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Master's Thesis of Science in Agriculture

**Can Livestock Farmers Overcome Barriers of
Improving Productivity through Urea-Molasses Block?
Evidence from Lao PDR**

라오스 축산 농가의 당밀요소블록에 대한
구매 의향과 결정요인 및 투자 가능성 연구

August 2020

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**Can Livestock Farmers Overcome Barriers of Improving Productivity
through Urea-Molasses Block?**

Evidence from Lao PDR

A thesis
submitted in partial fulfillment of the requirements to the faculty
of Graduate School of International Agricultural Technology
for the Degree of Master of Science in Agriculture

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Abstract

Can Livestock Farmers Overcome Barriers of Improving Productivity through Urea-Molasses Block? Evidence from Lao PDR¹

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In Lao PDR, smallholders who raise less than 10 cattle rely mostly on natural grassland grazing, which is not enough to fatten cattle. Also, the price of cattle is set low because the eyes of the middleman determine its worth. As a result, most livestock farmers make a minimal investment in cattle breeding. To overcome low productivity, the Lao government is trying to transform smallholders into commercial farms, which require appropriate intervention. Urea-Molasses Block (UMB) supplements can be an effective way to redress

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nutrient deficiency in low-quality roughage under the semi-intensive system, which is the traditional agricultural practice of smallholders' cattle production. Therefore, the purpose of this study is to grasp whether farmers are willing to invest in UMB as an input to fatten cattle in the early stages of transition to commercial farms in the survey area and what factors affect willingness to pay (WTP). This study performed a household survey with a total of randomly selected 258 farmers living in six villages in two districts of the Vientiane Capital, Lao PDR. We find that farmers who have a high level of education or who agree to the explained positive effect of UMB show high WTP. Especially, Parkngum district shows that male farmers, smallholders, consent to the effect of UMB and, the experience that was providing feed in the dry season and purchasing feed have a significant impact on WTP. The average WTP for UMB shows that in the early stages of the transition to commercial farms, farmers in the survey area are willing to pay up to USD 5.7 to improve productivity.

keywords: Contingent Valuation, Double-Bounded Dichotomous Choice, Willingness to Pay, Urea-Molasses Block, Cattle production, Lao PDR

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List of Abbreviations

CVM	Contingent Valuation Method
DAFO	District of Agricultural and Forestry Office
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
LAK	Lao Kip
Lao PDR	Lao People's Democratic Republic
LCA	Lao Census of Agriculture
MFB	Mineral Feed Block
NSEDP	National Socio-Economic Development Plan
NUOL	National University of Laos
UMB	Urea-Molasses Block
WTP	Willingness to Pay

1. Introduction

1.1 Background

Lao PDR (commonly known as Laos) is a small landlocked country located in the heart of the Greater Mekong Sub-region. Although about 65.2 percent of the labor force has engaged in agriculture, it contributes about 17.3 percent to the agricultural sector in total GDP due to inefficient farm productivity. Although the Lao government has tried to change in commercial-scale farms in 2016, 1.88 million smallholders still produce 98 percent of total agricultural output (Napasirth, P., & Napasirth, V., 2018). A smallholder raising large ruminants in Laos can define a farmer who raises fewer than 10 cattle or buffalo (Matsumoto et al., 2016). This situation can also explain why farmers experience difficulties in transitioning from conventional ways to modern technology in Laos (Ministry of Planning and Investment, 2016).

There are mostly three different farming systems in cattle production, as follows; extensive, semi-intensive, and intensive. First, the extensive system is a year-round grazing system where cattle graze freely in forests or communal land and do not need extra input, such as night shelter or salt supply. The system has the least role for farmers, and they care cattle only in emergencies. Second is the semi-intensive system, in which smallholders of Laos mainly produce

cattle. During the day, it is usually allowed to roam for food on its own, such as native grass, which grows by the roadside, and in the evening, water with salt is used to entice them home. Taking into account poor conditions that do not meet the nutritional requirements of cattle, farmers make limited investments, including rice straw, agricultural by-products, and salt, but this is far from enough to gain weight for cattle. Finally, the intensive system is the primary production system of commercial farming. The producer directly supplies water and finely chopped forage to the cattle in the cage. It is well known for its cutting and carrying systems (Matsumoto, N. et al., 2017; Nampanya, S. et al., 2014).

Currently, the Lao government has been making efforts to transform smallholders from semi-intensive to an intensive system to increase cattle production. Accordingly, in the 8th Five-Year National Socio-Economic Development Plan (NSED), which is announced every five years, the Lao government has presented three goals to increase productivity in the agricultural sector, especially in the livestock sector: First, transforming natural livestock to farming to generate cattle up to 30 percent of the total production, making it a sustainable source of income that reduces the poverty of rural people; Second, improving cattle breeds so that more cattle for commercial purposes can be produced for sufficient supply and export in Laos; Finally, to encourage commercial farmers, increasing the amount of fodder and feed

products to be used in the production of livestock feed (Government of Laos, 2015).

The production of beef in Laos is facing significant challenges such as feed intake with low nutritional value and the irregular feed supply by season (Bush et al., 2014). In addition to being used as a source of food protein and as draught animals, ruminants are considered essential assets available in emergencies as a safety net, so smallholders are more livestock keepers than producers (Napasirth et al., 2018). According to the Laos Census of Agriculture (LCA) between 2010 and 2011, 79 percent of farmers with livestock depend heavily on natural grazing, with 51 percent of smallholders giving rice straws as livestock feed (Makkar et al., 2007). It shows that the current stage of cattle production by smallholders is a semi-intensive system where they depend on natural grazing during the day, there is minimal or no additional feed input at all for cattle (Matsumoto, N. et al., 2017).

Previous studies deal with several problems that hinder productivity, including lack of land, poor animal husbandry skills, inadequate agricultural extension services, and an unstable market for smallholders (Nampanya et al., 2017). One of the factors affecting the low input-output system is that the price of the cattle is determined by the eyes of the middlemen and, not by weight (Nampanya et al., 2014). Given this situation, the corresponding expected return rate is reduced, so we can understand why smallholders in Laos keep its

investment in cattle to a minimum.

In the process of transition to an intensive livestock production system, there are various ways to increase the productivity of cattle in Laos, including technology, resources, and farmer's investment. Among them, we want to see the possibility of overcoming limited productivity based on the investment of farmers and selected UMB as one of the investment.

UMB has a positive relationship with productivity, and even with income in tropical countries such as Thailand and Vietnam (Wongnen, N., 2007; Duc Vu et al., 1999). A few studies cover the effect of UMB, but there are no studies on farmers' willingness to pay (WTP). Additionally, most of the countries in the tropical regions have difficulty in supplying sufficient nutrient diet of ruminants mainly from nature pasture and crop residues during the dry season (Makkar et al., 2007). Despite efforts from many international organizations and academia, dissemination of the UMB seems to be slow. Some studies insist that sustainable use for UMB is hampered by a variety of restrictions, cost, and unavailability of molasses in the area, lack of farmer's awareness, and extension services (Upadhyay, 2018; Lestari, 2016).

1.2 Purpose of Study

The purpose of this study is to clarify the current status and potential of smallholders' investment through their willingness to pay for UMB, a feed supplement for cattle, and to understand the factors that influence their WTP for UMB and what this means in the stage of transitioning to commercial farms.

Studies on factors affecting WTP for feed inputs, including Urea-Molasses Block, are also scanty in Southeast Asia. As a result, this research could contribute to understanding the role and potential of farmer's investment in the early stages of inducing commercial farming from the semi-intensive system, which is the current production stage of smallholders.

This paper is organized as follows. First of all, the current status of cattle production in Laos will be explained, focusing on smallholders. Second, the Urea-Molasses Block and its effect on cattle will be discussed. Third, theoretical studies and estimation results will be presented. Finally, implications based on results will be suggested to understand the investment intentions and possibilities of smallholders' potential at the initial stage of being a commercial farm.

2. Review of Literature

2.1 Current Status of Cattle Production in Lao PDR

The size of the herd in Laos has grown at an average annual rate of 5 percent from 1.52 million in 2010-2011 to 1.81 million in 2014-2015, and this growth is rapidly increasing the yearly demand for livestock products by 3.5 to 4 percent, leading to the expansion of the country's livestock production. Through this, livestock production can now be seen as one of the fastest-growing agricultural sectors in Laos.

The large ruminants in Laos are categorized by cattle and buffalo. As of 2017, the number of cattle and buffalo is about 1.9 million and 1.2 million, respectively, indicating that the head of cattle is nearly 1.5 times higher than that of buffalo. Besides, about 1.5 million heads of cattle are raised in the central region of the country, including Vientiane Capital, more than double the number in the southern and northern regions. Looking at the value of livestock production in Laos, the value of sales for large ruminants is USD 1.4 billion, about 70 percent higher than chickens, pigs, and goats so that we can confirm the importance of large ruminants in the current agriculture status in Laos.

Smallholders account for about 98 percent of cattle production in 2016, despite government efforts to transform smallholders into commercial farms. Here, smallholders can be defined as farmers who raise about 5 to 10 cattle, and

as of 2012, smallholders account for about 86 percent of them (Napasirth, P., & Napasirth, V., 2018).

The purpose of raising large ruminants is primarily to use as a means of storing wealth and selling it as meat and utilize it as a source of fertilizer for cropping. Also, they are farmers with an average of fewer than 10 cattle, serving as livestock keepers rather than producers (Nampanya, S. et al., 2014; Matsumoto, N. et al., 2017; Otte, J et al., 2008).

To improve large ruminant production, smallholders have to overcome many constraints, including feed deficiency in the dry season and endemic diseases such as foot and mouth disease (FMD), widely acknowledged as the main limitation for efficient and sustainable livestock production (Nampanya, S. et al., 2016). Bush, R. D. et al. (2014) showed that significant dependency on fibrous feed, including rice straw, especially during dry seasons, is far short of meeting minimum nutritional requirements such as nitrogen, minerals, and vitamins to maintain or increase weight. Besides, during the rainy season, only natural grasslands in certain permitted areas far from the rice paddies are edible, resulting in restrictions on feed intake (P. Napasirth et al., 2018).

In addition to the problems of the production system, limited market access is also one of the significant issues facing smallholders. Livestock farmers have low price bargaining power because there is no cattle market in Laos, and the price of cattle is determined by the visual assessment of

intermediate traders rather than by accurate weight measurements with weighing scale (Nampanya, S. et al., 2014). This situation supports the understanding of the current low input-output system in which smallholders naturally invest less in cattle breeding, taking into account the benefits they can get through investment. Moreover, Otte, J et al. (2008) studied that smallholders choose to sell to intermediate traders to avoid paying for logistics and transportation costs.

As for improving cattle productivity in developing countries, it usually emphasizes the need for inputs such as vaccines and forage systems (Millar et al., 2010). However, our study seeks to find out the potential of farmers' investment through UMB among many ways to increase productivity.

2.2. Urea-Molasses Block

The Urea-Molasses Block (UMB) is a licking block and an excellent supplementary feed that helps rumen microbial growth and ultimately help animals utilize poor quality fibrous feed, increasing feed conversion efficiency and productivity. Significant positive effects of UMB mentioned from prior studies (Makkar, H. et al, 2007; Mengistu et al., 2017) are rumen microbial growth, feed intake, digestibility, body weight gain, growth rate and milk production (1-1.5 kg/day). Further, it can support the necessity of its use as a

supplement to ruminants, including cattle.

Each ingredient of UMB plays an essential role in ruminants. Urea is the cheapest non-protein-nitrogen source used mainly to compensate for nitrogen deficiency in fibrous feed ingested by ruminants and helps improving digestibility, intake, and nutrient availability by optimizing rumen fermentation (Mengistu et al., 2017; Upadhyay et al., 2018; Windsor et al., 2018). Urea, commonly used as fertilizer, can be digested as a substance that forms ammonia in the rumen, but if consumed too much, it is highly toxic and at risk of sudden death. As a result, they created hard blocks to safely supply it, allowing ruminants not to chew at once and consume adequate amounts by licking blocks (Makkar et al., 2007). In short, the urea supplies protein and helps to increase the digestibility. Molasses is a source of readily fermentable carbohydrates and is a binder, which makes the block more palatable. Although UMB has advantages such as accessibility of the ingredients with minimum but essential nutrients, a reasonable price for farmers is a crucial component for sustainable use of UMB (Misra et al. 2008).

Windsor, P. A. et al. (2018) found that there is a positive relationship between productivity and medicated UMB in Laos even though there is no research on the increased rate of weight after UMB intake and on cost-benefit. Upadhyay et al. (2018) examined that in Nepal, average milk production is significantly higher in UMB treated cows compared to non-treated cows.

Suharyono et al. (2014) showed that there was a positive relationship between UMB and income in Indonesia. In Both Thailand and Vietnam, feed block with urea increased the rice straw intake, enhanced digestibility of nutrients, and improved feed value of the rice straw-based diets (Anantasook, N et al., 2014; Duc Vu, D. et al., 1999). The case of tropical countries with similar climates to Laos proves that the use and effectiveness of UMB is necessary in the process of moving to an intensive cattle production system in Laos.

2.3. Definition of Smallholders' Investment and Types of Constraints

FAO (2013) defined investment as a means to increase productivity, which in turn can be seen as the core of the transformation of agriculture that leads smallholder farmers to commercial farming. They are motivated to invest in agriculture to improve their performance if the following three minimum conditions are met. The first is whether the diversified assets can be accessed without reducing family consumption below the threshold level. Second, a safe environment should be created that provides the expectation of improvement in the technical and economic performance of the farm. Third, enjoying the benefits of improved living conditions concerning the use of public or private services, thinking that living in rural areas from agriculture or more diversified livelihoods is a viable option.

It classified the types of constraints on smallholders' investment as follows: asset, market, and institutional constraints. Assets are one of the key factors promoting investment because they can determine income and formatting capital. Their quantity and nature also affect the type of investment that smallholders can most easily participate in. The market decides how new investments can generate additional revenue and provides opportunities. Price stability, proximity, accessibility to promising markets, and bargaining power among various market agents are crucial to allowing smallholders to invest. For example, market uncertainty creates risk-averse behavior for smallholders that face both high variability and revenue constraints in an uncertain environment. In institutional types, gender, class, agricultural structure, racial discrimination, and property rights can all be factors addressed. They interact in complex ways, resulting in reinforced or contradicting characteristics.

3. Theory

Contingent valuation method (CVM) is the most widely used economic valuation method to estimate consumer's willingness to pay (WTP) for a good or service (Kabyanga et al., 2018). The CV approach derives from the value of a specified product by presenting respondents with a description of a hypothetical scenario and requires their WTP under positive changes. This method is used to compare the credibility of WTP estimates derived from the study (Zapata et al., 2014).

The CV method is mainly used in environmental economics, especially in estimating "passive-use" values, which consumers do not experience directly or that are assigned to new areas (Cawley, J, 2008). Ciriacy-Wantrup raised the idea of creating a virtual market in a survey and asking people to find the potential value of public goods where market prices do not exist (Hanemann, W. M., 2011). The lawsuit over the 1989 Exxon Valdez disaster led both Alaska and Exxon states to conduct CV studies on damaged environmental assets and to determine whether CV research is accurate and useful in general. Although the block as a supplement for cattle exported from Thailand is exchanged in regular markets in Laos, it is not widespread. As a result, UMB may symbolize hypothetical good for many smallholders.

In general, there are various ways to derive WTP using the contingent

valuation, such as open-ended questions, payment cards, and dichotomous choice questions (A. Lopez, 2012). This study designed a questionnaire using dichotomous choice questions. However, even if the actual willingness to pay is higher than the proposed amount, we only know the information and range based on a bid amount as a threshold. That is why single dichotomous choice question itself has limitations in understanding the WTP range. Besides, a relatively large sample is required to obtain an accurate estimation of WTP.

As a result, an alternative method to improve the efficiency of the estimate is the dichotomous question with a follow-up or double-bounded model. Hanemann (1985) and Carson first proposed this method and implemented it by Carson, Hanemann, and Mitchell. The double-bounded dichotomous choice questions provide a range closer to the actual WTP that was not observed by respondents while raising the lower limit and lowering the upper limit within the scope of a single choice. Hanemann et al. (1991) also say that by making the confidence interval tighter, it increases efficiency and accuracy.

According to previous findings (Hanemann et al., 2011), the response to the double-bounded CV questions give four possible discrete results (D): (1) the household was not willing to purchase UMB even at the half-price ("no," "no" to both bids); (2) the household was not willing to buy UMB at the initial price, but was willing to buy as the half-price ("no," "yes"); (3) the household was willing to purchase UMB at the initial price but not the double-price ("yes,"

"no"); or (4) the household was willing to purchase UMB at both the initial price and double-price ("yes," "yes"). The double-bounded model enables us to place the household's WTP into one of four intervals: $(-\infty, B_H)$, (B_H, B_I) , (B_I, B_D) , $(B_D, +\infty)$ where $B_H, B_I,$ and B_D are half, initial and double bids, respectively, represented as

$$D = \begin{cases} WTP < B_H & (\text{No, No}) \\ B_H \leq WTP < B_I & (\text{No, Yes}) \\ B_I \leq WTP < B_D & (\text{Yes, No}) \\ B_D \leq WTP & (\text{Yes, Yes}) \end{cases} \quad (1)$$

The utility that respondents feel for a particular item based on a given monetary income and individual characteristics is expressed as an indirect utility as follows: $v(j, y; s)$ where y and s represent income and personal characteristics, respectively. However, equation (2) below is the utility function that takes into account unobservable aspects when selecting or rejecting changes in the level of particular goods supply.

If the respondent answers “yes” to the question “Are you willing to pay A to improve the quality of the targeted goods?” the utility function is as shown in (3). This means that the benefits of implementing a project will be greater, despite a decrease in income than the utility enjoyed before it was implemented. X is the stochastic variable for stereotyping the distribution of utility gaps, and j indicates whether the quality of goods improves or not.

$$u(1, y - A; s) \geq u(0, y; s)$$

$$= v(1, y - A; s) + \varepsilon_1 \geq v(0, y; s) + \varepsilon_0 \quad (3)$$

$$\Delta v = v(1, y - A; s) - v(0, y - A; s) \geq \varepsilon_0 - \varepsilon_1 = X$$

Each respondent would increase the effectiveness of the individual by answering “yes” if the increase in indirect utility (Δv) was positive and agreeing to pay the proposed amount. Therefore, the probability that the respondent would say “yes” is the same as below where $F_X(\cdot)$ is the cumulative distribution function of stochastic variable X .

$$\Pr(\text{Yes}) = \Pr(\Delta v \geq X) = G_B(A) \quad (4)$$

However, if the respondent answered “yes” to the willingness to pay question, it means that stochastic variable, amount B , is: $\Pr(\text{Yes}) = \Pr(A \leq B) = 1 - G_B(A)$ where $G_B(\cdot)$ is the cumulative distribution function of the stochastic variable B , and A is also the suggested bid.

4. Empirical Approach

The contingent valuation was used to determine the WTP according to the characteristics of the households, including income and current status of inputs for cattle. We tested a double-bounded contingent valuation model with STATA 16 (Statacorp, 2019), which is a commonly used method, following the maximum likelihood estimator (Lopez-Feldman, 2012).

This paper uses the double Bound CV model, which asks the survey respondents successive questions that gradually narrow the WTP range to increase statistical efficiency. Hanneman et al. (1991) argued that this method is asymptotically more efficient than a single question. A simple, mathematical model shows the WTP as a function of explanatory variables and an error term for household i :

$$WTP_{iv}(z_{iv}, \alpha_v, u_{iv}) = \mathbf{z}'_{iv} \boldsymbol{\beta} + \alpha_v + u_{iv} \quad (1)$$

In equation (1), the formula to derive WTP is linear and simply $\widetilde{\mathbf{z}}'_i \widetilde{\boldsymbol{\beta}}$, where \mathbf{z}_{iv} is a vector of explanatory variables, $\boldsymbol{\beta}$ is a vector of parameters estimated by the maximum likelihood estimator, α_v is a village-fixed effect taking into account unobserved village-invariant factors and u_{iv} is an error term. By estimating $\boldsymbol{\beta}$, we can estimate the WTP depending on the values that we give to vector \mathbf{z}_{iv} . Finding explanatory variables that make up vector \mathbf{z} is a

meaningful output of modeling CV that takes into account the purpose of understanding WTP determinants of smallholders for the UMB (Campbell, Z et al., 2019).

Lopez (2012) suggested that the information derived directly from individual i is simply a dichotomous answer ($Y_i=0$ if the individual answers no and $Y_i=1$ if the answer is yes), given the question on paying a previously presented amount (t^i is random amounts shown by individuals). This research classifies consumer responses into four types. The first type of response is "Yes/No," which the researcher answered yes to the first question ($y_i^1 =1$) and no to the second question ($y_i^2=0$). The probability of an individual answering yes to the first question and no to the second question can be expressed as $\Pr(y_i^1 = 1, y_i^2 = 0 | \mathbf{z}_{iv})$ or $\Pr(s,n)$ omitting the fact that the probability is conditional on the value of the explanatory variable. Its probability model is as follows with the assumption that $WTP_{iv}(\mathbf{z}_{iv}, \alpha_v, u_{iv}) = \mathbf{z}'_{iv}\boldsymbol{\beta} + \alpha_v + u_{iv}$.

$$\begin{aligned}
\Pr(s,n) &= \Pr(t^1 \leq WTP < t^2) \\
&= \Pr(t^1 \leq \mathbf{z}'_{iv}\boldsymbol{\beta} + \alpha_v + u_{iv} < t^2) \\
&= \Pr\left(\frac{t^1 - \mathbf{z}'_{iv}\boldsymbol{\beta} - \alpha_v}{\sigma} \leq \frac{u_{iv}}{\sigma} < \frac{t^2 - \mathbf{z}'_{iv}\boldsymbol{\beta} - \alpha_v}{\sigma}\right) \quad (2) \\
&= \Phi\left(\frac{t^2 - \mathbf{z}'_{iv}\boldsymbol{\beta} - \alpha_v}{\sigma}\right) - \Phi\left(\frac{t^1 - \mathbf{z}'_{iv}\boldsymbol{\beta} - \alpha_v}{\sigma}\right)
\end{aligned}$$

$$= \Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^1}{\sigma}) - \Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma})$$

$\Pr(s,n)$ shows the probability that survey participants will accept the first offer and reject the next one. t^1 and t^2 indicate the amounts proposed for the first and second proposals, respectively. Equation (2) uses the symmetry of the normal distribution, and the last expression of equation (2) follows from $\Pr(a \leq X \leq b) = F(b) - F(a)$.

The second type of response is "Yes/Yes," which the researcher answered yes to both the first question ($y_i^1 = 1$) and the second question ($y_i^2 = 1$). Its probability model can be described based on Bayes' theorem, which says that $\Pr(A, B) = \Pr(A|B) * \Pr(B)$.

$$\begin{aligned} \Pr(s,s) &= \Pr(WTP > t^1, WTP \geq t^2) \\ &= \Pr(\mathbf{z}'_{iv}\boldsymbol{\beta} + \alpha_v + u_{iv} > t^1, \mathbf{z}'_{iv}\boldsymbol{\beta} + \alpha_v + u_{iv} \geq t^2) \\ &= \Pr(\mathbf{z}'_{iv}\boldsymbol{\beta} + \alpha_v + u_{iv} > t^1 | \mathbf{z}'_{iv}\boldsymbol{\beta} + \alpha_v + u_{iv} \geq t^2) * \Pr(\mathbf{z}'_{iv}\boldsymbol{\beta} + \alpha_v + u_{iv} \geq t^2) \quad (3) \\ &= \Pr(u_i \geq t^2 - \mathbf{z}'_i \boldsymbol{\beta} - \alpha_v) = 1 - \Phi\left(\frac{t^2 - \mathbf{z}'_i \boldsymbol{\beta} - \alpha_v}{\sigma}\right) \\ &= \Phi\left(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma}\right) \end{aligned}$$

The third type of response is "No/Yes," which the researcher answered no to the first question ($y_i^1 = 0$) and yes to the second question ($y_i^2 = 1$). Its probability model is as follows:

$$\begin{aligned}
\Pr(n,s) &= \Pr(t^2 \leq WTP < t^1) \\
&= \Pr(t^2 \leq \mathbf{z}'_i \boldsymbol{\beta} + \alpha_v + u_{iv} < t^1) \\
&= \Pr\left(\frac{t^2 - \mathbf{z}'_i \boldsymbol{\beta} - \alpha_v}{\sigma} \leq \frac{u_i}{\sigma} < \frac{t^1 - \mathbf{z}'_i \boldsymbol{\beta} - \alpha_v}{\sigma}\right) \\
&= \Phi\left(\frac{t^1 - \mathbf{z}'_i \boldsymbol{\beta} - \alpha_v}{\sigma}\right) - \Phi\left(\frac{t^2 - \mathbf{z}'_i \boldsymbol{\beta} - \alpha_v}{\sigma}\right) \\
&= \Phi\left(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma}\right) - \Phi\left(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^1}{\sigma}\right)
\end{aligned} \tag{4}$$

Finally, the fourth type of response is "No/No," which the researcher answered no to both the first question ($y_i^1 = 0$) and the second question ($y_i^2 = 1$). Its probability model is as follows:

$$\begin{aligned}
\Pr(n,n) &= \Pr(WTP < t^1, WTP < t^2) \\
&= \Pr(\mathbf{z}'_i \boldsymbol{\beta} + \alpha_v + u_{iv} < t^2) \\
&= \Phi\left(\frac{t^2 - \mathbf{z}'_i \boldsymbol{\beta} - \alpha_v}{\sigma}\right) \\
&= 1 - \Phi\left(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma}\right)
\end{aligned} \tag{5}$$

Using equations (2) to (5), the author derives the likelihood function for WTP estimation, and the function is:

$$\begin{aligned}
&\sum_{i=1}^N [d_i^{sn} \ln(\Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^1}{\sigma}) - \Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma})) + d_i^{ss} \ln(\Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma})) \\
&+ d_i^{ns} \ln(\Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma}) - \Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^1}{\sigma})) + d_i^{nn} \ln(1 - \Phi(\mathbf{z}'_i \frac{\boldsymbol{\beta}}{\sigma} + \frac{\alpha_v}{\sigma} - \frac{t^2}{\sigma}))]
\end{aligned}$$

where d_i^{sn} , d_i^{ss} , d_i^{ns} , d_i^{nn} are indicator variables that represent the values of survey response. By maximizing the function, we can directly obtain $\hat{\beta}$ and $\hat{\sigma}$ to estimate WTP.

The reason why a CV is used in this study is to find people's WTP for non-market products. The UMB, which was created by the National University of Laos and Seoul National University, is considered as a non-market market good because it is a 'potential' marketed product that is not yet on the market.

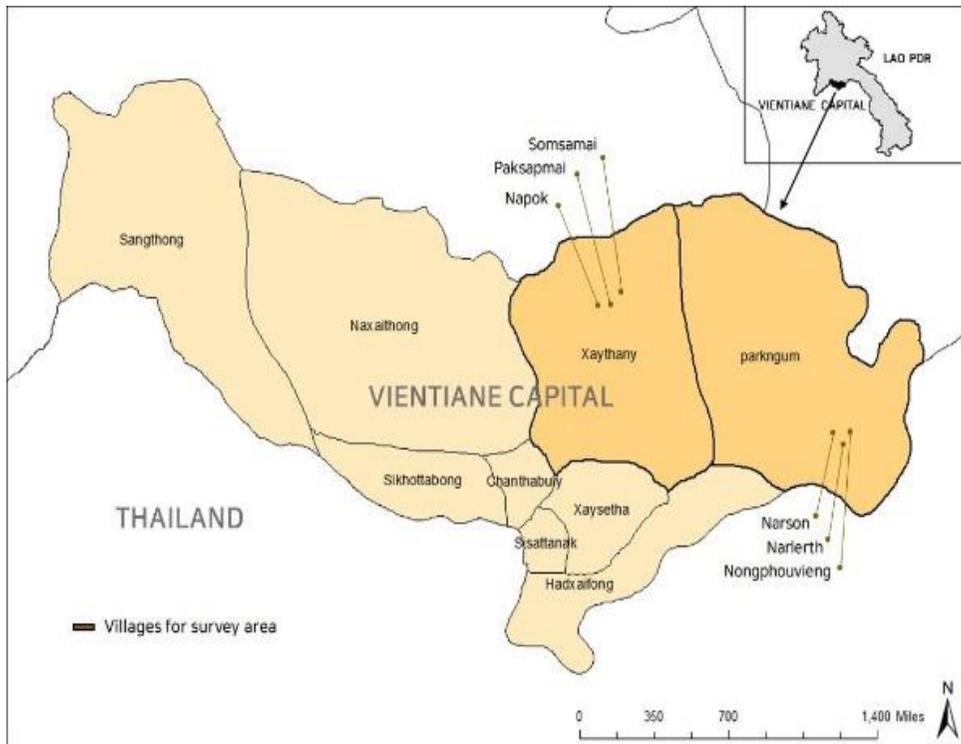
5. Data and Procedure

5.1. Research Area

Our research was conducted twice in January, and June 2019 in cooperation with professors and students from the Faculty of Agriculture, National University of Laos (NUOL), and the questionnaire was translated into the Lao language. The survey area has six villages in the Vientiane Capital (Xaythany and Parkngum district), as shown in Figure 1.

Vientiane Capital, one of the centers of raising 56 percent of Lao Cattle in the province unit, was chosen as the survey area (P. Napisirth et al., 2018). On the village level, village leaders and staff of the District of Agricultural and Forestry Office (DAFO) selected randomly the households who raise cattle. Accordingly, 103 households were selected in the Xaythany district, and 155 in the Parkngum district and a total of 258 households participated in our survey.

Figure 1. Map of Study Area in Lao PDR



The three villages of the Xaythany district have common characteristics. More than 80 percent of all residents are engaged in agriculture, including livestock. The Napok village has difficulties in agricultural activities during the dry season due to lack of irrigation facilities, and it is directly linked to the issue of the daily water requirements for cattle when grazing. The Somsamai village mainly consists of Hmong people, one of the minority tribes in Laos, and engage in agriculture for self-sufficiency. The Paksapmai village is located near the Faculty of Agriculture, the National University of Laos, which has more agricultural benefits than other villages.

In the three villages of the Parkngum district, more than 93 percent of all residents are engaged in agriculture. Both Narlerth and Nong Phou Vieng village are also struggling with the dry season due to lack of irrigation, while Narson village has irrigation facilities to use in the dry season. The rate of raising cattle in each village is 29 percent, 22 percent, and 17 percent, respectively, in the villages of Narlerth, Nong Phou Vieng and Narson.

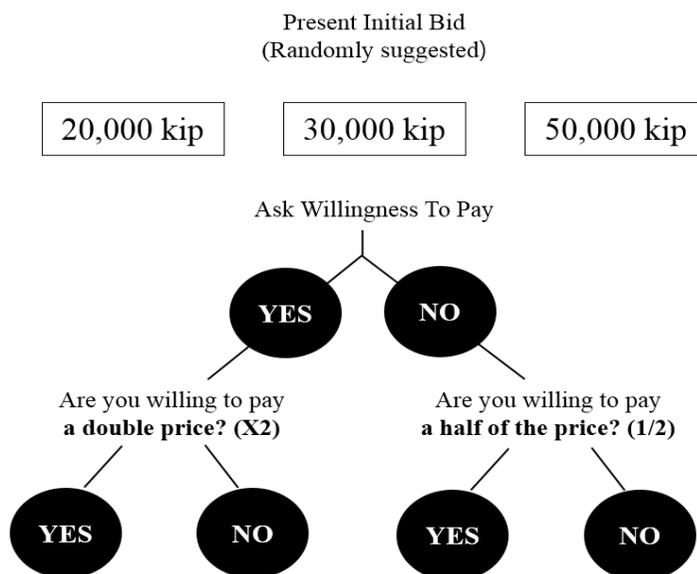
5.2. Survey Procedure

The survey is designed to assess potential factors of UMB adoption and WTP. Before the survey was conducted on respondents who agreed to participate, we gave explanations to help them understand what UMB is and its effects in virtual scenarios (Appendix 1).

The first section of the survey questionnaire includes questions to help us identify the status of raising cattle in Laos and understand cattle owner's perception of feed inputs, including UMB. The second part of the survey consists of double-bounded dichotomous choice questions asking respondents representing a household if they are willing to pay UMB at randomly suggested bids; 20,000, 30,000, and 50,000 LAK equal to USD 2.2, 3.3, and 5.6 respectively, with the amount set through the preliminary survey. The amount of the second bid increased (double price) or decreased (half price) depending

on the respondents' answer to the initial bid amount, as shown in figure 2. For example, if the respondent answered that they had no intention of purchasing UMB with the 20,000 LAK as the first bid, the second question would ask if they were willing to pay UMB with 10,000 LAK, half amount of the first bid.

Figure 2. Description of Bid Amounts in the WTP Activity



Although the questionnaire surveyed in January included basic knowledge of UMB and willingness to pay for it, it was difficult to understand the current system of feed inputs for smallholders in Laos. To make up for this, in addition to grazing on native grasslands during dry or wet seasons, we added questions such as whether feed was provided or purchased.

Our survey was conducted with verbal consent on the use of both results

of the survey and personal information from farmers aged 19 years or older who are raising cattle. It took about 20 to 25 minutes with the help of seven surveyors of the Faculty of Agriculture, National University of Laos, and we thanked the respondents for taking their time by offering refreshments.

5.3. Descriptive Statistics

Table 1 presents the descriptive statistics of the full 258 samples, of which 155 samples additionally address questions about the current situation of raising cattle in Laos. About 24 percent of farmers have heard about UMB. Besides, 91 percent of them have agreed with its effect after explaining the overview of UMB. Only 1.2 percent of them have purchased UMB during both the dry and wet season and a few times a year.

Of the total of 255 farmers interviewed in this study, they received an average of 6 years of education, which means that they graduated from elementary school at least. About 52 percent of them are female, and their average age is in mid-thirties. Also, 60 percent of them are household heads, and about 65 percent of them have an average annual income of more than or equal to 9 million LAK (USD 1,016). The total sum of non-agricultural activities and livestock account for 66 percent of total income. As for the total expenditure of inputs, 71 percent of them spent less than 500,000 LAK (USD

56) per year for cattle.

Furthermore, the respondent farmers own an average of 11 cattle, and about 60 percent of them are smallholders who raise less than 10 cattle. As referring to the data in 2017 from Ministry of Agriculture and Forestry, the semi-intensive production system of smallholders raised by natural grazing accounted for 60 percent of the total and closed extensive grazing systems that set up grassland areas or raise the cattle within the common grassland accounted for 30 percent of the total, with the remaining 10 percent being commercial farms in 2017. Therefore, it is possible to understand the livestock production system of the remaining 40 percent except for smallholders.

The information about raising cattle in Laos is as follows: The experience of providing feed to cattle was investigated by classifying them into the dry and wet season to see if farmers consider the seasonal changes of grass intake. The dry season is from November to April, while the wet season is from May to October. 92 percent of them are mainly dependent on native grassland for raising cattle, and there are difficulties in the use of grassland by season. In dry seasons, native grass does not grow well, and the energy required to eat fresh grass every day is much bigger than the energy available from grass intake. Therefore, it is necessary to supply feed other than native grass. On the other hand, there is another problem with the consumption of grass compared to the dry season, as the range of grass intake to protect rice paddies from cattle is

limited during the wet season. About 72 percent of them have provided feed other than native grass in the dry season, while about 77 percent of them have provided feed such as salt, rice straw, and hay in the wet season.

Besides, 32 percent of them purchased processed feed, while the rest of them gave their cattle rice straw, banana leaves, and cassava pulps, which are by-products of agricultural activities, instead of feed. Of them, 61 percent were raising the cattle for sale, while the rest for sale and self-consumption purposes. It reflects the shift in the purpose of cattle breeding from self-sufficiency to commerce. Also, 77 percent of them have sold an average of five cattle over the past three years, with the average price of 260,000 LAK (USD 29) and the average cattle being 30 months old when sold.

Table 1. Descriptive Statistics

Variables	Category	N ¹	Mean (SD)	Min	Max
<i>Dependent variable</i>					
Response to the first bid	Dummy	258	33.0 (12.4)	20	50
Response to the second bid	Dummy	258	51.4 (27.5)	10	100
<i>Independent variable</i>					
Ever heard about UMB (=1)	Dummy	258	0.2 (0.4)	0	1
Ever agreed about UMB (=1)	Dummy	258	0.9 (0.3)	0	1
Ever purchased UMB (=1)	Dummy	258	0.1 (0.3)	0	1
The highest level of formal education of farmers (years ²)	Continuous	258	6.0 (4.4)	0	16
Gender (1=Female)	Dummy	258	0.5 (0.5)	0	1
Household head (=1)	Dummy	258	0.6 (0.5)	0	1
Age ³	Continuous	258	3.4 (1.3)	1	5
Income per year ⁴	Continuous	258	5.8 (1.9)	1	7
Total expenditure on inputs for cattle per year ⁵	Continuous	258	1.6 (1.2)	1	6
Total number of cattle (head)	Continuous	258	11.1 (8.1)	1	50
Smallholders who raise the cattle less than 10 heads (=1)	Dummy	258	0.6 (0.5)	0	1
Ever provided feed in the dry season (=1)	Dummy	155	0.7 (0.5)	0	1
Ever provided feed in the wet season (=1)	Dummy	155	0.8 (0.4)	0	1
Ever purchased feed (=1)	Dummy	155	0.3 (0.5)	0	1
Whether or not to free grazing (=1)	Dummy	155	0.9 (0.3)	0	1
Purpose of raising cattle for sale (=1)	Dummy	155	0.6 (0.5)	0	1
Purpose of raising cattle for self-consumption (=1)	Dummy	155	0.0 (0.0)	0	1
Purpose of raising cattle for both sale and self-consumption (=1)	Dummy	155	0.4 (0.5)	0	1
Ever Sold the cattle during the last 3 years (=1)	Dummy	155	0.8 (0.4)	0	1
- If yes, Number of cattle being sold during the last 3 years	Continuous	120	4.9 (3.7)	1	20
- Price of cattle being sold during the last 3 years (10,000 LAK ⁶)	Continuous	120	26.1 (73.9)	70	500
- Month of cattle being sold during the last 3 years	Continuous	120	30.0 (19.7)	9	156

Notes:¹103 data were collected in January, and 155 data were in July 2019. 120 data were the number of people who answered yes to the question of whether they ever sold the cattle during the last 3 years.

²Primary school = 5 years; Secondary school = 7 years; University = 3 - 4 years

³1= 20s; 2= 30s; 3= 40s; 4= 50s; 5= more than or equal to 60s

⁴1= less than 1,500,000 LAK; 2= 1,500,000≤<3,000,000; 3= 3,000,000≤<4,500,000; 4= 4,500,000≤<6,000,000; 5= 6,000,000≤<7,500,000; 6= 7,500,000≤<9,000,000; 7= more than or equal to 9,000,000 LAK

⁵1= less than 500,000 LAK; 2= 500,000≤<800,000; 3= 800,000≤<1,100,000; 4= 1,100,000≤<1,400,000; 5=1,400,000≤<1,700,000; 6= more than or equal to 1,700,000 LAK

⁶LAK is the currency of Lao PDR and about 8,924 LAK = 1 USD

6. Results and Discussion

6.1 Response from the bid

The essential aspect to consider when using contingent valuation is whether an individual has responded reasonably to the bid amount. In other words, the higher the bid amount, the fewer respondents are expected to give positive answers, as shown in Table 2-a. It shows that there is a positive relationship between the probability of accepting bids and the initial bid amount. Table 2-b shows that in the 40,000 LAK range, respondents with relatively high initial bids are more likely to accept bids than respondents with relatively low initial bids.

Table 2-a. Response from the First Bid (N=258)

First Bid	No	Yes	Total
20,000	8 (9.0)	80 (91.0)	88 (100.0)
30,000	21 (23.9)	67 (76.1)	88 (100.0)
50,000	34 (41.5)	48 (58.5)	82 (100.0)
Total	63 (24.4)	195 (75.6)	258 (100.0)

Note: Figures in parentheses are percentages

Table 2-b. Response from the Second Bid (N=258)

Second Bid	No	Yes	Total
10,000	3 (37.5)	5 (62.5)	8 (100.0)
15,000	8 (38.1)	13 (61.9)	21 (100.0)
25,000	12 (35.3)	22 (64.7)	34 (100.0)
40,000	36 (45.0)	44 (55.0)	80 (100.0)
60,000	38 (56.7)	29 (43.3)	67 (100.0)
100,000	43 (89.6)	5 (10.4)	48 (100.0)
Total	140 (54.3)	118 (45.7)	258 (100.0)

Note: Figures in parentheses are percentages

6.2. Estimation Results

Table 3 presents the estimation results. The maximum likelihood provides the parameter estimates, and the WTP formula is a linear function of the vector of explanatory variables multiplied by the vector of estimated parameters. Total data is estimated with village fixed effect and all variables used from common questionnaires in both the survey period. Moreover, the difference in the period of the survey can also be seen as the difference of district level, since we surveyed Xaythany district in January and Parkngum district in July 2019.

Overall, willingness to pay for UMB is positively affected by the following factors under both Total and Xaythany district in Table 3: ever agreed about the explained effect of UMB by surveyor; years of receiving education. The person who agreed with the described effects of UMB is positively related to their willingness to pay, which means that the more they agree on the effects of UMB, the more likely they are to pay for UMB. Because the farmers heard explanations about UMB's virtual scenarios, they were able to better understand UMB itself and its function and effects. Therefore, it could increase farmers' willingness to pay for UMB, contributing to alleviating their uncertainty over new agricultural technologies

A high level of education is positively related to willingness to pay. The reason for this is assumed to be that the new technology was perceived as challenging to understand and required potential buyers to develop new skills

and understanding, indicating that higher-level farmers were more willing to buy UMB (Supaporn et al., 2013).

Table 3. Results from the Double-Bounded Dichotomous Choice by District

Variables	Total	Xaythany	Parkngum
Heard_UMB	3.609 (4.928)	-4.954 (6.728)	5.595 (6.293)
Agree_UMB	23.698*** (6.101)	31.026*** (8.627)	19.597** (7.731)
Purchased_UMB	3.366 (6.211)	-1.388 (7.992)	-3.344 (9.465)
Edu_years	0.960** (0.464)	1.780** (0.541)	-0.566 (0.703)
Female	-2.917 (4.391)	8.831 (5.504)	-12.562** (6.045)
Head of HH	2.999 (4.577)	-0.603 (6.114)	3.848 (6.384)
Age	1.197 (1.770)	2.511 (2.196)	-0.351 (2.554)
Income / year	1.279 (0.986)	0.083 (1.249)	1.392 (1.500)
Exp_input / year	1.096 (1.545)	0.470 (1.897)	0.121 (2.242)
No. of raising cattle	-0.232 (0.329)	0.105 (0.408)	-0.810* (0.464)
Smallholders	0.108 (5.506)	2.782 (6.438)	-7.007 (7.859)
Provide_feed_dry			13.808*** (5.305)
Provide_feed_wet			-2.543 (6.337)
Purchased_feed			18.164*** (5.967)
Free grazing			5.549 (8.873)
Purpose_sale			-14.605 (29.878)
Purpose_both			1.028 (30.177)
Sold_cattle			-0.895 (5.740)
V_Napok	5.493 (6.283)	7.381 (7.449)	
V_Somsamai	4.598 (6.370)	5.383 (8.183)	

V_Paksapmai	-10.336		
	8.503		
V_Nalerth	3.252		1.836
	(6.026)		(6.426)
V_Nong Phou Vieng	4.309		-0.201
	(5.857)		(6.173)
Constant	24.294***	19.639***	22.796***
	(1.588)	(2.052)	(1.99)
Log likelihood	-284.131	-102.547	-158.334
N	258	103	155

Note: *10% significance level, **5% significance level, ***1% significance level.
 Figures in parentheses are standard errors. V_Narson is omitted.

As shown in the Parkngum district of Table 3, it added seven survey questions for complementing the first survey to understand better the situation for raising cattle in Laos. The farmers' willingness to pay for UMB is also positively affected by the following variables: ever agreed with the described effect of UMB; ever provided the feed in the dry season; ever purchased the UMB. The variable indicating consent to the UMB effect shows significant results with directions similar to both Total and Xaythany district in Table 3. Moreover, the farmers who provided feed during the dry season for their cattle that did not get enough nutrition are more willing to buy UMB than others who do not. This finding shows that although they do not spend money, those who have invested their time and resources for cattle tend to invest more for them. Besides, it implies that the farmers recognize that nutrition is not enough for the dry season through native grasslands and give additional feed. Farmers who buy feed for cattle are more willing to pay UMB than those who do not. Naturally, the WTP is higher than those who do not because they recognize the

need for investment to increase productivity.

On the other hand, farmers' willingness to pay for UMB is negatively affected by the following variables: gender and the number of raising cattle. One of the main findings is that men have higher WTP than women, which is thought to affect the negative or unfamiliar attitude toward the UMB itself as female farmers lack relatively information on UMB or feed types. As the number of raising cattle increases, they are less likely to pay UMB. Finally, the estimates with the village fixed effect cannot show significant values up.

Table 4 shows the results of using the double-bounded dichotomous choice by the village. In the case of Paksapmai village of the Xaythany district, 16 small samples were omitted in the process of estimating results through STATA. Whether to agree to the effects of UMB as described by the surveyor has a positive effect on WTP. As the education level is high, they are more likely to pay UMB in the Napok and Somsamai village of Xaythany district. For gender, women living in Napok village have significantly higher WTP than other villages, and men in Narlerth village show higher WTP than others. In the case of Napok village, the smallholders are willing to pay UMB, but the opposite results were shown in the Narlerth village.

One of the significant findings from Table 4 is Narlerth villagers' willingness to pay for UMB is positively affected by variables such as income per year and expenditure for inputs per year. These results can explain that the

farmer who can afford to buy some feed other than natural grass or ever invested something for their cattle is more likely to pay UMB as a feed. Lastly, the smaller the number of raising cattle, the less the burden on the amount spent compared to the large farms, which increases the willingness to pay.

Table 4. Results from the Double-Bounded Dichotomous Choice by Village

Variables	Xaythany district		Parkngum district		
	Napok	Somsamai	Narlerth	Nong Phou Vieng	Narson
Heard_UMB	-4.024 (11.178)	11.568 (13.130)	-1.305 (8.807)	-1.370 (16.615)	1.224 (12.750)
Agree_UMB	41.317*** (12.965)	20.132 (15.010)	15.564 (11.819)	-18.508 (18.027)	81.620*** (22.332)
Purchased_UMB	-18.874 (13.150)	-8.533 (21.877)	122.760 (23946.760)	8.728 (28.743)	6.711 (13.647)
Edu_years	2.198* (1.221)	1.661** (0.694)	-1.607 (1.063)	1.761 (1.620)	0.373 (1.439)
Female	20.634** (10.456)	7.388 (7.349)	-13.616** (7.927)	-7.189 (11.728)	-1.111 (14.539)
Head of HH	7.534 (10.169)	-5.739 (8.760)	1.956 (8.147)	3.431 (13.014)	14.654 (13.497)
Age	0.812 (4.020)	2.869 (3.382)	-6.213 (3.984)	5.546 (4.867)	-5.012 (5.879)
Income/year	1.810 (2.371)	0.138 (1.744)	4.142*** (1.372)	-5.836 (4.398)	-2.900 (4.422)
Exp_input/year	2.699 (3.296)	-1.269 (3.014)	15.505** (7.436)	9.276 (10.970)	-0.096 (2.670)
No. of raising cattle	0.133 (0.497)	1.380 (0.933)	-2.242*** (0.775)	0.955 (1.404)	-0.011 (0.721)
Smallholders	19.693* (10.578)	8.622 (11.218)	-18.739* (10.654)	6.219 (19.590)	17.653 (16.128)
Constant	20.073*** (3.356)	18.358*** (2.824)	17.810*** (2.484)	24.890*** (4.162)	25.234*** (3.916)
Log likelihood	-37.877	-43.672	-49.661	-48.649	-51.240
N	42	45	51	51	53

Note:*10% significance level, **5% significance level, ***1% significance level.

Figures in parentheses are standard errors

6.3. Willingness to Pay for UMB

Table 5 shows the average willingness to pay and confidence interval for UMB in each village, respectively. The Narlerth village of the Parkngum district has a wider confidence interval (CI) than other villages. Based on the characteristics and descriptive statistics of this village, we can see that the experience of purchasing UMB before was the lowest at 4%. These results may indicate that respondents have never heard of this technology and that the reliability of the technology is low, resulting in a wide range of CI distributions.

The WTP estimate of total data is a constant estimated at 49,400 LAK, taking into account the explanatory variables, which can be interpreted as willingness to pay up to 5.5 USD for the monthly purchase of 10kg of UMB for one cattle. Likewise, WTP for Xaythany and Parkngum district is 49,500 LAK (5.7 USD) and 56,900 LAK (6.5 USD), respectively, and found that there is a slight difference in their WTP between two districts when the explanatory variables are affected. The magnitude of the change is expressed in LAK, the currency of Lao PDR, and is based on 1,000 LAK in units of Table 5.

Table 5. Average Willingness to Pay and Confidence Interval for UMB

District	Village	Obs.	Mean WTP	95% CI
	Napok	42	55.2 (\$6.3)	44.2(\$5.1) - 66.3 (\$7.6)
Xaythany	Somsamai	45	55.7 (\$6.4)	44.3 (\$5.1) - 67.0 (\$7.7)
	Total	103	46.4 (\$5.3)	35.4 (\$4.1) - 57.4 (\$6.6)
	Narlerth	51	73.9 (\$8.5)	-5747.4 (-\$658.6) - 5895.3 (\$675.5)
Parkngum	Nong phou vieng	51	60.9 (\$7.0)	45.9 (\$5.3) - 75.9 (\$8.7)
	Narson	53	50.0 (\$5.7)	36.6 (\$4.2) - 63.5 (\$7.3)
	Total	155	56.9 (\$6.5)	45.4 (\$5.2) - 68.3 (\$7.8)
Total		258	49.4 (\$5.7)	46.0 (\$5.1) - 52.9 (\$5.9)

Notes: 1) Exchange rate: 1 USD = 8,732 LAK based on July 2019

2) Paksapmai village of the Xaythany district is omitted due to the small sample.

As shown in Table 5, the WTP estimate for UMB is 49,400 LAK, not much different from the Mineral Feed Block (MFB), which is currently sold at 50,000 LAK or 5.7 USD as the pilot project at the National University of Laos (NUOL). Moreover, we can understand the difference in WTP by the village calculated without a fixed effect. An interesting finding shows that the Paksapmai village of the Xaythany district, which is not listed in Table 4 and 5, could not get WTP through STATA due to its 16 small sample. Still, the WTP obtained through the total average WTP was 37,600 LAK, 8 percent less than the average price. Paksapmai village was the only one trained in how to make UMBs, so the idea of making them on its own if they exceed the upper limit set by farmers may have led to a low willingness to pay.

Another finding is that WTP of Narlerth and Nong Phou Vieng village from the Parkngum district indicates a higher WTP than other villages. Here it

is possible to assume that even with an insufficient irrigation system, farmers have provided feed for cattle in the dry season, showing an active willingness to overcome the situation through an investment such as UMB.

6.4. Discussion

Farmer's WTP for UMB allows us to consider factors that are useful in inducing investment for improving the productivity of cattle in Laos. First of all, the estimation results showed that the household who agree with the explained effect of UMB positively affects to the willingness to pay. Before surveying farmers who are not familiar with the UMB, we explained the effects of rumen microbial growth, feed intake, digestibility, weight gain, growth rate, milk production, which are simultaneously with the concept of UMB (Appendix 1). In the case of the above effect, few experiments are held on the UMB effect on Lao cattle, so we referred to neighboring countries such as Thailand and Vietnam, which have a similar climate to Laos. In this regard, it is recommended to actively deliver information on supplements such as UMB and the positive effects of intake. Also, it may be more useful to estimate the cost-benefit, a daily weight gain based on the case of Lao cattle, not the case of other countries.

Second, it is suggested to provide UMB-related education first for

farmers with high education levels. Most smallholders are reluctant to accept the technology because the new agricultural technology is perceived as hard to understand, so after training the above farmers, information can spread around the leading farmers, making it easier to understand (Alexander. K et al., 2020).

Third, male farmers in the Parkngum district have a positive effect on farmers' willingness to pay for UMB according to the estimation results. In most livestock farms, the timing of the sale of large ruminants is determined through in-family discussions. Still, women were mainly in charge of managing funds from sales, and women predominantly manage household funds in Laos, according to a prior study (Nampanya, S et al., 2016; Nampanya, S et al., 2017). Encouraging female farmers to buy UMB is mostly likely to lead to actual UMB consumption.

Fourth, if they have experience in providing feed other than fibrous feed in the dry season, it appears to affect their willingness to pay for UMB as supplementary feed. In this regard, this experience makes it more favorable for farmers who provide feed during the dry season to provide UMB to their cattle. Furthermore, when farmers have experience in purchasing feed at their own expense to improve current breeding methods, more positive results have been shown than for farmers who do not invest in increasing the productivity of cattle.

Lastly, smallholders who raise less than 10 cattle were more likely to pay UMB. The FAO report (2015) shows that in the case of smallholders, they

are more susceptible to income risks than commercial farms. As a result, they pursue a method that is relatively less productive but safer than technology-intensive methods such as mixed feed and grassland creation, which can represent high returns. For commercial farmers who provide sufficient fodder for cattle, UMB serves as a supplement or snack. Still, in the production system of smallholders that rely on natural grassland, it is relatively more practical and vital. It can be understood that smallholders are more inclined to pay UMB than large farms. As a result, it is recommended to make efforts, such as training or access to materials for making UMB, to disseminate UMB to smallholders in the survey area.

7. Conclusion

The purpose of this study is to clarify the current status and potential of smallholders' investment through their willingness to pay for UMB, a feed supplement for cattle, and to understand the factors that influence farmers' WTP. The results show that ever agreed with the explained effect of UMB by surveyor; years of receiving education affect positively on smallholders' willingness to pay for UMB.

The limitation of this study was that the survey questionnaire was approved by the Institute Review Board (IRB) of Seoul National University after conducting the survey. Although the IRB was not attained during the survey, the procedure was carried out following IRB recommendations. Also, the survey questions were the same as the IRB submitted version, and the approved IRB survey document accompanies the appendix.

Previous studies have pointed out that reasonable prices are an important factor in sustainable use of UMB (Makkar et al., 2007; Misra et al. 2008). The ultimate purpose of this study is to find out how much small farmers are willing to invest to increase productivity in the current system and what factors influence it. The biggest reason why the willingness to invest does not lead to actual consumption is that it has an unstable sales system, which does not benefit from the investment in addition to the amount of money.

Here are a few suggestions for the effective strategy to overcome the barriers of improving productivity: firstly, it is necessary to select highly educated farmers as leading farmers so that productivity-boosting technologies, including UMB, can spread through them considering the difficulty of smallholders accepting new technologies.

The second one is information on the effectiveness and necessity of UMB for smallholders rather than commercial farmers should be delivered through training. It is because UMB's effect on smallholders who do not make any input other than natural grasslands is incomparable to large farmers who raise cattle that have enough feed.

Lastly, according to the results of the study, farmers are willing to invest USD 5.7. In addition to the farm's efforts, government institutional and policy support is needed to create a cattle market environment in which farmers can make profits as much as they invest.

In conclusion, the findings could contribute to the Lao government's establishment of an effective strategy in consideration of investment potential in the initial process of transitioning from smallholders to commercial farms in the central region in Lao PDR.

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Appendix 1: Survey Questionnaire*

*Although the survey used in this study has been approved by the Institute Review Board (IRB) since the survey was conducted, the process and methods of the survey were conducted in accordance with IRB recommendations. The questionnaire used was the same version with the IRB submission document attached to this appendix. Some of IRB documents including personal information are not attached.

IRB No. 1908/001-017 유효기간: 2020년 8월 5일

ແບບຟອມຍິນຍອມ(ສໍາລັບຜູ້ເຂົ້າຮ່ວມ)

ຫົວຂໍ້ການຄົ້ນຄວ້າ: ການສຶກສາກ່ຽວກັບຄວາມເຂົ້າໃຈຂອງຜູ້ບໍລິໂພກກ່ຽວກັບຜະລິດຕະພັນກະສິກໍາໃນປະເທດລຸ່ມແມ່ນ້ຳຂອງ ແລະ ຄົ້ນຫາການຮ່ວມມືເຕັກໂນໂລຊີກະສິກໍາສາກົນ: ການສຶກສາຄວາມຄິດເຫັນຂອງຊາວກະສິກອນ ຜູ້ລ້ຽງງົວຂະໜາດນ້ອຍກ່ຽວກັບ ກ້ອນອາຫານເສີມງົວ ແລະ ຄວາມເຕັມໃຈທີ່ຈະຈ່າຍຄ່າກ້ອນອາຫານເສີມງົວໃນ ໑.ປ.ປ ລາວ
 ຫົວໜ້າການຄົ້ນຄວ້າ: ແທປຸນ ຄິມ
 (ຮອງສາສະດາຈານ, ໂຮງຮຽນປະລິນຍາໂທເຕັກໂນໂລຊີກະສິກໍາລະຫວ່າງປະເທດ, ມະຫາວິທະຍາໄລແຫ່ງຊາດເຊອຸນ)

1. ຫ້າມໄດ້ອ່ານຄູ່ມືນີ້ ແລະ ປຶກສາຫາລືກັບນັກຄົ້ນຄວ້າຜູ້ຮັບຜິດຊອບ.
2. ຂ້າພະເຈົ້າໄດ້ຍິນກ່ຽວກັບຄວາມສ່ຽງ, ຜົນປະໂຫຍດ ແລະ ໄດ້ຮັບຄໍາຕອບທີ່ຫນ້າພໍໃຈກັບຄໍາຖາມຂອງຂ້າພະເຈົ້າ
3. ຂ້າພະເຈົ້າສະຫນັກໃຈເຂົ້າຮ່ວມການສຶກສານີ້.
4. ຂ້າພະເຈົ້າຕົກລົງເຫັນດີວ່າຂໍ້ມູນກ່ຽວກັບຕົນເອງທີ່ໄດ້ຮັບຈາກການສຶກສານີ້ແມ່ນໄດ້ຖືກວິເຄາະແລະນໍາສະເໜີທີ່ປະເທດເກົາຫລີໃຕ້.ເທົ່າທີ່ກົດລະບຽບ ແລະ ກົດຫມາຍໃນປະຈຸບັນທີ່ຄະນະກຳມະການສະຖາບັນອຸປະກອນໃຫ້.
5. ຂ້າພະເຈົ້າຕົກລົງເຫັນດີທີ່ຈະກວດເບິ່ງຂໍ້ມູນສ່ວນບຸກຄົນຂອງຂ້າພະເຈົ້າທີ່ຖືກເກັບຮັກສາເປັນຄວາມລັບ, ເມື່ອທີ່ມາການຄົ້ນຄວ້າ ຫຼື ຜູ້ແທນຂອງຂ້າພະເຈົ້າດຳເນີນການຄົ້ນຄວ້າ ຫຼື ຄຸ້ມຄອງຕົນໄດ້ຮັບ ແລະ ໃນເວລາທີ່ອົງການຈັດຕັ້ງຂອງລັດຖະບານ ແລະຄະນະກຳມະການມະຫາວິທະຍາໄລແຫ່ງຊາດເຊອຸນ ຕາມກົດຫມາຍໂດຍສະເພາະຂອງການສໍາຫຼວດ.
6. ຂ້າພະເຈົ້າຮັບຮູ້ດີວ່າ ຂ້າພະເຈົ້າສາມາດຖອນການເຂົ້າຮ່ວມໃນການສຶກສາຄັ້ງນີ້ໄດ້ທຸກເວລາ ແລະ ການຕັດສິນໃຈນີ້ຈະບໍ່ເຮັດໃຫ້ຂ້າພະເຈົ້າຄວາມເສຍຫາຍໃດໆ.
7. ລາຍເຊັນຂອງຂ້າພະເຈົ້າຫມາຍຄວາມວ່າຂ້າພະເຈົ້າໄດ້ຮັບສໍາເນົາຂອງຂໍ້ຕົກລົງນີ້ ແລະ ຂ້າພະເຈົ້າຈະຮັກສາມັນລວມທັງລາຍເຊັນຂອງນັກຄົ້ນຄວ້າຈົນກ່ວາການຄົ້ນຄວ້າຈະສໍາເລັດ

_____	_____	_____
ຊື່ (ຜູ້ເຂົ້າຮ່ວມ)	ລາຍເຊັນ	ວັນທີ
_____	_____	_____
ຊື່ (ນັກວິເຈ)	ລາຍເຊັນ	ວັນທີ



ແບບຟອມຍືນຍອມ(ສໍາລັບນັກຄົ້ນຄວ້າ)

ຫົວຂໍ້ການຄົ້ນຄວ້າ: ການສຶກສາກ່ຽວກັບຄວາມເຂົ້າໃຈຂອງຜູ້ບໍລິໂພກກ່ຽວກັບຜະລິດຕະພັນກະສິກໍາໃນປະເທດລຸ່ມແມ່ນໍ້າຂອງ ແລະ ຄົ້ນຫາການຮ່ວມມືເຕັກໂນໂລຊີກະສິກໍາສາກົນ: ການສຶກສາຄວາມຄິດເຫັນຂອງຊາວກະສິກອນ ຜູ້ລ້ຽງງົວຂະໜາດນ້ອຍກ່ຽວກັບ ກ້ອນອາຫານເລີມງົວ ແລະ ຄວາມເຕັມໃຈທີ່ຈະຈ່າຍຄ່າກ້ອນອາຫານເລີມງົວໃນ ສ.ປ.ປ ລາວ
ຫົວໜ້າການຄົ້ນຄວ້າ: ແທຍຸນ ດີມ
(ຮອງສາສະດາຈານ, ໂຮງຮຽນປະລິນຍາໂທເຕັກໂນໂລຊີກະສິກໍາລະຫວ່າງປະເທດ, ມະຫາວິທະຍາໄລແຫ່ງຊາດເຊອຸນ)

1. ຈື່ງໄດ້ອ່ານຄູ່ມືນີ້ ແລະ ປຶກສາຫາລືກັບນັກຄົ້ນຄວ້າຜູ້ຮັບຜິດຊອບ.
2. ຂ້າພະເຈົ້າໄດ້ຍືນຍອມກ່ຽວກັບຄວາມສ່ຽງ, ຜົນປະໂຫຍດ ແລະ ໄດ້ຮັບຄໍາຕອບທີ່ໝັ້ນໃຈກັບຄໍາຖາມຂອງຂ້າພະເຈົ້າ
3. ຂ້າພະເຈົ້າສະໜັກໃຈເຂົ້າຮ່ວມການສຶກສານີ້.
4. ຂ້າພະເຈົ້າຕົກລົງເຫັນດີວ່າຂໍ້ມູນກ່ຽວກັບຕົນເອງທີ່ໄດ້ຮັບຈາກການສຶກສານີ້ແມ່ນໄດ້ຖືກວິເຄາະແລະນໍາສະເໜີທີ່ປະເທດເກົາຫລີໃຕ້.ເທົ່າທີ່ກົດລະບຽບ ແລະ ກົດໝາຍໃນປະຈຸບັນທີ່ຄະນະກຳມະການສະຖາບັນອະນຸຍາດໃຫ້.
5. ຂ້າພະເຈົ້າຕົກລົງເຫັນດີທີ່ຈະກວດເບິ່ງຂໍ້ມູນສ່ວນບຸກຄົນຂອງຂ້າພະເຈົ້າທີ່ຖືກເກັບຮັກສາເປັນຄວາມລັບ, ເມື່ອທີ່ມາງານຄົ້ນຄວ້າ ຫຼື ຜູ້ແທນຂອງຂ້າພະເຈົ້າດໍາເນີນການຄົ້ນຄວ້າ ຫຼື ຄຸ້ມຄອງຜົນໄດ້ຮັບ ແລະ ໃນເວລາທີ່ອົງການຈັດຕັ້ງຂອງລັດຖະບານ ແລະຄະນະກຳມະການມະຫາວິທະຍາໄລແຫ່ງຊາດເຊອຸນ ຕາມກົດໝາຍໂດຍສະເພາະຂອງການສໍາຫຼວດ.
6. ຂ້າພະເຈົ້າຮັບຮູ້ດີວ່າ ຂ້າພະເຈົ້າສາມາດຖອນການເຂົ້າຮ່ວມໃນການສຶກສາຄັ້ງນີ້ໄດ້ທຸກເວລາ ແລະ ການຕັດສິນໃຈນີ້ຈະບໍ່ເຮັດໃຫ້ຂ້າພະເຈົ້າຄວາມເສຍຫາຍໃດໆ.
7. ລາຍເຊັນຂອງຂ້າພະເຈົ້າໝາຍຄວາມວ່າຂ້າພະເຈົ້າໄດ້ຮັບສໍານຳຂອງຂໍ້ຕົກລົງນີ້ ແລະ ຂ້າພະເຈົ້າຈະຮັກສາມັນລວມທັງລາຍເຊັນຂອງນັກຄົ້ນຄວ້າຈົນກ່ວາການຄົ້ນຄວ້າຈະສໍາເລັດ

_____	_____	_____
ຊື່ (ຜູ້ເຂົ້າຮ່ວມ)	ລາຍເຊັນ	ວັນທີ
_____	_____	_____
ຊື່ (ນັກວິໄຈ)	ລາຍເຊັນ	ວັນທີ
_____	_____	_____
ຊື່ (ຫົວໜ້າການຄົ້ນຄວ້າ)	ລາຍເຊັນ	ວັນທີ



ພາກ ກ: ການອະທິບາຍກ່ຽວກັບກ້ອນແຮ່ທາດ (UMB)

ຈຸດປະສົງຂອງການນີ້ໃຊ້ ກ້ອນແຮ່ທາດ ແລະ ຜົນຄາດວ່າຈະໄດ້ຮັບ



ກ້ອນແຮ່ທາດຂອງມະຫາວິທະຍາໄລເຫງຊາດມະລິດ



ກ້ອນແຮ່ທາດຕາມຕະຫຼາດ

- 1) ກ້ອນແຮ່ທາດແມ່ນຫຍັງ (UMB)?
 - ກ້ອນແຮ່ທາດແມ່ນຜະລິດຕະພັນເສີມທາດອາຫານສຳລັບກົວ-ຄວາຍ ແລະ ສັດຕ້ວງເຮື້ອ ເຊິ່ງມັນບໍ່ແມ່ນອາຫານຫລັກ.
 - ສ່ວນປະກອບຫລັກຂອງກ້ອນແຮ່ທາດປະກອບມີ ຢຸເລຍ (ປຸ່ຍລັ່ງ) ເພື່ອສະໜອງທາດໂປຼຕຽນໃຫ້ກັບຈຸລິນຊີທີ່ບໍ່ມີປະໂຫຍດໃນກະເພາະກົວ ແລະ ການນໍາຕານ ເພື່ອສະໜອງພະລັງງານ
 - ກ້ອນແຮ່ທາດທີ່ແຂງແມ່ນຈະຕິດການກິນຢຸເລຍໃນຝະລິມາຍທີ່ເໝາະສົມຂອງກົວ ແລະ ມັນສະດວກໃນການຂົນສົ່ງ ແລະ ການເກັບຮັກສາ.
- 2) ຈຸດປະສົງຂອງການນີ້ໃຊ້ກ້ອນແຮ່ທາດ
 - ໃນລາວ, ແມ່ນຍາກທີ່ຈະໃຫ້ກົວໄດ້ກິນຫຍ້າສົດ ແລະ ມີຄຸນນະພາບສູງໃນຊ່ວງລະດູແລ້ງ ເນື່ອງຈາກຫ່ຽງຫຍ້າມີຈຳກັດ.
 - ເຊິ່ງມັນບໍ່ເປັນຜົນເຮັດໃຫ້ເກີດການຂາດສານອາຫານ ແລະ ເຮັດໃຫ້ການຈະເລີນເຕີບໂຕຂອງກົວຊຳລົງ.
 - ຈຸດປະສົງຫລັກຂອງການໃຊ້ກ້ອນແຮ່ທາດແມ່ນເພື່ອເສີມອາຫານທີ່ບອດໄພ ແລະ ຄອບສະໜອງປະລິມານທາດໂປຼຕຽນ ແລະ ພະລັງງານໃຫ້ແກ້ກົວຢ່າງສະເໝີກໍ່ສະເໝີ.
- 3) ຜົນຄາດວ່າຈະໄດ້ຮັບຈາກການໃຊ້ກ້ອນແຮ່ທາດ
 - ມັນຊ່ວຍເພີ່ມນ້ຳໜັກກົວ ແລະ ເພີ່ມຜົນຜະລິດດັ່ງກ່າວໄດ້ຫຼາຍຂຶ້ນ ໂດຍການຕອບສະໜອງທາດສິ້ນຢ່າງຕໍ່ເນື່ອງ.
 - ໃນປະເທດໄທ, ກົວທີ່ໄດ້ກິນກ້ອນແຮ່ທາດແມ່ນມີນ້ຳໜັກເພີ່ມຂຶ້ນສາມເທົ່າ ຖ້າຫາກບໍ່ກົວທີ່ບໍ່ໄດ້ກິນກ້ອນແຮ່ທາດ.
 - ກ້ອນແຮ່ທາດສາມາດຊ່ວຍໃຫ້ປະສິດທິພາບການຫຍ່ອຍອາຫານໄດ້ດີ ແລະ ການເສີມພິ່ນໄດ້ດີ.
 - ການເພີ່ມຂຶ້ນຂອງນ້ຳໜັກກົວ-ຄວາຍ ແມ່ນສາມາດປະກອບສ່ວນເຂົ້າໃນການສ້າງລາຍຮັບຈາກການລົງສັດ.



<p>8. ເຈົ້າເຄີຍຊື້ອາຫານເສີມໃຫ້ຈິວ-ຄວາຍບໍ່ໃນຊ່ວງ 12 ເດືອນຜ່ານມາ?</p>	<p><input type="radio"/> ເຄີຍ <input type="radio"/> ບໍ່ເຄີຍ</p>
<p>9. ເຈົ້າເຄີຍໄດ້ກຽມກ້ອນແຮ່ທາດມາກອນບໍ່ (UMB)?</p>	<p><input type="radio"/> ເຄີຍກຽມ <input type="radio"/> ບໍ່</p>
<p>10. ເຈົ້າເຫັນດີບໍ່ວ່າ ກ້ອນແຮ່ທາດຈະຊ່ວຍໃຫ້ຈິວ-ຄວາຍດຸ້ຍຂຶ້ນ ແລະ ມີສຸຂະພາບດີ?</p>	<p><input type="radio"/> ເຫັນດີ <input type="radio"/> ບໍ່ເຫັນດີ</p>
<p>11. ເຈົ້າເຄີຍຊື້ກ້ອນແຮ່ທາດມາກອນບໍ່?</p>	<p><input type="radio"/> ເຄີຍຊື້ <input type="radio"/> ບໍ່ເຄີຍ (ໄປຂໍ້ 14)</p>
<p>12. ຖ້າເຄີຍຊື້, ເຈົ້າຊື້ກ້ອນແຮ່ທາດເລື້ອຍປານໃດ? (ກະລຸນາໝາຍເອົາໜຶ່ງຂໍ້ດຽວ)</p>	<p><input type="radio"/> ປະມານ ທຸກໆອາທິດ <input type="radio"/> ປະມານ ທຸກໆສອງອາທິດ <input type="radio"/> ປະມານ ໜຶ່ງຄັ້ງຕໍ່ເດືອນ <input type="radio"/> ປະມານ ໜຶ່ງຄັ້ງຕໍ່ສາມເດືອນ <input type="radio"/> ປະມານ 2-3 ຄັ້ງຕໍ່ປີ (ບໍ່ສະໝັກສະເໝີ) <input type="radio"/> ປະມານ ບໍ່ລະຄັ້ງ <input type="radio"/> ອື່ນໆ : _____</p>
<p>13. ຖ້າເຄີຍຊື້, ຊ່ວງເດືອນໃດທີ່ເຈົ້າຊື້ກ້ອນແຮ່ທາດ? (ກະລຸນາໝາຍເອົາໜຶ່ງຂໍ້ດຽວ)</p>	<p><input type="radio"/> ລະດູແລ້ງ, ພະຈິກ (11) ຫາ ເມສາ (4) <input type="radio"/> ລະດູຝົນ, ພຶດສະພາ (5) ຫາ ຕຸລາ (10) <input type="radio"/> ທັງສອງລະດູ</p>

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

ພາກ ຄ: ຄຳຖາມກ່ຽວກັບຄວາມພິເຈດີຈະຈ່າຍສຳຫລັບກ້ອນແຮ່ທາດ (JMB)

ສົມທຸດວ່າລາຄາກ້ອນແຮ່ທາດທີ່ແນະນຳຂໍາລຸ່ມໄດ້ແມ່ນ ຄຳໃຊ້ຈ່າຍຕໍ່ໜຶ່ງເຕືອນກ້ຽວ ໜຶ່ງໄຕ

ລາຄາແນະນຳ
50,000 ກີບ

<p>14. ເຈົ້າເຕັມໃຈທີ່ຈະຈ່າຍຕາມລາຄາທີ່ແນະນຳນີ້ບໍ່?</p>	<p><input type="radio"/> ແມ່ນ (ໄປຂໍ້ 15) <input type="radio"/> ບໍ່ (ໄປຂໍ້ 16)</p>
<p>15. ຖ້າເຕັມໃຈ, ເຈົ້າເຕັມໃຈຈ່າຍໃນລາຄາ ສອງເທົ່າ ຂອງລາຄາທີ່ແນະນຳບໍ່?</p>	<p><input type="radio"/> ແມ່ນ (ໄປຂໍ້ 18) <input type="radio"/> ບໍ່ (ໄປຂໍ້ 18)</p>
<p>16. ຖ້າບໍ່, ເຈົ້າເຕັມໃຈຈ່າຍໃນລາຄາ ເຄິ່ງໜຶ່ງ ຂອງລາຄາທີ່ແນະນຳບໍ່?</p>	<p><input type="radio"/> ແມ່ນ (ໄປຂໍ້ 18) <input type="radio"/> ບໍ່ (ໄປຂໍ້ 17)</p>
<p>17. ເຈົ້າເຕັມໃຈຈ່າຍຢ່າງໜ້ອຍ 1,000 ກີບ ຕໍ່ກ້ອນແຮ່ທາດໜຶ່ງກ້ອນບໍ່?</p>	<p><input type="radio"/> ແມ່ນ (ໄປຂໍ້ 18) <input type="radio"/> ບໍ່ (ໄປຂໍ້ 19)</p>
<p>18. ເຫດຜົນຫລັກກ່ອນທີ່ເຈົ້າເຕັມໃຈຈ່າຍສຳຫລັບຊື້ກ້ອນແຮ່ທາດ? (ກະລຸນາໝາຍເອົາພຽງຂໍ້ດຽວ)</p>	<p><input type="radio"/> ເພື່ອປ້ອງກັນພະຍາດຕ່າງໆ</p> <p><input type="radio"/> ເພື່ອປັບປຸງການສົນທິສັນຂອງກິດຈະກຳ</p> <p><input type="radio"/> ເພື່ອເພີ່ມລາຄາຂາຍເມືອງ-ຄວາມມັ້ນຄົງເພີ່ມຂຶ້ນ</p> <p><input type="radio"/> ອື່ນໆ : _____</p>
<p>19. ເຫດຜົນຫລັກກ່ອນທີ່ເຈົ້າເຕັມໃຈຈ່າຍສຳຫລັບຊື້ກ້ອນແຮ່ທາດ? (ກະລຸນາໝາຍເອົາພຽງຂໍ້ດຽວ).</p>	<p><input type="radio"/> ຂາດເຂົນເງິນໃນການຊື້ກ້ອນແຮ່ທາດ</p> <p><input type="radio"/> ການນຳໃຊ້ກ້ອນແຮ່ທາດບໍ່ມີຜົນປະໂຫຍດ</p> <p><input type="radio"/> ບໍ່ມີຄວາມສົນໃຈໃນການໃຊ້ກ້ອນແຮ່ທາດ</p> <p><input type="radio"/> ອາຫານສັດປັດຈຸບັນແມ່ນພຽງພໍແລ້ວ</p> <p><input type="radio"/> ບໍ່ມີຂໍ້ມູນພຽງພໍກ່ຽວກັບກ້ອນແຮ່ທາດ</p> <p><input type="radio"/> ຂາດຄວາມເຂື່ອນຖືກວຽວກັບກ້ອນແຮ່ທາດ</p> <p><input type="radio"/> ອື່ນໆ : _____</p>

1 2 3 4 5 6 7 8 9 0
1 2 3 4 5 6 7 8 9 0
1 2 3 4 5 6 7 8 9 0

PART A. EXPLANATION ON UREA-MOLASSES BLOCK (UMB)

THE PURPOSE OF USING UREA-MOLASSES BLOCK & EXPECTED EFFECT



UMB of National University of Lao (NUOL)



UMB on the market

1) Urea-Molasses Block (UMB)?

- UMB is a dietary supplements for cattle and ruminants and it is not a main diet.
- Main components of UMB are Urea providing non-protein N and Molasses providing energy
- Hard UMB is good for cattle to eat right amount of Urea and easy to transport and store.

2) The Purpose of using Urea-Molasses block

- In Lao PDR, it is hard for cattle to eat fresh grass and high quality forage in the dry season due to limited area for grass.
- As a result, it causes nutrient deficiency and it slows fattening cattle down.
- Main purpose of UMB is to supplement safe and proper amount of nitrogen and energy consistently.

3) The Expected effect of Urea-Molasses Block

- It helps cattle to increase weights and thus create more meat production by supplying protein consistently.
- In Thailand, cattle that eats UMB are about three times more fatten than those who didn't eat UMB.
- UMB can increase feed conversion efficiency and animal reproduction.
- Fattening cattle can contribute to increasing the income of livestock farm.

8. Have you ever purchased the feed for the cattle during last 12 months?	<input type="radio"/> Yes <input type="radio"/> No
9. Have you heard about urea-molasses block (UMB)?	<input type="radio"/> Yes <input type="radio"/> No
10. Do you agree with that UMB will help cattle grow big and healthy?	<input type="radio"/> Yes <input type="radio"/> No
11. Have you ever bought UMB before?	<input type="radio"/> Yes <input type="radio"/> No (Go to Q14)
12. If yes, how often do you purchase UMB? Please check only one.	<input type="radio"/> About every week <input type="radio"/> About every two weeks <input type="radio"/> About once a month <input type="radio"/> About once every three months <input type="radio"/> A few times a year (irregularly) <input type="radio"/> About once a year <input type="radio"/> Others : _____
13. If yes, when did you buy the urea-molasses block? Please check only one.	<input type="radio"/> Dry season (November to April) <input type="radio"/> Rainy season (May to October) <input type="radio"/> Both

PART C. QUESTION ON WILLINGNESS TO PAY FOR UREA-MOLASSES BLOCK (UMB)

Assuming that the following costs are used monthly for one cattle,

Suggested Price	50,000 kip
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14. Are you willing to pay the suggested price?	<input type="radio"/> Yes (Go to Q15) <input type="radio"/> No (Go to Q16)
15. If yes, are you willing to pay double amount of suggested price?	<input type="radio"/> Yes (Go to Q 18) <input type="radio"/> No (Go to Q18)
16. If no, are you willing to pay half amount of suggested price?	<input type="radio"/> Yes (Go to Q18) <input type="radio"/> No (Go to Q19)
17. Are you willing to pay at least 1,000kip for UMMB?	<input type="radio"/> Yes (Go to Q 18) <input type="radio"/> No (Go to Q19)
18. What is the biggest reason to pay for UMB? Please check only one.	<input type="radio"/> To prevent diseases <input type="radio"/> To improve performance in reproduction <input type="radio"/> To increase selling price of fattening cattle <input type="radio"/> Others : _____
19. What is the main reason to not willing to pay for UMB? Please check only one.	<input type="radio"/> Lack of money to pay for UMB <input type="radio"/> No benefits using UMB <input type="radio"/> No interest in UMB <input type="radio"/> Sufficient with current feed <input type="radio"/> Insufficient information about UMB <input type="radio"/> Lack of reliability regarding UMB

Abstract (Korean)

국 문 초 록

라오스 축산 농가의 당밀요소블록에 대한 구매 의향과 결정요인 및 투자 가능성 연구

김령임

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현재 10마리 미만의 소를 키우는 라오스 축산농가의 자연 초지에 의존하는 가축 생산 시스템으로는 소의 증체 더 나아가 축산업 발전에 있어서 한계가 있다. 또한 소의 판매가격은 중간상인의 목측에 의해 측정되기 때문에 우시장에서 판매했을 때의 기대 금액보다 낮게 평가되어 소농들은 자연스럽게 사육에 최소한의 투자를 하고 있다. 라오스 정부는 이러한 생산성 증대에 있어 어려움을 해소하기 위해 소농을 상업농으로 전환하기 위한 노력을 기울이고 있으나, 2015년 기준 소를 사육하는 농가의 98%가 소농이 차지하고 있어 소농의 현황을 고려한 적절한 개입이 필요하다. 본 연구는 생산성을 높일 수 있는 다양한 방법 중에서 섬유질 위주 섭취로 인한 영양소 결핍의 문제를 보완할 수 있는 당밀요소블록을 통해 소농의 투자가능성을 보고자 한다. 따라서, 본 연구의 목적은 라오스 비엔티엔시의 축산업에 종사하는 소농들이 상업적 농장으로의 전환하는 초기 단계에서 농가가 소를 살찌우기 위한 투입물로 당밀요소블록에 투자할 의향이 있는지 그리고 이에 영향 미치는 요인을 파악하는 것이다.

무작위 표본추출을 통해 선정된 총 258명의 농가를 대상으로 설문조사를 진행하였으며, 조건부 가치 측정법의 이중 경계 양분선택형 모델을 이용하여 수집된 자료를 분석하였다. 결과적으로, 높은 교육수준을 가지고 있거나 당밀요소블록의 긍정적인 효과에 동의하는 농부들이 높은 구매 의향을 보인다는 것을 발견했다. Parkngum 군의 경우, 남성 농가일 수록, 소농일수록, 연구자가 설명한 블록의 효과에 동의하거나 건기에 사료 제공해본 경험이 있거나 농가가 직접 소를 위해 사료를 구매해본 경험이 있을 수록 유의하게 구매 의향에 긍정적인 영향을 미친다는 것을 보여준다. 당밀요소블록의 평균지불액은 최대 5.7달러로, 이는 상업농으로 전환하는 단계에 있어서 현재 조사지역 농민들이 생산성 향상을 위해 투자하고자 함을 알 수 있다. 결론적으로, 농가들의 투자에 기반한 생산성 향상을 유도하기 위해서는 먼저 교육 수준이 높은 농가를 선도 농가로 선정해 당밀요소블록을 비롯한 생산성 증대 기술이 이들을 통해 확산될 수 있게 교육이 필요하다. 둘째, 상업농보다 소농들을 대상으로 당밀요소블록 효과와 필요성에 대한 정보 제공과 교육이 필요하다. 마지막으로 농가 단위의 노력 외에 농가들이 투자한 만큼 수익을 낼 수 있는 우시장 환경 조성을 위해 정부의 제도적 및 정책적 지원이 필요할 것으로 사료된다.

주요어: 조건부 가치 측정법, 이중 경계 양분선택형 모형, 구매의향, 당밀요소블록, 가축 생산, 라오스.

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