Factors Affecting Perception and Adoption of Longan Production Technology of Farmer in Lamphun Province

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ABSTRACT

The objective of this study wasto study on and analyze factors affecting perception and adoption of properlongan production technologiesof longan farmers in Lamphun province by estimating the Ordered Probit model. The results showed that factorsaffecting the perception of longan farmers in statistically significantarerelationship between agricultural extension agents and farmers, farmers' gender, training experiences and the education level bachelor degree or higher. Factors affecting the adoption of longan farmers are level of farmers' technology perception, the education level senior high school or vocational certificate, the education level bachelor degree or higher, memberships of agricultural institutions and relationship between agricultural extension agents and farmers. By the education level senior high school or vocational certificate and the education level bachelor degree or higher do negatively affect the probability of technology adoption.

Keywords: Longan, Factors affecting Perception and Adoption, Longan's technological

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Introduction

Longan is a significant economic crop in Thailand which is a top-ranking agricultural product in terms of manufacturing and exports. Also, the growth rate of exports seem to increase steadily. Concerning most of the exported longan products, it is found that fresh longan comes in the first (Office of the National Economics and Social Development Board, 2015). The cultivation of longan is widespread in the upper north region of Thailand, most especially in Lamphun province with its optimal climate conditions. Moreover, Lamphun has a strategic plan to make the province a city of longan because its yield is concerned an important economic crop. The province also has lots of cultivated areas and harvested areas, resulting in the leading number of all longan outputs within the country. In 2014, there were 242,734 rai of cultivated areas and 236,184,700 kilograms of total outputs. Viewing annual export figures of both seasonal and off-seasoned longan, it is obvious that the quantity is not less than 50,000 tons per year (Lamphun Provincial Agricultural Office, 2015). And Lamphun's Gross Provincial Product (GPP) in 2012 shown that the agricultural products solely valued 22,365.24 million baht, represented 30.75 percent of the GPP. (Office of the National Economics and Social Development Board, 2013)

In spite of the substantial crop lands and its economical value in Lamphun province, the quantity and price of longan products have been broadly afflicting longan farmers in the area. The main problem is the productivity does not meet market demand. Therefore, it has an effect on the price the farmers should get. There is a big gab of sale price between an AA-graded and A-graded longan. From the longan price survey in 2015, it was found that the AA-graded cut-on-seed-head longan obtained the highest price at 23 baht per kilogram, the second highest were A-graded and B-graded which costed 18 and 19 baht per kilogram, respectively. Harvested-with-branch longan sale price was 38 baht per kilogram for the AA-grade, 36 baht per kilogram for the A-grade, and 33 baht per kilogram for the mixed selected grade.

Nowadays, there are several technological practices which help in longan production and fine-quality longan growingbut most farmers do not know nor accept this technologies yet. Due to the low quality product constraints, it results in poor quality of the yield and incomes decrease that can be related to low quality of life of the farmers themselves. Thus, it is necessary to study on factors affecting the perception and adoption of the longan production technologies of longan farmers in Lamphun province, as object to acknowledge problems occurred, create appropriate guidelines, and adjust the research plan to improve the quality of longan, reduce the costs, and increase profitability from selling high quality products.

Objective of the study

The aim of this study was to study on and analyze factors affecting perception and adoption of longan production technologies. By perception refers to knowing the information and the information's sources to improve the quality of longan and adoption refers to using longan production technologies in their own agricultural areas.

Materials and methods

This research, the observed representative sample in this study is longan farmers in Lamphun province, where it has the most appropriate cultivated areas for longan farming. The sample consisted of 400 longan farmers and was calculated using Taro Yamane with 95 percent confidence interval.

OrderedProbit Model

The specific technology perception of the farmer should be evaluated in term of the factors which affect to the decision, reception and the application of agricultural technology(Akinwumi A. Adesina และ Moses M. Zinnah, 1992) because the perception occurs in mind' s feeling, knowledge and experience of the receiver. Besides, comprehension or interpretation does not always accurate. Interpretation will base on belief, opinion and experience, feeling organization and understanding of the receiver(Kotler, 2003). Related theories of technology adoption have been widely used over time. There are many researchers who have studied on this issue. Griliches (1957) was the first economist who analyzed the acceptance and diffusion of innovation from economic aspects. Later, the Technology Characteristics Farmers' Perceptions and Adoption Decisions: A Tobit Model Application in Sierra Leone by Adensina, A. and Zinnah, M.M. (1993) revealed that technology characteristics are the crucial influence of farmers' adoption decisions. Subsequently, there were more researchers who had an interest in this topic. For example, McNamara, Wetzstein, and Douce (1991) conducted their research on Factors Affecting Peanut Producer Adoption of Integrated Pest Management in Georgia

The ordered probit can be estimated by several software and is theoretically superior to most other models for the data analyzed in this work. The following was used here:

$$Y_i^* = \beta' x_i + \varepsilon_i \qquad (1)$$

where Y_i^* refers to level of longan technology perception and adoption for longan's farmer *i* is set the minimum value at 0 (which means $y_i^* \geq 0$), β is the vector of parameters to be estimated, x_i is the vector of observed non-random explanatory variables measuring the factors affecting perception and adoption of longan's farmer*i*, and ε_i is the random error term following standard normal distribution. Accordingly, the mean and the variance of ε_i can be wrote $\varepsilon_i \sim iidN(0,1)$.

The level of longan technology perception and adoption for longan's farmer, Y_i, is determined from the model as folloes:

$$Y_i = \begin{cases} 0, & \text{if } -\infty \leq Y_i^* \leq \mu_1 \text{ (never know/adopt any techno logy)} \\ 1, & \text{if } \mu_1 \leq Y_i^* \leq \mu_2 \text{ (recognize/ adopt technologies in the lowest rate)} \\ 2, & \text{if } \mu_2 < Y_i^* \leq \mu_3 \text{ (recognize/ adopt technologies in low rate)} \\ 3, & \text{if } \mu_3 < Y_i^* \leq \mu_4 \text{ (recognize/ adopt technologies in moderate rate)} \\ 4, & \text{if } \mu_4 < Y_i^* \leq \mu_5 \text{ (recognize/ adopt technologies in high rate)} \\ 5, & \text{if } \mu_5 < Y_i^* \leq \alpha \text{ (recognize/ adopt technologies in the highest rate)} \end{cases} \qquad (2)$$

where μ_i represent thresholds to be estimated (along with the parameter vector β)through the maximum likelihood method(Green, 2002).The probabilities associated with the coded responses of an ordered probit model are as follows:

$$
\begin{aligned}
P_i(0) &= \Pr(Y_i = 0) = \Pr(Y_i^* \le \mu_1) = \Pr(\beta' x_i + \varepsilon_i \le \mu_1) \\
&= \Pr(\varepsilon_i \le \mu_1 - \beta' x_i) = \phi(\mu_1 - \beta' x_i) \\
P_i(1) &= \Pr(Y_i = 1) = \Pr(\mu_1 < Y_i^* \le \mu_2) \\
&= \Pr(\varepsilon_i \le \mu_2 - \beta' x_i) - \Pr(\varepsilon_i \le \mu_1 - \beta' x_i) \\
&= \phi(\mu_2 - \beta' x_i) - \phi(\mu_1 - \beta' x_i) \\
P_i(k) &= \Pr(Y_i = k) = \Pr(\mu_k < Y_i^* \le \mu_{k+1}) \\
&= \phi(\mu_{k+1} - \beta' x_i) - \phi(\mu_k - \beta' x_i) \\
P_i(K) &= \Pr(Y_i = K) = \Pr(\mu_K < Y_i^*) \\
&= 1 - \phi(\mu_K - \beta' x_i)
\end{aligned}
\tag{3}
$$

where*i* is an individual, *k* is a response alternative, $P(Y_i = k)$ is the probability that individual *n* responds in manner *k*, and $\phi(\ )$ is the standard normal cumulative distribution function, using LIMDEP software.

Dataset characterization

From the aforementioned literature reviews, the researcher divided the factors that influence the perception and adoption of technologies into 3 main points; that are (1) Personality factors including age, gender, education level, and previous experiences of farmers (2) Economic factors covering farmers' longan production costs, farm size, and labour resources (3) Social factors regarding technology perceptions, training experiences, memberships to agricultural associations, and familiarity between farmers and agricultural extension agents. Table 1 presents the definition of each explanatory variable together with its mean (Mean) and standard deviation (SD.) values.

Table 1 Explanatory variables

Variables	Explanatory variables	Type	Coding	Mean	SD.
AGE	Farmers' age (year)	Continuous	Continuous variable	58.390	8.591
SEX	Farmers' gender	Binary	1 if male, 0 if female	0.630	0.484
EDU01	Farmers' level of education	Binary	1 if Bachelor degree or higher, 0 if Others	0.080	0.272
EDU02	Farmers' level of education	Binary	1 = Diploma or Hight vocational certificate, 0 if Others	0.125	0.332
EDU03	Farmers' level of education	Binary	1 = Senior High school or Vocational certificate, 0 if Others	0.175	0.381
EXP	Farmers' farming experiences (year)	Continuous	Continuous variable	20.595	10.362
CAPITAL	Farmers' longan production costs (baht)	Continuous	Continuous variable	7668.913	21731.994
LAND	Farm size (rai)	Continuous	Continuous variable	11.273	17.831
LABOR	Labour uses (person per area)	Continuous	Continuous variable	19.985	19.315

PERCEP	Level of technology perception	Dummy	0 if Never know any technology, …, 5 if Recognize technologies in the highest rate	3.225	1.250
TRANING	Training experiences (times per person)	Continuous	Continuous variable	1.820	2.673
MEMBER	Memberships of agricultural institutions (number of group per person)	Continuous	Continuous variable	1.740	0.892
AGENT	Relationship between agricultural extension agents and farmers	Binary	1 if Extension agents help farmers in longan production, 0 if extension agents do not help farmers in longan production	0.425	0.496

Results

Table 2 and Table 3show the analysis of factors that have influences on Lamphun farmers' perception and application of agricultural technology represented through Order Probit Model. The Tables result the coefficient (β) of the variables, Z-Ratio, and Marginal effect. Marginal effect is a score indicating chances or possibilities that would bring about toY = 00, 01, … , 05. Y = 00 means none of the farmers have perception of/ apply the agricultural technology while Y = 01 specifies the lowest level of perception and application, ordering to the highest level which is Y = 05, subsequently. By this, the symbol +/- represents the possibility that would be increased or reduced.

Table2 The estimation value of factors that have influences on farmers' perception of agricultural technology represented through Order Probit Model

			Marginal effect					
Variable	**Coefficient (β)**	**Z-Ratio**	Y = 00	Y = 01	Y = 02	Y = 03	Y = 04	Y = 05
AGE	-0.014	0.150	0.0001	0.0007	0.0044	0.0003	-0.0020	-0.0037
SEX	0.337	0.041**	-0.0023	-0.0192	-0.1037	-0.0046	0.0474	0.0824
EDU 01	0.510	0.091*	-0.0017	-0.0180	-0.1463	-0.0353	0.0464	0.1549
EDU 02	-0.199	0.432	0.0014	0.0119	0.0616	0.0013	-0.0290	-0.0472
EDU 03	-0.192	0.389	0.0013	0.0112	0.0595	0.0018	-0.0277	-0.0461
EXP	-0.006	0.496	0.0000	0.0003	0.0017	0.0001	-0.0007	-0.0014
CAPITAL	-0.326	0.381	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAND	0.003	0.713	0.0000	-0.0001	-0.0008	-0.0001	0.0003	0.0007
LABOR	-0.006	0.381	0.0000	0.0003	0.0017	0.0001	-0.0007	-0.0014
TRANING	0.073	0.035**	-0.0004	-0.0038	-0.0224	-0.0018	0.0098	0.0185
MEMBER	0.067	0.517	-0.0004	-0.0035	-0.0207	-0.0016	0.0091	0.0171
AGENT	0.766	0.000***	-0.0045	-0.0379	-0.2259	-0.0267	0.0902	0.2047

Denote *Significant at0.10 Log likelihood function -271.7182

** Significant at0.05	Restricted log likelihood	-300.6744
*** Significant at0.01	Chi squared	57.91236
	Degrees of freedom	12

Table3 The estimation value offactors that have influences on farmers' application of agricultural technology represented through Order Probit Model

			Marginal effect					
Variable	**Coefficient(β)**	**Z-Ratio**	Y = 00	Y = 01	Y = 02	Y = 03	Y = 04	Y = 05
AGE	-0.009	0.413	0.0000	0.0003	0.0026	-0.0013	-0.0016	0.0000
SEX	0.278	0.114	-0.0002	-0.0110	-0.0846	0.0462	0.0492	0.0004
EDU 01	-0.625	0.054*	0.0010	0.0399	0.1929	-0.1510	-0.0824	-0.0004
EDU 02	-0.062	0.815	0.0000	0.0023	0.0187	-0.0100	-0.0111	-0.0001
EDU 03	-0.575	0.014**	0.0007	0.0317	0.1779	-0.1257	-0.0841	-0.0005
EXP	-0.008	0.326	0.0000	0.0003	0.0025	-0.0013	-0.0015	0.0000
CAPITAL	0.424	0.258	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
LAND	-0.006	0.392	0.0000	0.0002	0.0019	-0.0009	-0.0011	0.0000
PERCEP	1.344	0.000***	-0.0008	-0.0484	-0.4047	0.2040	0.2480	0.0019
LABOR	0.009	0.185	0.0000	-0.0003	-0.0027	0.0013	0.0016	0.0000
TRANING	0.026	0.459	0.0000	-0.0009	-0.0079	0.0040	0.0048	0.0000
MEMBER	0.254	0.021**	-0.0001	-0.0092	-0.0765	0.0385	0.0469	0.0004
AGENT	0.507	0.013**	-0.0003	-0.0175	-0.1486	0.0672	0.0984	0.0009

Denote	*Significant at0.10	Log likelihood function	-189.1967
	** Significant at0.05	Restricted log likelihood	-305.8226
	*** Significant at0.01	Chi squared	233.2517
		Degrees of freedom	13

Discussion

Factors that have influences on farmers' perception of agricultural technology

The study of these factors finds that the value of Log likelihood function is -271.7182 while Restricted log likelihood is -300.6744, and 57.91236 is the value of Chi squared, accordingly. The factor that has effects on perception of the farmers withthe statistical significance at 99% of confidence level is the relationship between agricultural staff and the farmers (AGENT). Gender of the farmers (SEX) and training experience on agriculture (TRAINING) are at 95% of confidence level, whereas Bachelor's Degree or higher level of education (EDU 01) has impacts on farmers' perception of technology at 90% of confidence level. According to Table 2, the descriptions of

each factor are arranged descending from most to least the factor has an importance and strong effects on farmers' perception as followed:

The relationship between agricultural staff and the farmers (AGENT) is the first statistically significant factor and has strongest effects on farmers' perception of technology (Yaron, Dinar & Voet, 1992) for longan production with the coefficient of 0.766. When this variable is investigated with the marginal effect at the highest level of farmers' perception of technology (Y = 05), the coefficient is 0.2047. This could be regarded that if the agricultural staff of each agricultural area have a good relationship with the farmers, the possibility these farmers percept longan production technology at the highest level would be increased to 20.47%. By this, Department of Agricultural firstly have to focus on creating good and intimate relationships between the staff and the farmers if they would like the farmers to percept agricultural technology at the highest level (Genius et al., 2013).

Bachelor's Degree or higher level of education (EDU 01) is the second statistically significant factor and has strong effects on perception of the farmers. This variable has the coefficient of 0.510. When investigating this variable with the marginal effect at the highest level of farmers' perception of technology (Y = 05), the coefficient is 0.1549. This could be described that the higher education level of the farmers, the more possibility the farmers would percept agricultural technology (Waller et al., 1998) at the highest level increasing to 15.49% because the farmers who have a Bachelor's Degree or higher level of education could access to sources and knowledge more than the others (Place et al., 2002).

Sexes of the farmers (SEX) is statistically significant factor and has effects to farmers' perception of technology for longan production at 95% of confidence level with the coefficient of 0.337. Sexes of the farmers have a close relationship with the farmers' perception of technology, especially male that has a level of perception higher than female. That is to say, male has an important role in agriculture than female. Thus, they are more familiar in the agricultural areas. Additionally, most of male is a head of the family; they are a representative of their family to participate in the meetings and the activities of the village (Omonona et al., 2005; Mignouna et al., 2011).

Training experience on agriculture (TRAINING) is statistically significant factor and has effects on the farmers' perception at 95% of confidence level with the coefficient of 0.073. Investigating the influences of this variable with the marginal effect at the highest level of the perception of technology (Y = 05), it is found that the coefficient is 0.0185. This could be implied that if the farmers have a chance to participate in the meetings or trainings on longan production (Ayse Sezgin, Tuğba Erem Kaya, Murat külekçi, Hediye kumbasaroğlu, 2010; Swagata ''Ban'' Banerjee, Steven W. Martin, Roland K. Roberts, Sherry L. Larkin, James A. Larson, Kenneth W. Paxton, Burton C. English, Michele C. Marra, and Jeanne M. Reeves, 2008), 1.85% of their perception of technology

would be increased. Therefore, Department of Agriculture should give more precedence to the meetings and trainings in order to improve the farmers' perception of agriculture technology.

Factors that have influences on farmers' application of technology

The results of these factors show that the value of Log likelihood function is -189.1967; Restricted log likelihood is -305.8226; and Chi squared values at 233.2517. Factor that is statistically significant and has influences on farmers' application of technology at 99% of confidence level is the perception level of farmers on longan production (PERCEP). Meanwhile, high school education or vocational education (EDU 03), numbers of agricultural groups that the farmers are the members of (MEMBER), and the relationship between agricultural staff and the farmers (AGENT), are at 95% of confidence level. Lastly, 90% of confidence level is found in the factor of Bachelor's Degree or higher level of education (EDU 01). As it is described in Table 3, the descriptions are presented by most-to-least significant and intense factors that have impacts on Lamphun farmers' application of technology for longan production as followed:

Farmers' perception level of technology (PERCEP) is the most statistically significant factor impacting on technology application for longan production among the farmers, with 1.344 of the coefficient value. From this outcome, it could be said that Department of Agriculture should emphasize on improving knowledge and perception of agricultural technology toward the farmers in order to increase technology application. When this variable is closely examined with the marginal effect, it has the coefficient of 0.0019 at the highest level of technology application (Y = 05) that it has effects on. The marginal effect at the high level of technology application (Y = 04), however, has a higher value of the coefficient which is 0.2480. The value of this level is far higher than the value in the highest level. Thus, the increasing perception of technology may influence on the application of technology among the farmers at the high level (Polson and Spencer, 1991; Voh, 1982; Osuntogun et al., 1986; Kebede et al., 1990; Aloyce R.M. Kaliba, Hugo Verkuijl, Wilfred Mwangi, 2000), but could not reach the highest level. According to the interviews with the farmers, they give the answers that some technologies are not suitable for their farms and could not help increasing the crops. As a result, those technologies are not applied to use in the farms. This issue is interesting to research in details later.

The relationship between agricultural staff and the farmers (AGENT) is the statistically significant factor and has the most impacts on both farmers' perception and application of technology with the coefficient of 0.507. This could be explained that a good and intimate relationship between the staff and the farmers would increase the level of technology application among the farmers (Genius et al., 2010). The value of the coefficient of the marginal effect at the highest level of technology application (Y = 05) that this factor has influences on is 0.0009. The coefficient is less when comparing to the coefficient in the high level of technology application (Y = 04) which is 0.0984. To be said, a good and intimate relationship between agricultural staff and the farmers may effect on farmers'

higher application of technology, but could not reach the highest level. The result of this variable is interesting to research in details later.

Numbers of agricultural groups that the farmers are the members of (MEMBER) is the statistically significant factor and has effects on farmers' application of technology in agricultural areas at 95% of confidence level with the coefficient of 0.254. This could be described that numbers of agricultural groups that the farmers are participated in, have impacts on the application of technology for longan production among the farmers. Because of being a member of an agricultural group helps the farmers to share knowledge and know each other (Mignouna et al., 2011). By this, the farmers are confident to apply more technologies in their farms. The examination of the impacts of this variable with the marginal effect at the high level of technology application (Y = 04) is 0.0469 of the coefficient value, which is far higher than the value at the highest level (Y = 05) that has the coefficient of 0.0004. Being a member of an agricultural group, thus, may support the farmers to apply more technologies in farming at the high level but could not reach the highest level. The research in details on this outcome would be conducted later.

Bachelor's Degree or higher education level (EDU 01) is the statistically significant factor and has the most influences on both farmers' perception and application of technology for longan production. Surprisingly, the coefficient of this variable is (-0.625). This means that high level of education of the farmers reduces the application of technology in agriculture. To answer this conclusion, examining the influences of this variable on technology application at the highest level (Y = 05) finds that the coefficient is -0.0004. The value is minus and far less than the value at the low level of technology application (Y = 02) which has the coefficient of 0.1929. This could be implied that farmers who have high level of education would reduce the application of technology, because they have self-confidence. They do not quite trust and are not confident in the technology that Department of Agriculture informs to them. (Rachel J. Johnson, Damona Doye, David L. Lalman, Derrell S. Peel, Kellie Curry Raper, Chanjin Chung, 2010)

High school education or vocational education (EDU 03) has a minus value of the coefficient of (-0.575). The result could be explained that farmers who have high school education or vocational education would reduce applying technology in their farms, like those who have an education in the higher level. To support this outcome, this variable has impacts on farmers' application of technology at the highest level (Y = 05) with the coefficient of -0.0005 of the marginal effect. When comparing this value to the coefficient at the low level of technology application (Y = 02) that this variable has impacts on, the value is far less than the value in the low level, which has the coefficient of 0.1779. From this far different result, it could be said that farmers who have high school education or vocational education would possibly reduce the application of technology. Causes of this effect are the preservation and confidence of old technologies that are inherited by the ancestors of the farmers. The inherited technologies assure the farmers with their similar incomes in each year. As a result, the farmers are not confident and do not trust to apply new technologies that are different from the technologies they have used in the past. Besides, anyone could

not guarantee the quantity of crops the farmers would get by using new technologies. The farmers, therefore, possibly reduce the application of new technologies.

Conclusion

In the past, longan cultivation was main occupation and main income of farmers' family in Lamphun Province. As time passes longan production that was main income of famers became to low quality of production, poor quality of the yield and it will become lower in every year. Due to the low quality product constraints, it results in incomes decrease that can be related to low quality of life of the farmers. Thus most of farmers turn to loan money and some of them sold their some agricultural areas in order to receive money for spending in their household and being costs of longan production, it result in increases household debt. Nowadays, there are several technological practices which help in longan production and fine-quality longan growing but most farmers do not know nor accept this technologies yet. So, the researcher wanted to study on factors affecting the perception and adoption of the longan production technologies of longan farmers in Lamphun province, as object to acknowledge problems occurred, create appropriate guidelines, and adjust the research plan to improve the quality of longan, reduce the costs, and increase profitability from selling high quality products. In this research, the researcher has collected the questionnaires from 400 farmers who plant longan in Lamphun Province, before analyzing the data and making a result. According to the result, it finds that factors which have influences on farmers' perception of agricultural technology are including the relationship between agricultural staff and the farmers (AGENT), gender of the farmers (SEX), training experience on agriculture (TRAINING), and Bachelor's Degree or higher education level (EDU 01). On the contrary, the application of technology in agricultural areas is depended on the farmers' perception level of technology (PERCEP), high school education or vocational education (EDU 03), numbers of agricultural groups that the farmers are the members of (MEMBER), the relationship between agricultural staff and the farmers (AGENT), and Bachelor's Degree or higher education level (EDU 01). The education level of the farmers (EDU 01 and EDU 03) causes the farmers to reduce the chance of applying new agricultural technology. The farmers, thus, possibly apply technology in the low level rather than reach to the highest level. Other factors, which are the farmers' perception level of technology (PERCEP), numbers of agricultural groups that the farmers are the members of (MEMBER), and the relationship between agricultural staff and the farmers (AGENT), have effects on improving the level of technology application among the farmers to the high level but could not reach to the highest point. The issue about this result is interesting to research in deep details later.

Acknowledgement

I would like to express my sincere appreciation to all thesis advisors and my family for their assistance, advice, and encouragement during conducting this thesis. I also wish to thank all farmers for their corporation on this project. Finally, the completion of this research could not have been possible without the assistance of Faculty of

Economics, Chiang Mai University, who support research fund throughout this dissertation. Their assistance is deeply appreciated.

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