A Long-Term Negative Effect of Monetary Incentives On Participatory Surveillance of Animal Disease

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Research Article

Keywords: behavioral economics, incentive, monetary market, participatory disease, surveillance, social market

Posted Date: September 9th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-846132/v1>

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Abstract

Background

Generally animal diseases affect widely on human health, therefore practical animal diseases surveillance system is important controlling system to motivate participants in the long term. The objective of this study is to determine the effect of monetary and social motivation on the participatory surveillance of animal diseases. Based on the Fiske's relational theory (1992), we proposed that there were basically two types of motivation; monetary incentives (monetary markets) and non-monetary incentives (social markets). Our hypothesis is that the effort by monetary motivation is higher than the efforts by social motivation during the payment period. This effort decreases at the end of the payment period, whereas the effort by social motivation is stable.

Methods

We analyzed the data generated by a pilot project that started in 2014 by using a smartphone application to report on the symptoms that indicate animal health malfunctions in Chiang Mai province, northern Thailand. This experiment involved the participation of 67 volunteers from 17 areas in the central part of the province.

Results

The results of the experiment demonstrated that monetary motivation was more effective during the payment period. However, after the termination of the payment period, the social motivation group was more effective. The volunteers given monetary motivation demonstrated not only lower effort than those given social motivation, but the group with monetary motivation was also not re-motivated immediately by social motivation after the payment period had terminated.

Conclusions

In the long run, the social motivation was more efficient and sustainable than the monetary motivation.

Background

The incidence of animal diseases in agricultural sector can increase costs and reduce profitability significantly. It can contribute to an increased in the farm's vulnerability. Hence, disease surveillance system is an important part of diseases controlling. It's included reporting the disease or events, analysing the data, responding to those events, and implementing measures aimed at prevention and control. The disease reporting is the first stage in disease surveillance system and subsequently induces other processes. It can lead to a major early detection and rapid response activity. Therefore, the World

Organization for Animal Health (OIE) formally indicated that the OIE country members have a duty to report their country's animal disease situation in order to guarantee transparency and to improve knowledge of world animal health [1]. At a local level, farmers and livestock owners play an important role in reporting animal diseases. They confront with animal health closer than the veterinary. They can provide important data in which indicates the data on population and the area at risk to the authorities. It can then be used in animal disease surveillance system. Several types of disease surveillance, consist of passive and active surveillance [2]. After reporting stage, the passive surveillance is the system by which veterinary authorities obtaining the data on animal diseases. The veterinary authorities do not establish the specific objective and data collection system. They select only the relevant data for applying in animal disease surveillance system from their routine work, and the reports from farmers or other sources. For this reason, passive surveillance is an inexpensive and commonly used by the veterinary authorities. On the other hand, the active surveillance needs to be designed and conducted by the veterinary authorities with the specific objective of disease surveillance system. The system involves spending a great deal of time, labour, and budgetary resources [3, 4].

Participatory disease surveillance system and the PODD project

Participatory disease surveillance system is a type of active disease surveillance system that involves public health practitioners to provide health and disease data together. However, the participatory disease surveillance system is less expensive and more flexible than other types of active surveillance ones [3].

Moreover, it can also be conducted on a large scale, allowing for animal population-based monitoring at a low cost. For the participatory disease surveillance system, the key stakeholders are the community, who are willing to respond rapidly in sharing health data and who can provide insight data about health behaviour [5]. In addition, digital technology, particularly mobile phone devices such as smartphones, allows them to share the data faster [6].

In 2014, the Participatory One Health Disease Detection project, or PODD, was set up by the veterinary inspection authorities to test animal epidemic control systems using smartphone applications in Chiang Mai province[1], in collaboration with Chiang Mai University (CMU), the Skoll Global Threats Fund, and the Chiang Mai Provincial Livestock Office. The PODD project was a pilot project which involves various parties, i.e. digital technology, local government agencies, and community volunteers. A total of 296 volunteers from 74 local government agencies were involved in the project [7]. These volunteers play an important role in the PODD system by reporting abnormal animal sicknesses and deaths, animal diseases, animal bites, food safety issues, human diseases, and environmental problems via smartphones. However, to sustain the viability of the project, the volunteers need to be motivated in order to remain their commitments.

Motivation and participatory disease surveillance system

Motivation is important for the performance and success of participatory disease surveillance system. There are many explanations of motivation involve with this study. Maslow, in 1943, separated human needs into five levels that motivate individuals to achieve; physiological needs, safety needs,

belongingness and love needs, esteem needs, and self-actualization needs [8]. However, it is undeniable that today's utilization of money as a motivation is widespread. That is because we live in the age of market triumphalism, in which money can buy most of our desires [9]. For instance, the standard labour model of economics, human beings as labourers will offer their effort and time in exchange for compensation [10].

According to the standard labor model of economics, people work more for high wages and work less for low wages. In other words, if there is no payment, there is no effort. However, the overarching question is how should we do so? If we want to motivate participants in the participatory system of disease surveillance system. Is money the only effective motivation way, or is the non-monetary motivation way even more effective and sustainable? While the participatory system of disease surveillance has been developed, the outbreaks situation of diseases is quite high impact in the present. For example, in 2005, the zoonoses such as avian influenza affected on populations in Southeast Asia. Modeling research forecasts have predicted that between 2 to 7.4 million people worldwide could be infected and die in the next pandemic [11]. These forecasts have many implications for societies, including economic losses, human and animal health problems, and food insecurity. Regarding such pandemics, the future continues to be uncertain because vaccines for humans, such as those for influenza or avian influenza, are not yet ready for widespread use. That is because the candidate vaccines are still under development [12]. Therefore, we need not only better to have vaccines against viruses, but also own a rapid alert system for early detection. So that these issues can be dealt with by applying the controlling the pathogen spreading before causing a pandemic. However, surveillance system is an on-going activity that must be sustainable, so the PODD project encountered the issue of how to motivate volunteers, especially in the long term.

Theories of monetary and non-monetary incentives

In this study, we attempted to use the theory of monetary and non-monetary incentives to explain the short-term and long-term responses of participants. Monetary and non-monetary incentives are respectively called monetary markets and social markets [13], which is the theoretical framework of this study. This concept was derived from the Fiske's relational models theory (1992). Fiske analysed human relationships by reviewing studies from various communities. The model categorizes human relationships into four models; communal sharing (CS), authority ranking (AR), equality matching (EM), and market pricing (MP). These four types of relationships are not only represent relationships in society as a whole, but also represent it in a social group or between individuals [14]. Heyman and Ariely's study in 2004 reorganized the Fiske's relational models by combining the CS, AR, and EM together. The combination was called social markets [13]. Only the MP was called monetary markets.

Under the social markets, people live in a well-balanced human relationship and focus on altruism. People give out their time and energy without expectation of return. If eventually there is some type of returns, it does not have to be immediate, nor does it have to be equal to the input of time or effort. For example, volunteer careers commit to care for the elderly without expecting anything in return. They

frequently receive only gratitude instead. The social market is unclear and indirect which is contrast to the monetary market. People calculate the cost and benefits of every action, even the opportunity costs, which is the other option loss after one option is chosen. The return must be straightforward and clear without any ambiguity and should be dominated over cost. For instance, if an elderly person requires attention, hourly compensation must be paid. When the compensation is stopped, the provision of care ceases.

Previous researches demonstrated that when the social and monetary incentive must interact with each other, monetary incentives are more influential. It means that social incentives will disappear for a long time, and it is difficult to draw back to social incentives after money incentives are used [10,15, 16]. Therefore, using monetary incentives must be careful of the consequences, especially in the case of social activities that requires volunteer groups. It makes them compare their compensation to the normal wage rate and their expectation in which equal to the amount of compensation [17]. Moreover, monetary incentive can reduce effort after the compensation are terminated [18, 19]. In addition, pushing people to monetary incentive can be done easily by making them thinking about money even though there are no real payment [20]. Therefore, compensation payment is enough to shift volunteers from the social incentive to the monetary incentive.

As the results of reviewing the literature, the main objective of this study is to compare and describe the effect of monetary and social incentives on participants' efforts during the course of the study. The specific objectives could be identified as follows;

- Objective 1: To compare and describe the effects of monetary and social incentives during the period when compensation is paid.
- Objective 2: To compare and describe the effects of monetary and social incentives at the end of the payment period.
- Objective 3: To compare and describe the effects of monetary and social incentives in the long term after the compensation was terminated.

Footnote:

[1] Chiang Mai province is in northern Thailand; population 1.7 million, area: 20,107 km², density: 83.93 km²

Methods

Study design

This study is based on information from the Participatory One Health Disease Detection project, or the PODD project conducted in the Chiang Mai province, the province where the pilot was conducted. Population in this study is 296 PODD volunteers, who participated in the project since 2015. The limiting condition of this study is the geographical structure where the province is mostly

mountainous (Fig 1). This limitation has an effect on the quality of the Internet signal. Moreover, there were a variety of livestock, population densities in different areas of the province. We could not use systematic sampling from all of the volunteers in the PODD project because of our limiting condition. In this study, we recruited 67 volunteers from 17 areas of the study area (3 to 5 volunteers per areas). All volunteers were residing in the central part of Chiang Mai province to reduce the impact of other difference factors, i.e. the variety of livestock, population densities, and the Internet signal, which is our limiting condition.

Procedures

For this study, participants were divided into two groups (Table 1). The first group was the experimental group, with 49 volunteers from 12 areas, who received a monthly transfer of 400 Baht^[2] (\$11.5). The transfer is included payment for a smartphone (\$54.5) and compensation for monthly calls and Internet charges. Whether they reported or not, this group of volunteers was still paid every month until the end of the payment period. The volunteers in this group were drawn to this study by monetary incentive and were reminded of the monthly compensation and other benefits they received. The second group was the control group, with 18 volunteers from 5 areas, who received no compensation (no monthly salary, smartphone, or compensation for calls and Internet charges). The volunteers in this group were drawn to this study without any monetary incentive. They were motivated to participate in this study by the social incentive, involving using their own smartphone and Internet package to install the PODD application and report.

Table 1
The number of reports per month according to group of volunteers

Group of volunteers	Number of volunteers	Reports per month			
		Period 1 ^a	Period 2 ^b	Period 3 ^c	Period 4 ^d
Experimental group: (Monetary Group)					
1	5	17	14	0	9
2	4	19	13	17	2
3	4	21	23	9	9
4	4	23	13	16	5
5	4	25	20	15	6
6	4	22	10	5	6
7	4	24	26	25	19
8	4	28	25	24	8
9	4	30	29	27	6
10	4	24	17	0	0
11	4	31	28	23	0
12	4	27	31	24	8
Control group: (Social Group)					
1	4	12	21	18	10
2	4	30	12	11	8
3	4	13	26	26	17
4	3	11	19	9	18
5	3	20	20	10	18
Sources: Computation and analysis from PODD volunteers report database Note :a Period 1 refer to the period of 5 months before the end of compensation b Period 2 refer to the period of 1 month after the end of compensation c Period 3 refer to the period of 5 months after the end of compensation d Period 4 refer to the period of 10 months after the end of compensation					

Both groups were informed of the benefits to society and trained by the PODD project with the same explanations regarding animal epidemics, the importance of reporting, and how to install and submit their report via smartphone applications. Their duty was to report both usual and unusual animal-related events in the communities for which they were responsible. Reports included taking photographs, sharing the location, and observing through the smartphone application. The type of the data on animal health abnormalities in this project was based on four categories of livestock; backyard chickens, pigs, dairy cattle, and beef cattle. They were trained by the project how to observe the basic symptoms of important epidemic diseases such as Newcastle disease in poultry, porcine reproductive and respiratory syndrome (PRRS) in pigs, and foot-and-mouth disease (FMD) in cattle. Under normal circumstances, they had to report a normal event to confirm that there were no unusual animal-related events in the area. For this reason, they had to report each day whether they had noticed any sign of animal diseases [7].

The only differences between the groups were recompensed in the form of monthly salary payment, and provided with a smartphone with free calls and Internet for the period of the study. We designed this study to answer three study questions based on our objectives. It could be identified as follows;

- Question 1 : During the period when compensation is paid, are the efforts of the volunteers in the monetary market group higher than those in the social market group?
- Question 2 : Do the volunteers' efforts in the monetary market group decrease at the end of the payment period, whereas the efforts of the volunteers in the social market group do not decrease over the same period of time?
- Question 3 : Do the volunteers in the monetary market group perform less well compare to the social market group in the long term after the compensation has ceased?

From question 1 in which demonstrates the effect of monetary incentives (compensation and smartphone with Internet) on volunteers in the monetary incentive group. We assume that the effort of the monetary group is higher than that of the social group. Then, question 2 demonstrates the comparison of the efforts of both groups for all periods of time. Our assumption concerning this question is that the effort of the social group does not change over time, whereas the monetary group's effort decreases once the compensation has ceased. Finally, question 3 reflects the effect of monetary incentives in the long term. Our assumption concerning this question is that there is a monetary incentive negative effect in the long term, which reduces the efforts of the monetary group. Moreover, this question demonstrates that when the monetary incentive is terminated, the volunteers will maintain their behaviour based on the monetary incentive or return to the social incentive.

Instruments

For the instruments of this study, the reporting data from both groups on the PODD application were recorded by the PODD automatic system, which was linked to the Department of Livestock and the local government. Each volunteer in both groups received their own ID to sign in on the PODD application.

Their reports were measured by the number of reports per month based on the areas for which they were responsible (Table 1). Moreover, as our study concerned the rate of occurrences. We calculated average reports per month by counting only whether a report was received, meaning that the variation of occurrences had no effect on the average reports per month. The maximum number of reports per month were 30-31, and the lowest number of report was zero. The available data that was collected from the project covered a period of two years from 2015-2016. Due to the fact that the social and monetary groups did not start participating in the project at the same time, this study used data collected after July 2015.

Statistical analysis

To analyse the data of this study, the outcome variable in this study is the number of report per month. The number of reports per month were reported as the mean, using repeated measurement ANOVA to test the significant interaction of treatment and time. The p -value was set at 0.05. The number of reports per month from each group were separated into four periods of time; Period 1 (five months before the end of the compensation), Period 2 (one month after the end of the compensation), Period 3 (five months after the end of the compensation), and Period 4 (10 months after the end of the compensation). The values at each single point of time were compared by t-test (paired analyses). The p -value was set at 0.05 to demonstrate the significant differences.

A number of questions were raised in relation to this study results. Question 1 was tested using t-test to compare the average report between the two groups in Period 1 (five months before the end of compensation). If the average report of the monetary group is higher than in the social group, our assumption is that the effort of the monetary group is higher than the social group is correct. Question 2 was tested using repeated measurement ANOVA. Our assumption is that the effort of the social group does not change over time while that of the monetary group decreases after the end of the compensation. Finally, question 3 was tested using t-test to compare the average report between the two groups in Period 4 (10 months after the end of compensation). If the result shows that there is statistical significance, we can conclude that it is correct to say that the effort of the monetary group is lower than the social group.

Footnote:

[2] 1 Bath equal to 0.028 USD or 0.026 EUR

Results

To obtain the result of this study, we tested the normality, correlated error, and homogeneity using the data from the four periods of time, the duration of each of which was a five-month interval. This data did not violate the assumption before analysis of repeated measurement ANOVA.

As shown in Fig. 2, Question 1 was tested using t-test to compare the report of the two groups in Period 1. The results indicated that the average reports of the monetary group were 24.146 reports per month, while

that of the social group were 17.32 reports per month (Table 2). During the time in which volunteers in the monetary group were paid, the monetary group's effort was significantly higher than that of the social group, the p -value, $p = 0.032$ (Table 2). Therefore, the first assumption was confirmed by these results.

Table 2
The t -test results comparing Social and Monetary group in the period 1 to 4

	Social group n = 5		Monetary group n = 12		t-test		
	Mean	SD	Mean	SD	t	df	p-value
Period 1	17.32	7.88	24.15	4.23	-2.36	15	.032*
Period 2	19.70	4.94	20.7	7.09	-.285	15	.779
Period 3	14.75	7.03	15.36	9.81	-.128	15	.900
Period 4	14.05	4.78	6.46	4.92	2.92	15	.011*
Source: Calculation							
* ($p < 0.05$)							

Then for question 2, it was tested using the RM ANOVA. The results indicate that the report of the monetary group was found to have a statistically significant decreasing trend, $F_{3,13} = 25.512$, $p < 0.001$ (Table 3). The descriptive statistics in Table 2 indicated the decreasing trend of the monetary group's report. Moreover, the results indicate that there were no significant differences of reporting effort in the social group throughout the experimental period, $F_{3,13} = 2.001$, the p -value, $p = 0.164$ (Table 3). The second assumption was therefore confirmed by these results.

Table 3
The repeated measurement ANOVA test between Social and Monetary group

Group		Value	F	p-value
Social Group	Pillai's trace	.316	2.001	.164
	Wilks' lambda	.684	2.001	.164
	Hotelling's trace	.462	2.001	.164
	Roy's largest root	.462	2.001	.164
Market Group	Pillai's trace	.855	25.512	.000**
	Wilks' lambda	.145	25.512	.000**
	Hotelling's trace	5.887	25.512	.000**
	Roy's largest root	5.887	25.512	.000**
Source: Calculation				
** ($p < 0.001$)				

Finally, question 3 was tested using the t-test to compare the reporting of the two groups in Period 4. The results indicated that after the compensation was terminated for 10 months, the monetary group had a significant lower reporting effort than the social group, the p -value, $p = 0.011$ (Table 2). The average of the reporting effort of monetary group was 6.458 times per month, while the result of the social group was 14.05 times per month (Table 2). Thus, the third assumption was also confirmed by these results.

Discussion

From this study we experienced that on-farm infectious animal diseases should be regarded as a major risk. It can cause financial losses and even insolvencies as well as spreading to other farms and the whole regions. With this background, this study focuses on the topic of motivation on animal health reporting in relation to the difference between monetary and social incentives (non-money). Data from the PODD project was used in this study. The initial results indicate that monetary incentive reduced the effort of the volunteers in the monetary group after the end of the payment period and in the long term. On the other hand, the social incentive can maintain the effort of the volunteers in the social group all periods of time in this study.

Monetary incentives are results successful means to increase effort when the payment is still in progress. The result from this study demonstrate that the monetary group had higher reporting efforts than the social groups during the payment period ($p < 0.05$). The level of reporting effort of the volunteers in the monetary market responded to the compensation they received. However, it was found that after the compensation was terminated, the reporting effort of the monetary group showed a decreasing trend ($p <$

0.001), whereas the social groups reported steadier efforts over time ($p = 0.164$). For all the periods, the effort of the monetary group tended to decline consistently. At the 10-months interval after the end of payment, the effort of the monetary group had dropped by 73% compared with the payment period ($p < 0.001$), which was 54% lower than in the social group ($p < 0.05$). This means that when volunteers were forced to enter the monetary market, they could no longer return to the social market, even if our time frame was 10 months while the social incentive was able to motivate the social group to produce reports during all periods of time without any compensation. Monetary incentive was not only reduced the effort of the monetary group in the long term, but also became an obstacle for their return to a subsequent social market relationship. The long-term negative impact of the monetary market was that, even if we want the volunteers to return to the social market, it is not easy to do so.

Under monetary markets, people lose their motivation when the compensation is not as much as their expectation. Using the Fiske's 1992 theory is equivalent to the changes in social relationships, whether CS, AR, or EM, into the MP relationship [14]. Under monetary market conditions, compensation can be compared to the effect of the wind on a sailing boat – the boat only sails as long as the wind is blowing [16]. The results demonstrate the difference volunteers behaviors in the monetary group compare to the standard labour model of economics. At the end of the compensation period, it was notable that the efforts of the monetary group did not vanish, which is the opposite of the economic standards prediction. The atmosphere of social activity may reduce the decline of efforts for a while, but eventually it was reduced by the impact of the monetary market. Moreover, after 10 months of compensation, the social groups had a higher report rate than the monetary groups. It does not align with the standard economics of labour model [10]. The results from this study show a different dimension for understanding human motivation which is different from the rationality of economic assumption. On the other hand, the result confirm that monetary incentives are more influential than social incentives. The social incentives cannot be used for a long time after money incentives are used [10, 15, 16].

Future more, our results suggest that the monetary markets are useful for motivating people in the short term. Using monetary incentives have the positive effect of increasing effort as long as there is still a compensation. At the same time it drives people to consider the costs and benefits of their effort, forcing them to think more about self-interest rather than social benefits while the volunteers in the social group work for their community without expecting any compensation in return. In summary, the study demonstrated that over time, volunteers were more motivated to work without payment compared with the situation when they receive money at the beginning and payment ceases later. It has been found that social incentives are more efficient than monetary incentives at least in a sustainable sense. It's not only they can motivate long-term efforts but also they remain at the lower cost. Nonetheless, the social markets are very sensitive and can easily be challenged by the monetary market. Likewise, the volunteers' motivation is quite steady in the long term. It is driven by using the social markets rather than the monetary markets in the participatory surveillance system. This allow the participatory surveillance system developer to understand the whole picture better, especially the part which plays by the incentives for participants and stakeholders.

The limitations of this study were the limitation of the Internet signal, variation of livestock which constrained this study design in the central part of Chiang Mai province. Moreover, it was a long term study of the actual project which involves studying the real situation. It involved handling lots of budget and the PODD project had to run the process on time. We could not find more samples to extend the sample size or use systematic sampling in this study. There are some challenges for future studies, such as differences in culture or geography as the tools for comparing the impact of the social and monetary markets. In this study we focus only on the number of report. Further studies could be extended to the study on quality of report in order to gain a greater understanding of the effect of monetary and social incentives on participatory surveillance systems.

Conclusions

This study indicated that in the long run of participatory disease surveillance, the social motivation was more efficient and sustainable than the monetary motivation. The volunteers who work without payment trend to maintain their willingness in the long-term period.

List Of Abbreviations

PODD = Participatory One Health Disease Detection project

CS = communal sharing

AR = authority ranking

EM = equality matching

MP = market pricing

ID = identification

Declarations

Ethics approval and consent to participate

This analyzed only the data on the number of reports about animal diseases in the community via smartphone application in the PODD animal surveillance system to indicate the effort between the two study areas (with monthly and no payment for reporting). The data are available in the PODD animal surveillance system.

The research planed included reviewing the number of report records via the PODD smartphone application of each study area under the compensation condition in 2015-2016. The number of reports per month in each area of study (not in personal report or detail report) and the condition of compensations in each area (with monthly and no payment for reporting) were used in this study. The

results of the research were reported as an average report in each area not in person. It did not effect on human or animal health in the study area.

This research involves minimal risk, as the number of reports about animal diseases in the community via smartphone application is for limited information. The information is not sensitive in nature, and the data are not derived from clinical procedures. There is an extremely low probability of harm to subjects' status, employment, or insurability. Contacting subjects to obtain their consent could be considered an invasion of privacy and cause subjects' undue anxiety.

The rights and welfare of the individual would not be adversely affected because the report and compensation condition were already completed, regardless of the research. None of the results of the research would affect the human or animal health because the results are analyzed after the fact.

The research could not be practicably carried out without a waiver. Identifying and contacting the subjects, although possible, would not be feasible for a review of their report information that would not change their perspective of compensation they would have already received.

It would not be appropriate to provide these subjects with information about the results of the research as the results have no effect on the subjects or animals. The number of reports and compensation have both been completed for these subjects. There is no anticipated benefit to subjects that would change what has already occurred.

Consent for publication

Not applicable

Availability of data and materials

All data generated and analyzed during the current study are available from PODD center, Chiang Mai University on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This study was supported by the Food Security Center of the University of Hohenheim [DAAD, 57160040]; University of Hohenheim, Stuttgart, Germany, and the SKOLL Global Threats Fund. The funding institutes had no role in the study design, data collection and statistical analysis, decision to publish, or the preparation of the manuscript.

Authors' contributions

TK: data management; conceptualization; methodology; data collection; economics analysis; writing original draft preparation. CS: data collection; interpretation; conceptualization. TY: data collection; interpretation; paper framework and scope, manuscript preparation. RD: interpretation; conceptualization; methodology; validation; supervision

Acknowledgements

This study is the output of a PhD scholarship. The authors would like to thank the Food Security Center of University of Hohenheim, which is part of the DAAD (German Academic Exchange Service), and the hosting institute of Computer Applications and Business Management in Agriculture (410 c), The department of Farm Management, University of Hohenheim for supporting the PhD scholarship, and also the Fiat Panis Foundation for supporting the research fund. Special thanks also go to the PODD project and the SKOLL Global Threats Fund for supporting the data collection process and for providing the data for this study.

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Figures

Figure 1

Study Area and Sample area in the Chiang Mai Province of Northern Thailand. Source: Own figure after Google map

Figure 2

The reporting effort of PODD Volunteers comparing between Social and Market group. In the long-term period, the Social group showed higher number of report than Market group.