Willingness to Pay Farmers on Turmeric Extract to Reduce Health Impacts Due to Pesticide

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ABSTRACT

Pesticide exposure has been shown to cause various diseases such as acute neurotoxicity, cardiovascular disease, cancer, allergies and nervous disorders. Economic assessment of the health costs of using pesticides is necessary to design effective policies and reduce poisoning in farming populations The herbal medicines used have the efficacy of preventing and treating chronic non-communicable diseases. The most widely consumed herbal medicine is turmeric. This study aimed to analyze the willingness to pay value of turmeric extract and the factors that influence the willingness to pay of turmeric extract. All shallot farmers have turmeric extract WTP as a herbal medicine to reduce the risk of pesticide poisoning. The average WTP of turmeric extract reaches IDR 625,777 per year.

Key word: willingness to pay; turmeric extract; pesticide; extract; medicine.

INTRODUCTION

Excessive use of pesticides has a negative impact on the environment and human health. Pesticide exposure has been shown to cause various diseases such as acute neurotoxicity, cardiovascular disease, cancer, allergies and nervous disorders. Declining farmer health can have a significant negative health impact on agricultural production. Pesticide poisoning has become a major health risk in developing countries and the chronic long-term effects of exposure to pesticides have not been widely recognized and documented. (Wang et al. 2018). Economic assessment of the health costs of using pesticides is necessary to design policies that are effective and reduce poisoning in rural populations. Farmers often do not think about medical expenses for diseases caused by exposure to pesticides. Farmers also do not consider intangible costs such as inconvenience, pain and suffering as part of their daily routine work (Wang et al. 2018).

The use of herbal medicines has grown and gained popularity globally over the last decades. Based on this, the World Health Organization (WHO) has developed general guidelines on research methods and evaluation of traditional medicines (biopharmaceutical products) to maintain safety, efficacy and quality control. WHO recommends biopharmaceutical products for health care, prevention and treatment of diseases, especially chronic, degenerative and cancer (WHO 2013).

The results of a 2019 study on workers in Thailand stated that workers with chronic non-communicable diseases such as diabetes, liver disease, cancer, dyslipidemia were users of herbal medicines with a percentage of 32.6%. The herbal medicines used have the efficacy of preventing and treating chronic non-communicable diseases. The most widely consumed herbal medicine is turmeric (Kanjanahattakij et al. 2019). Turmeric (Curcuma longa L) is used as food coloring and traditional medicine. Curcumin is an active compound in turmeric rhizome (Venigalla et al. 2016). Curcumin is a natural polyphenol compound that is useful as an anti-inflammatory, antioxidant, anti-tumor, immunomodulator, and neuroprotector (Daverey and Agrawal 2016). Curcumin is an antioxidant that can clean up free radicals (Eren et al. 2019).

Willingness to pay/WTP for cost reduction the health of pesticide use has been carried out in the United States and the European Union (Bazoche et al. 2014). The results of a 2014 study in South Africa showed that urban and rural residents are WTP against herbal medicines for non-communicable diseases because herbal medicines do not have side effects thereby reducing health care costs (Hughes et al. 2022).

RESEARCH METHODS

The research location is in Brebes Regency, Central Java Province. Location determination considers shallot production levels, namely high, medium and low. A total of three sub-districts namely Brebes, Jatibarang and Wanasari sub-districts were selected from 12 sub-districts. The sampling technique used is purposive sampling. There are 135 farmers living in the Districts of Brebes, Wanasari and Jatibarang. The research was conducted from October 2020 to December 2020. The independent variables of this study were farm income, education, number of family members, home ownership status, perceptions of pesticide risk and cholinesterase activity. The independent variable was the farmer's WTP in reducing the health impact. The value of the WTP proposed to farmers starts at IDR 50,000 (Charan and Biswas 2013).

Data Collection

Data collection was carried out through interviews and distribution of questionnaires to farmers in Brebes, Wanasari and Jatibarang sub-districts. Interviews were conducted face to face with farmers.

Validity and Reliability Test

To obtain the validity and reliability of the analysis results, a valid and reliable research questionnaire is needed. The research questionnaire needs to be tested for validity and reliability before data collection is carried out. This has been done by distributing the questionnaire to 135 respondents. The validity test shows the extent to which a measuring device (indicator) can measure the variable you want to measure. If the loading factor value ≥0.60, then an indicator can be said to be valid. The reliability test was carried out to determine the extent to which a measurement result is relatively consistent when done repeatedly. The measurement of a variable is said to be reliable if it has a Cronbach value $\alpha \geq 0.60$ (Shiroiwa et al. 2013).

Contingent valuation method (CVM)

CVM method for assessing WTP of turmeric extract in shallot farmers in Brebes, Wanasari and Jatibarang Districts. The stages of WTP analysis using CVM analysis consist of five steps:

A. Build a mortgage market Farmers were given information about health maintenance due to exposure to pesticides by consuming turmeric extract supplements regularly. Explanation of the antioxidant mechanism of curcumin in turmeric extract which can increase cholinesterase activity based on the theory and results of experimental research by researchers. Farmers are expected to have an overview of the mortgage market after getting information from researchers. This is done so that farmers can determine the amount of money they are willing to pay. The information delivery stage is as follows:

a. Incidence of pesticide poisoning in Indonesia Pesticide poisoning in Indonesia.

b. Characteristics of pesticide poisoning Symptoms of moderate to severe poisoning include headache, blurred vision, nausea, cough, muscle weakness, dizziness, fatigue, dry throat, joint pain and skin irritation (Sapbamrer and Nata 2014).

c. Benefits of turmeric extract Turmeric extract contains curcumin which can prevent poisoning (Farkhondeh et al. 2016). Turmeric extract is also useful as a neuroprotective, antitumor, antioxidant, anticancer, anti-inflammatory, radioprotective, antinephrotoxicity, anti-antimicrobial infection, antiviral, hepatoprotective and antimalarial (Amalraj et al. 2017).

Obtain the value of the WTP offer

The farmer's WTP value is obtained using the bidding game method, carried out by asking respondents whether they are willing to pay IDR 50,000 as the initial price offered. The question

posed is "For example, turmeric extract costs IDR 50,000 for a bottle containing 50 capsules consumed by one person for one month, are you willing to pay for this product? If the answer is "yes", the next price will be increased by 5% up to the agreed level. The price returns to the initial price if the answer is "no" (Shono et al. 2014).

Calculating the estimated value of the average WTP

Estimation of the average WTP value of turmeric extract is calculated based on data on the distribution of WTP farmers. The results of calculating the average WTP for each District of Brebes, **Wanasari, Jatibarang in one month.**

Determining the Total WTP

The total WTP value of turmeric extract is obtained from multiplying the average WTP of turmeric extract by the number of farmers.

Variables

Independent variables WTP of turmeric extract of farmers in Brebes, Wanasari and Jatibarang districts is the independent variable in this study. WTP levels of turmeric extract at five prices: IDR 50,000; IDR 52,500; IDR 55,000; IDR 57,500; IDR 60,000.

Table 1. Dependent variable

Variabel Name	Category	Symbol
Farming income	1= Rp<2,461,000; 2 = Rp2,461,000 - Rp3,699,000; 3 = Rp3,700,000 - Rp4,939,000; 4 = Rp>4,939,000	FI
Last education	Completed elementary school = 1; Completed junior high school = 2; Graduated from high school= 3; College graduated = 4	LE
Number of family members	NFM 2 people = 1; NFM 3 people = 2; NFM 4 people = 3; NFM > 4 people = 4	NFM
Perception of pesticide risk	I think my health is affected by exposure to pesticides	PPR_1
	I consider myself more at risk of exposure to pesticides than other people	PPR_2
	I don't worry about my future	PPR_3
	I will participate in activities to reduce the impact of pesticides on health.	PPR_4
	Pesticides are useful for improving crop quality and harvest	PPR_5
Cholinesterase activity	Normal = 1; Abnormal = 2	CHO

Modified from Remoundou *et al.* (2015) *Sci Tot Env*. 505: 1082–1092.

Data Analysis

The research data was analyzed with the R Studio Desktop 2022.02.0+ application software. The data analysis method used in this study is descriptive analysis, Contingent Valuation Method (CVM), analysis of the effect of independent variables on the WTP of turmeric extract.

RESULT AND DISCUSSION
Descriptive Analysis of WTP Class of Turmeric Extract

Table 2. Percentage of WTP of turmeric extract for each district

WTP Class	Jatibarang	Wanasari	Brebes
1 : IDR 50,000	53,33	60	68,89
2 : IDR 52,500	8,89	13,34	11,11
3 : IDR 55,000	15,56	20	8,89
4 : IDR 57,500	11,11	2,22	4,44
5 : IDR 60,000	11,11	4,44	6,67
Total	**100,00**	**100,00**	**100,00**

Source: data processing

Table 2 shows the percentage of WTP of turmeric extract in each district. In the WTP category, turmeric extract is less than IDR 50,000, which has the highest WTP percentage of turmeric extract. The WTP percentage of turmeric extract in Jatibarang District was 53.33%, the percentage of WTP turmeric extract in Wanasari District was 60%, and the WTP percentage of turmeric extract in Brebes District was 68.89%.

Table 3. The coefficient of estimation of the probit model for the WTP value of turmeric extract in Jatibarang, Wanasari and Brebes

Variable	Coeffisient estimation	z-scores
Farming income	0,112***	-1,359
Education	-0,011	-0,375
Number of family numbers	0,125***	3,933
Pesticide risk perception	0,147***	2,920
Cholinesterase activity	0,137***	2,664
Intercept	-2,315	12,976

*** Significant at p <0,01. Source: data processing

Based on Table 3, it can be seen that the variables that have a significant effect on the WTP of turmeric extract in Jatibarang, Wanasari, and Brebes Districts are farm income, number of family members, perceptions of pesticide risk and cholinesterase activity. This significance can be seen from the p-value <0.01. It can be concluded that if there is an increase in farming income, the WTP value of turmeric extract will increase. When the number of family members increases and the perceived risk of pesticides increases, the WTP value of turmeric extract increases. If the cholinesterase activity is lower, it will increase the WTP value of the turmeric extract.

The results of the analysis show that farm income has an influence on the WTP of turmeric extract. The results of this research are consistent with empirical findings in previous research. Demand for the health benefits of herbal medicines increases along with farm income (Hughes et al. 2022). Farmers with high farming income are able to pay a higher WTP compared to farmers with lower farming income (Khan and Damalas 2015). The variable number of farmer family members has a significant effect on WTP. The results of this study indicate that farmers with larger families have a higher WTP compared to farmers with fewer families because larger families have higher awareness of the risk of pesticide poisoning (Wang et al. 2018). Farmers' perceptions of pesticide risk regarding the impact of pesticide exposure on health showed positive and significant results. It can be concluded that farmers with higher perceptions of pesticide risk will have a higher WTP to reduce the risk of pesticide poisoning. Based on the research results of Khan and Damalas (2015), it can be concluded that farmers who have a high perceived pesticide risk have a higher WTP than farmers

with a perceived pesticide risk. Farmers with low cholinesterase activity had a higher WTP than farmers with high cholinesterase activity.

CONCLUSION

All shallot farmers have turmeric extract WTP as a herbal medicine to reduce the risk of pesticide poisoning. The average WTP of turmeric extract reaches IDR 625,777 per year. All farmers are willing to pay WTP for turmeric extract to reduce the risk of pesticide poisoning. The total WTP value of turmeric extract is IDR 2,380,000 per month.

REFERENCES

Amalraj A, Pius A, Gopi S, Gopi S. 2017. Biological activities of curcuminoids, other biomolecules from turmeric and their derivatives – A review. *J Traditional Compl Med.* 7(2):205–233. doi:10.1016/j.jtcme.2016.05.005.

Bazoche P, Combris P, Giraud-Héraud E, Seabra-Pinto A, Bunte F, Tsakiridou E. 2014. Willingness to pay for pesticide reduction in the EU: Nothing but organic? E*uropean Rev Agric Econ*. 41(1):87–109. doi:10.1093/jbt011.

Charan J, Biswas T. 2013. How to calculate sample size for different study designsin medical research? *Indian J Psycholog Med*. 35(2): 121–126. doi:10.4103/0253-7176.116232.

Daverey A, Agrawal SK. 2016. Curcumin alleviates oxidative stress and mitochondrial dysfunction in astrocytes. *Neuroscience*.1(2):92–103. doi:10.1016/ j.neuroscience.2016.07.012.

Eren B, Di Nç N, Selçuk AY, Kefeli Oğlu H. 2019. Ameliorative and protective effect of antioxidant curcumin against chlorpyrifos induced chromosome aberrations. *Biharean Biol*. 13(2):110–113.

Farkhondeh T, Samarghandian S, Samini F. 2016. Antidotal effects of curcumin against neurotoxic agents: An updated review. *Asian Pac J of Trop Med*. 9(10): 947–953. doi:10.1016/j.apjtm.2016.07.027.

Hughes GD, Aboyade OM, Okonji OC, Clark B, Bawa WA, Xavier C, Rasu RS. 2022. Cost of traditional herbal medicines for noncommunicable diseases inrural and urban communities in South Africa. *Value Health Reg Iss.* 29: 66–75. doi:10.1016/j.vhri.2021.08.006.

Kanjanahattakij N, Kwankhao P, Vathesatogkit P, Thongmung N, Gleebbua Y, Sritara P, Kitiyakara C. 2019. Herbal or traditional medicine consumption ina Thai worker population: pattern of use and therapeutic control in chronic diseases. *BMC Comp Alt Med*.19:(1): 1–9. doi:10.1186/s12906-019-2652-z.

Khan M, Damalas CA. 2015. Farmers' willingness to pay for less health risks by pesticide use : A case study from the cotton belt of Punjab, Pakistan. *Sci Tot Environ.* 10(1):520–531. doi:10.1016/j.scitotenv.2015.05.110.

Remoundou K, Brennan M, Sacchettini G, Panzone L, Butler-ellis MC, Capri E, Charistou A, Chaideftou E, Gerritsen-ebben MG, Machera K, Spanoghe P, Glass R, Marchis A, Doanngoc K, Hart A, Frewer LJ. 2015. Science of the Total Environment Perceptions of pesticides exposure risks by operators , workers , residents and bystanders in Greece , Italy and the UK. *Sci Tot Env*.505: 1082–1092. doi:10.1016/j.scitotenv.2014.10.099.

Sapbamrer R, Nata S. 2014. Health symptoms related to pesticide exposure and agricultural tasks among rice farmers from northern Thailand. *Environ Health Prev Med*. 19(1): 12–20. doi:10.1007/s12199-013-0349-3.

Shiroiwa T, Igarashi A, Fukuda T, Ikeda S. 2013. WTP for a QALY and health states: more money for severer health states?. *Cost Effect Res Alloc*. 11(22):1-7. doi:10.1186/1478-7547-11-22.

Shono A, Kondo M, Ohmae H, Okubo I. 2014. Willingness to pay for public health services in rural Central Java, Indonesia: Methodological considerations when using the contingent valuation method. *Soc Sci Med*. 110: 31–40. doi:10.1016/j.socscimed.2014.03.025.

Venigalla M, Sonego S, Gyengesi E, Sharman MJ, Münch G. 2016. Novel promising therapeutics against chronic neuroinflammation and neurodegeneration in Alzheimer's disease. *Neurochem Int.* 95:63–74. doi:10.1016/j.neuint.2015.10.011.

Wang W, Jin J, He R, Gong H, Tian Y. 2018. Farmers' willingness to pay for health risk reductions of pesticide use in China : a contingent valuation study.*Int J Environ Res Publ Health.* 625(15):2-10. doi:10.3390/ijerph15040625.

[WHO]World Health Organization. 2013. *WHO Traditional Medicine Strategy 2014-2023*. Edisi Tahun 2013. Geneva: WHO Pr.