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Source: Advanced Science Letters, Volume 24, Number 4, April 2018, pp. 2320-2323(4)

Publisher: American Scientific Publishers

DOI: <https://doi.org/10.1166/asl.2018.10944>

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Abstract

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Keywords: Agrochemicals; Paddy Farmers; Value of a Statistical Life (VSL)

Document Type: Research Article

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Publication date: April 1, 2018

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Advanced Science Letters
Vol. XXXXXXXXX

Value of A Statistical Life of Agrochemicals Use Paddy Farmers

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The research aims to investigate the value of a statistical life (VSL) of agrochemicals use paddy farmers in Chiang Mai. The VSL was analyzed from Willingness to Accept (WTA) results. The VSL empirical results of respondents who reduced 50% of chemical fertilizers use and increased 50% of organic fertilizers use was approximated 4.31 million Baht (USD 122,408.44) per household. For respondents who reduced 75% of chemical herbicides use and increased 25% of organic herbicides use was approximated 4.16 million Baht (USD 118,148.28) per household and respondents who reduced 25% of chemical insecticides use and increased 25% of organic insecticides use was approximated 5.09 million Baht (USD 144,561.24) per household. The VSL informs the invisible health cost of agrochemicals use paddy farmers therefore the policy makers should realize in this issue before promoting the agrochemicals reduction policy.

Keywords: Value of a statistical life (VSL), Agrochemicals, Paddy Farmers.

1. INTRODUCTION

Currently, use of chemicals in agriculture has continuously increased throughout the world. The agrochemicals excessive use are harmful effects on environment and human health [1]. Moreover, Hasan et al. (2015) mentioned that most of famers in developing countries use agrochemicals without well aware of poisoning effects and lacking enough safety measures [1]. Thailand is an agricultural country. Nowadays, the rice pattern of Thailand has changed from traditional to modern farming. Many farmers always apply agrochemicals in their farms for increasing productivity causing use of agrochemicals has increased. The agrochemicals use has not only successfully increased productivity however it has also significantly caused negatively environmental problems and has greatly affected on health of people especially farmers.

Agrochemicals directly causes problems to farmers' health. The 2010 annual report of surveillance presented the four-fold increase of pesticide poisoning rate of farmers in Chiang Mai province during 2008-2010 [2]. Although

there is no dead person, this record represented the health risk of agrochemicals used of farmers.

Thus, this research estimated the value of statistical life (VSL) of 220 agrochemicals use paddy farmers for reducing agrochemicals used in Chiang Mai province, Thailand.

2. LITERATURES REVIEW

Wilson (2005) studied the influent factors to VSL in Sri Lanka. The influent factors were frequent of chemicals use, income, education level, number of crops, type of chemicals and number of chemicals use land. And, evaluating farmers' valuation of agro-biodiversity on Hungarian small farms by applying Choice Experiment (CE) [3]. They used WTP to ask the respondents.

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There were 4 components of Hungarian's agrobiodiversity including richness of crop varieties and fruit trees, crop landraces, integrated crop and livestock production and soil micro-organism diversity. The results showed the variation in private values of home gardens and their attributes across household and regions, contributing to understanding the potential role of home gardens in the agri-environmental schemes [4].

In Thailand, the VSL researches always used WTP to evaluate the preferences. Opal (2000) studied the VSL of herbicide chemicals cabbage farmers in Chiang Mai by using cost of illness (COI), opportunity cost and spraying protected cost. Finding showed that VSL of integrated farming system farmers was 832.50 Baht/household and VSL of conventional farmers was approximately 1,292.40 Baht/household [5]. And, Agate (2004) evaluated the economic value of health in chemicals used vegetable farmers. He applied human capital concept and willingness to pay (WTP) in his study. The human capital and WTP result were approximated 1,326.37 Baht/year and 1,978 Baht/year, respectively [6]. Furthermore, Manussanun and Kanokwan (2012) also applied WTP to estimate VSL for pomelo farmers to reduce the probability risk from chemicals used in Phichit province. The WTP result indicated at 752.56 Baht/household and VSL was 17.87 million Baht/household [7].

3. METHODOLOGY

Value of A Statistical Life (VSL)

In term of economic concept, human body is one of production factors (human capital) because people use their body for earning income. Consequently, they get sick or death implying that the economic valuation of human capital is loss [2]. There are 2 methodologies to estimate human capital consists of human capital method and individual preference method.

1) Human Capital Method or Forgone Earning Approach. This method evaluates from their loss of future wage in case of sick or died and COI.

2) Individual Preference Method consisting of

2.1) Revealed Preference Technique (RP) This technique is used to evaluate non-market resources value by analyzing consumers' preferences to market resources attributes [5]. The techniques of RP are travel cost model (TCM) and hedonic price model (HP). However, the RP technique has the limitation, it is unable to analyze the non-use value of resources [6].

2.2) Stated Preference Technique (SP), this technique is developed to modify the limitation of RP. Contingent valuation method (CVM), hypothetical situation, is set for estimating both use and non-use resources including willingness to pay (WTP) and willingness to accept (WTA).

In this research, questionnaire was used to conduct data and using iterative bidding method to ask respondents. The WTA questions consisted of 3 main issues; 1) decrease of chemical fertilizers and increase of organic fertilizers, 2) decrease of chemical herbicides and increase of organic

herbicides and 3) decrease of chemical insecticides and increase of organic insecticides. WTA was analyzed from marginal willingness to accept (MWTa) in each attributes and MWTa was estimated from marginal rate of substitution (MRS) as shown:

$$MWTa_{ATT} = - \frac{\partial P}{\partial ATT}$$

Then, brought WTA results to analyze the value of a statistical life (VSL) and VSL model is followed:

$$VSL = \frac{\Delta WTA}{\Delta R}$$

where

VSL is Value of a statistical life

ΔWTA is Changing of willingness to accept in each attributes: before (WTA_0) and hypothetical situation (WTA_1)

ΔR is Changing of pesticide poisoning risk was 0.000019 (5.99 to 7.89 per hundred thousand population during 2008-2010)

4 EXPERIMENTAL RESULT

Table 1. shows WTA of paddy farmers in each attributes for example farmers will decrease 25% of chemical fertilizers use and increase 75% of organic fertilizers use if they receive 28.38 Baht per Rai and they will decrease 25% of chemical insecticides use and increase 75% of organic insecticides use if they receive 96.63 Baht per Rai.

Table.1. WILLINGNESS TO ACCEPT (WTA) OF PADDY FARMERS

ATTRIBUTES	WTA (Baht/Rai)
1. decreased 25% of chemical fertilizers and increased 75% of organic fertilizers (ORGF_75)	28.38
2. decreased 50% of chemical fertilizers and increased 50% of organic fertilizers (ORGF_50)	81.88
3. decreased 75% of chemical fertilizers and increased 25% of organic fertilizers (ORGF_25)	28.00
4. decreased 25% of chemical herbicides and increased 75% of organic herbicides (ORGH_75)	8.63
5. decreased 50% of chemical herbicides and increased 50% of organic herbicides (ORGH_50)	69.00
6. decreased 75% of chemical herbicides and increased 25% of organic herbicides (ORGH_25)	79.13
7. decreased 25% of chemical insecticides and increased 75% of organic insecticides (ORGI_75)	96.63

ATTRIBUTES	WTA (Baht/Rai)
8. decreased 50% of chemical insecticides and increased 50% of organic insecticides (ORGI_50)	69.00
9. decreased 75% of chemical insecticides and increased 25% of organic insecticides (ORGI_25)	95.00

Table 2. presents the VSL of rice farmers which the calculation of VSL as shown below:

Table.2. VALUE OF STATISTICAL LIFE (VSL) OF PADDY FARMERS

ATTRIBUTES	VSL(Baht/ Household)
1. decreased 25% of chemical fertilizers and increased 75% of organic fertilizers (ORGF_75)	1.48 million
2. decreased 50% of chemical fertilizers and increased 50% of organic fertilizers (ORGF_50)	4.31 million
3. decreased 75% of chemical fertilizers and increased 25% of organic fertilizers (ORGF_25)	1.47 million
4. decreased 25% of chemical herbicides and increased 75% of organic herbicides (ORGH_75)	4.54 hundred thousand
5. decreased 50% of chemical herbicides and increased 50% of organic herbicides (ORGH_50)	3.63 million
6. decreased 75% of chemical herbicides and increased 25% of organic herbicides (ORGH_25)	4.16 million
7. decreased 25% of chemical insecticides and increased 75% of organic insecticides (ORGI_75)	5.09 million
8. decreased 50% of chemical insecticides and increased 50% of organic insecticides (ORGI_50)	3.63 million
9. decreased 75% of chemical insecticides and increased 25% of organic insecticides (ORGI_25)	5.00 million

1. VSL of paddy farmers who decreased 25% of chemical fertilizers and increased 75% of organic fertilizers (ORGF_75)

$$= \frac{WTA_{i1} - WTA_{i0}}{\Delta R}$$

$$WTA_{i0} = 0, WTA_{i1} = 28.38$$

$$= \frac{[28.38 - 0]}{0.00019}$$

$$= 1,488,421.05$$

This implied that VSL of paddy farmers who decreased 25% of chemical fertilizers and increased 75% of organic fertilizers was approximated 1.49 million Baht/household.

2. VSL of paddy farmers who decreased 50% of chemical fertilizers and increased 50% of organic fertilizers (ORGF_50)

$$= \frac{WTA_{i1} - WTA_{i0}}{\Delta R}$$

$$WTA_{i0} = 0, WTA_{i1} = 81.88$$

$$= \frac{[81.88 - 0]}{0.00019}$$

$$= 4,309,473.68$$

This implied that VSL of paddy farmers who decreased 50% of chemical fertilizers and increased 50% of organic fertilizers was approximated 4.31 million Baht/household.

3. VSL of paddy farmers who decreased 75% of chemical fertilizers and increased 25% of organic fertilizers (ORGF_25)

$$= \frac{WTA_{i1} - WTA_{i0}}{\Delta R}$$

$$WTA_{i0} = 0, WTA_{i1} = 28.00$$

$$= \frac{[28.00 - 0]}{0.00019}$$

$$= 1,473,684.21$$

This implied that VSL of paddy farmers who decreased 75% of chemical fertilizers and increased 25% of organic fertilizers was approximated 1.47 million Baht/household.

4. VSL of paddy farmers who decreased 25% of chemical herbicides and increased 75% of organic herbicides (ORGF_75)

$$= \frac{WTA_{i1} - WTA_{i0}}{\Delta R}$$

$$WTA_{i0} = 0, WTA_{i1} = 8.63$$

$$= \frac{[8.63 - 0]}{0.00019}$$

$$= 454,210.53$$

This implied that VSL of paddy farmers who decreased 25% of chemical herbicides and increased 75% of organic herbicides was approximated 4.54 hundred thousand Baht/household.

5. VSL of paddy farmers who decreased 50% of chemical herbicides and increased 50% of organic herbicides (ORGF_50)

$$= \frac{WTA_{i1} - WTA_{i0}}{\Delta R}$$

$$WTA_{i0} = 0, WTA_{i1} = 69.00$$

$$= \frac{[69.00 - 0]}{0.00019}$$

$$= 3,631,578.95$$

This implied that VSL of paddy farmers who decreased 50% of chemical herbicides and increased 50% of organic herbicides was approximated 3.63 million Baht/household.

6. VSL of paddy farmers who decreased 75% of chemical herbicides and increased 25% of organic herbicides (ORGF_25)

$$= \frac{WTA_{i1} - WTA_{i0}}{\Delta R}$$

$$\begin{aligned}
 WTA_0 &= 0, WTA_1 = 79.13 \\
 &= \frac{[79.13 - 0]}{0.00019} \\
 &= 4,164,736.84
 \end{aligned}$$

This implied that VSL of paddy farmers who decreased 75% of chemical herbicides and increased 25% of organic herbicides was approximated 4.16 million Baht/household.

7. VSL of paddy farmers who decreased 25% of chemical insecticides and increased 75% of organic insecticides (ORGF 75)

$$\begin{aligned}
 &= \frac{[WTA_1 - WTA_0]}{\Delta R} \\
 WTA_0 &= 0, WTA_1 = 96.63 \\
 &= \frac{[96.63 - 0]}{0.00019} \\
 &= 5,085,789.47
 \end{aligned}$$

This implied that VSL of paddy farmers who decreased 25% of chemical insecticides and increased 75% of organic insecticides was approximated 5.09 million Baht/household.

8. VSL of paddy farmers who decreased 50% of chemical insecticides and increased 50% of organic insecticides (ORGF 50)

$$\begin{aligned}
 &= \frac{[WTA_1 - WTA_0]}{\Delta R} \\
 WTA_0 &= 0, WTA_1 = 69.00 \\
 &= \frac{[69.00 - 0]}{0.00019} \\
 &= 3,631,578.95
 \end{aligned}$$

This implied that VSL of paddy farmers who decreased 50% of chemical insecticides and increased 50% of organic insecticides was approximated 3.63 million Baht/household.

9. VSL of paddy farmers who decreased 75% of chemical insecticides and increased 25% of organic insecticides (ORGF 25)

$$\begin{aligned}
 &= \frac{[WTA_1 - WTA_0]}{\Delta R} \\
 WTA_0 &= 0, WTA_1 = 95.00 \\
 &= \frac{[95.00 - 0]}{0.00019} \\
 &= 5,000,000
 \end{aligned}$$

This implied that VSL of paddy farmers who decreased 75% of chemical insecticides and increased 25% of organic insecticides was approximated 5.00 million Baht/household.

5. CONCLUSIONS

This VSL research targeted to 3 main issues; 1) decrease of chemical fertilizers and increase of organic fertilizers, 2) decrease of chemical herbicides and increase of organic herbicides and 3) decrease of chemical insecticides and increase of organic insecticides. The valuation of each attributes were presented such as VSL of paddy farmers who decreased 50% of chemical fertilizers and increased 50% of organic fertilizers was approximated 4.31 million Baht/household, VSL of farmers who decreased 75% of chemical herbicides and increased 25% of organic herbicides was approximated 4.16 million Baht/household and the VSL of farmers who decreased 25% of chemical insecticides and increased 75% of organic insecticides was approximated 5.09 million Baht/household.

The VSL implied the invisible health cost of agricultural chemicals use. Therefore, paddy farmers should realize in this issue before using agricultural chemicals in farms for better health and environment.

ACKNOWLEDGMENTS

The authors would like to acknowledge deeply to office of agricultural research and extension, Maejo University for funding this research project.

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