extension systems (called "e-farming") which promotes information exchange in developing countries, there is a dearth of literature that examines how communications actually take place among the members. One concern for promoting this kind of communities is how active information exchange will be, particularly because interpersonal ties between members in VCoPs are typically weak, compared to real communities in villages where the social network is very dense. One way to find this out is to examine whether a norm of reciprocity plays a role in facilitating information exchange even in a virtual space. Particularly, indirect reciprocity, rather than direct reciprocity, may be an important motivation for the information exchange with other VCoP members (Jung, 2017; Nowak and Sigmund, 2005; Wasko, 2005).

I construct a monthly panel data to addresses a Facebook group member's motivation for information exchange between January 2015 and May 2017. Based on Poisson and negative binomial regressions, I found that: (1) members who have previously asked questions are more active in sharing information than people who have never asked; (2) other members' positive expressions to previous information shared (such as clicking likes) promote future information sharing; (3) the act of information sharing by one's peer promote his/her own information sharing, and (4) the more the member shares information in the past, the more s/he asks information today. These findings suggest that reciprocity does play a significant role in motivating information exchange even in the VCoPs, similar to CoPs. I also confirm that professional reputation is one of

the motivations for information sharing and that there is a positive effect of peer's prosocial behavior.

Based on these findings, it can be concluded that in a real community, the SNT targeting method seems to be a way to disseminate information to more people, and SURS targeting method may be suitable to enhance the knowledge level of their neighbors. However, both methods are less likely to deliver accurate information than SRS because of bias generated by those samplings. Regarding the motivation of information exchanges between farmers in a virtual community, I clarify that reciprocity and professional reputation play important roles in enhancing professional knowledge exchange even in VCoPs. If the members in a VCoP have a common motivation, information exchange can be activated, and such active exchange of information will lead to the growth of the community.

This dissertation introduces targeting methods using location information and social networks, which is rarely used in the analysis of development economics, and makes a contribution to suggest effective targeting methods to transmit information to more people or to spread accurate information. Furthermore, this dissertation clarifies that reciprocity and professional reputation play important roles in enhancing professional knowledge exchange even in VCoPs using large-scale data from a virtual community. As the adoption rate of Information and Communication Technology (ICT) increases, the demand for e-farming for the effective and efficient dissemination of agricultural information in developing countries may increase. The results of this dissertation will be useful for promoting e-farming in the countries.