

Chapter 5

Discussion and Conclusion

This chapter concludes this thesis. It presents a summary of the research. Findings of the study and are discussed and interpreted. Recommendations for further study are also provided at the end of each section.

5.1 Research Summary

To help us understand the transmission of the disease the study used a One Health approach to develop a transdisciplinary framework. This framework considers interaction of highlanders with the pigs they grow and their environment as a single system. The study identified four subsystems to investigate Trichinellosis risk: animal husbandry, food chain, environment, and economy. The results of a transdisciplinary process involved the development of a Bayesian Belief Network model of Trichinellosis risk and in-depth study of two highlander villagers, including one that experienced an outbreak. The study developed and tested a novel survey instrument consistent with the model and the One Health approach. The model and our survey results suggested the above subsystems, including pig husbandry, food chain, environment, and highlanders' economic circumstances are entirely interdependent, and thus must be considered as an integrated whole when devising disease interventions.

5.2 Discussion and Interpretation of Findings

5.2.1 Transdisciplinary Trichinellosis Risk Framework

a) Animal Husbandry

The study found that females have equal opportunity to be part of the pig rearing process. In fact, most of pig growers are females. On average, the pig growers have high experience in pig rearing. The study also presented that the pig growers acquire knowledge about pig rearing from public health officers who are their neighbors. Some households use local wisdom in healing sick pigs such as using herbs. From the interview, we can see that these people have naïve morality. They claimed that they never sell any sick pigs to others. Surprisingly, many households apply deworming drugs to their pigs twice annually. Though, this practice cannot effectively kill parasites located in muscles, it shows a good sign that they are aware of parasitic diseases in pigs. However, most of the pig growers in these villages do not recognize that keeping pigs in pens can prevent their pigs from parasitic zoonoses. After they were educated by the enumerators, most of them tended to change their practices to keep their pigs in pen. However, the main reason that some people decided not to change their practices is because of the financial constraint and time that they needed to devote to pig rearing.

b) Food Chain

The study found that, each year, villagers kill native pigs on the special occasions related with traditions and beliefs. In addition, the pork is almost always shared with the neighbors and even with visitors or strangers and

always served raw. These people may pass along meat that is infected by *Trichinella* or other parasitic diseases to others. These people have a high tendency to consume a large amount of infected meat in these special occasions. On the other hand, the parasitic zoonoses experts claimed that eating outside of the house such as at a restaurant, market or church have relatively lower risk since the infected meat may be mixed with non-infected meat and shared with several people.

The study also found that eating habits and food choice depend largely on personal preference as well as the influence of peers or family members. There is a possibility that children will follow their parents' behavior and acquire the same eating habits as adults. Knowledge can prevent some people from eating raw meat. Additionally, for those who eat raw meat for pleasure (good taste), being informed about the dangers does not appear to dissuade them from continuing to eat it. Those who consume it mainly for its tonic effect tend to be more easily induced to stop.

An area of future research that might provide valuable would be to investigate the impact of raw meat consumption on individual health, productivity in work, level of income, and overall wellbeing including the possibility to falling into a poverty trap. Furthermore, the preliminary results of this study are being used as basis for expanding the research to include a component of participatory prevention and control measures aimed at reducing disease risk in the highlander population.

c) Environment

Environment is seen as the major risk factor explaining the transmission of *Trichinella* in highlanders. Since these people allow their pigs to wander around for food in the natural environment, this presents a high risk of infection from wild animals or rodents to their pigs. Though, a few households raise pigs in the forest, many households have seen wildlife around the villages and also lots of rodents. A few of them recognize the danger of these animals that could possibly bring diseases to their pigs or to themselves. This study considered the cleanliness of surroundings and pig areas since we believe they are important factors leading to *Trichinella* infection in pigs. Keeping pigs in pens can reduce the risk that pigs will be infected by *Trichinella* if pig growers do not feed their pigs with animal carcasses, cleaning pig areas frequently and removing feed after feeding every time.

d) Economic Conditions

Economic factors seem to be a driving force for any decision making among these populations. These highlanders use the intuition in decision-making process in pig rearing based on their objectives and constraints such as time, money and knowledge. The study discovered that there are three objectives of pig rearing in highlanders, including self-subsistence, ritual uses and commercial purposes. In terms of the commercial purpose, it is more likely an acquaintanceship selling to neighbors or friends when they are in need. In this case, they can get a fair price considering the quality and weight of the pigs they sell and do not need to compete with each other over price. The objectives of pig rearing determine the kinds of pig production modes these people apply. Those who tend to raise pigs

purposely for their own consumption or those who sell pigs to their friends do not pay a lot of attention to the welfare or productivity of pigs compared with those who attempt to sell the pigs out to market for good price. Therefore, the commercial farmers are willing to invest more income in constructing better housing or buying better feed for their pigs. This study also found out that different pig production modes lead to different cost structure and revenue. However, a more in-depth study concerning the mechanism of cost and the revenue stream of pig rearing, agricultural market mechanism and the adaptation of farmers in different situations related with pig rearing should be a focus in the next study.

5.2.2 Bayesian Belief Network model of Trichinellosis risk

The conceptual transdisciplinary framework of Trichinellosis risk is developed by the transdisciplinary experts' team to explain interconnection of the risk factors. Bayesian Belief Networks (BBNs) offered convenient ways to solve the decision problems related with management of the relevant institutions in attempting to reduce the risk including (1) institution's decision to support money for pig pen construction to pig growers and (2) institution's decision to encourage people to stop consuming raw or undercooked meat. The accuracy of the models was based on experts' judgments. In addition, we used scoring rule results, including, logarithmic loss, quadratic loss, spherical payoff, error rate, and sum square errors to select models. We recommend using more advance qualitative statistical tools to measure the accuracy of a model and to select a model in the next study.

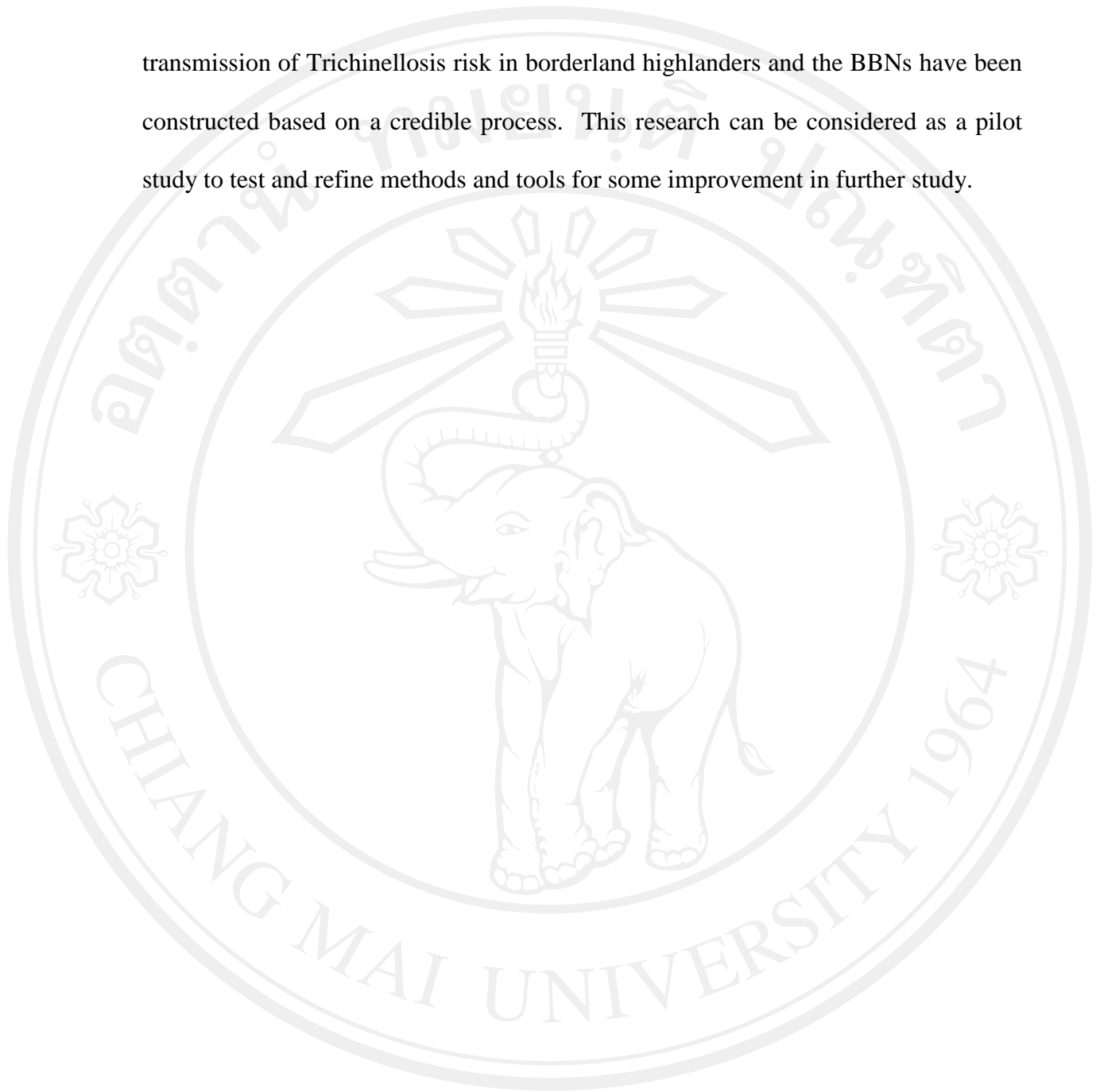
Regarding the advantages of BBNs, they allowed us to make a decision under an uncertainty such as when we do not know the behaviors of target

populations. They also allowed flexibility in the prediction about how the situation will behave which is very useful for policy making. In addition, they also provided an outcome of any decision, and the models are very adaptable. We can start constructing a model with limited knowledge and improve it later as we acquire new understanding. Therefore, we recommend conducting further research in other areas to refine the creditability of the models.

In considering the disadvantages of BBNs, for this study we found a so-called curse of dimensionality problem that has often been a difficulty with Bayesian statistics when the posterior distributions often have many parameters. This problem occurs when there are many more features than data points. This problem we can often find in some real world problems. It can create noise that impedes the learning algorithm from recognizing the features that are distinguishing with respect to the target concept (Pansombut et al., 2011). As a consequence, we recommend the further research to be aware of this problem and try to avoid variables that possess too many features. However, in case that we cannot include this kind of variable in the model, we may need to increase the sample size. In this study, we found this problem in the pig production mode. Indeed, there should be only 5 features. This variable has 13 features since we cannot calculate the cost structure and revenue stream from these 5 different features but we can for the 13 features. Therefore, for the further research, we can avoid the under-determined problem if we can find the cost structure and revenue stream of these 5 different kinds of pig production.

The above constraints make these models not the perfect tools to make a decision. However, the research has fulfilled the obligations to explain the

transmission of Trichinellosis risk in borderland highlanders and the BBNs have been constructed based on a credible process. This research can be considered as a pilot study to test and refine methods and tools for some improvement in further study.



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