

# Factors Affecting Good Agricultural Practice in Pineapple Farming in Thailand

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## **Abstract**

The main objective of this study is to investigate factors affecting the Good Agricultural Practice (GAP) in pineapple farming in Thailand. A Logit model is applied to a sample of 350 growers. This study identified of significant variables with respect to their marginal effects i.e. the average farm price, having contract with buying companies, age, average yield, being a progressive farmer, food safety and food standard requirements of the importing countries, and the farmer's own environmental concern. The finding suggest that price incentive as well as price stability and market certainty via contract farming are relatively effective policy measures. To accelerate adoption of GAP, appropriate strategies to enhance growers' concern are strongly recommended.

**Key words:** *Thailand, pineapple farming, good agricultural practice system, logit model, policy variables*

## **I. INTRODUCTION**

Thailand, traditionally an agricultural country and a major food exporter, is undergoing rapid rate of structural change and industrial growth. While decreasing as a share of GDP, agricultural products occupied the top position in exports until being unseated by industrial products in the 1990s. The encouragement of agro-industry since the 1970s led to the development of exports (beside rice such as rubber, sugar cane, and broiler chickens) making this the most important domestic industry. In the 1980s, shrimp farming began, and frozen shrimp export to Japan and USA grew rapidly. Thailand's food processing industry has been developing at a rapid rate throughout the past decade despite suffering a slight setback during the 1997-1998 recession. Thailand is able to capitalize on an abundant supply of raw materials from local agricultural production and is rich in natural resources. Thailand is one of the few countries in the Asia Pacific region that has the capacity to produce more food than it consumes (Canadian Embassy in Bangkok, 2000). Thailand is one of the world's leading producers and an exporter of processed food products including canned pineapple, and is home to more than 7,000 food processors. Most of these firms are small and medium size companies, which for the most part are serving the domestic market. The larger companies are generally geared to produce for the export market and, accordingly, must produce products of a quality necessary to meet international standards. Thailand's food processing sector is heavily export-oriented with about 50 % of production sold outside the country.

The global trade agreement GATT/TRIPS under the WTO, and various international standards such as Codex Alimentary Standard, ISO (International Standard Organization) 9001 and ISO 14000, encourage growing care about the products' quality, appropriate

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waste management, as well as environmental protection (BOIOT, 2000). Consumers, especially in the EU and the USA market, are increasingly concerned about the safety of their food as well as local production circumstances. The EU common market is consolidating and harmonizing the rules for food safety and for labeling, while Canada, Mexico and the USA are taking steps to harmonize regulation within the North American Free Trade Agreement (NAFTA). Food processors, like Thailand, who export to the two largest blocks of food importers, have to look for options to comply cost-effectively with import regulations or otherwise face costly rejections (Humpal and Guenette, 2000). The standards resulting from these regulations need to be considered as a basic requirement if access to the world market is the objective. For developing countries that depend on agro-industrial exports, the stakes are high in this regard because food exports can contribute to rural growth and poverty alleviation.

Thailand's processed food exports has been facing environmental and quality pressures and constraints in the global trade. Domestically, Thailand is also observing a growing public awareness of environmental problems, particularly among the professional class and higher income groups in Bangkok metropolitan area. Almost all ranks of the influential middle class in Thailand demand a higher quality of life to accompany their rising income. Therefore, environmental issues and public health concerns will continue to dominate the political and economic agendas for sometime, and will receive large media coverage and publicity. Clearly, there is a growing public support in Thailand for improving environmental legislation and enforcement. International pressures, linked to global and regional environmental concerns, are also driving domestic environmentally sensitive markets and will further encourage rigorous enforcement of Thailand's new and tougher environmental laws.

Pineapple production is an example of this development. Pineapple producers face (inter)national pressures to adapt their production processes and products accordingly not until 2002, pineapple production at the farm level in Thailand had not been subject to any policies that promoted the environmental friendly and food safety measures. In 2002 foreign importers of foods from Thailand demanded the fulfillments of certain food standards and food safety assurances. In response, the Thai government launched the environmental friendly and food safety production policy and for pineapple farming assigned the responsibility to the Department of Agriculture. This department cooperated with the Department of Agricultural Extension, which has local staff that works closely with farmers, to campaign implementation of the Good Agricultural Practice (GAP) at the farm level. The GAP system requires that farm records are made of all stages of pineapple farming, restricts the use of pesticides and chemicals only to those that are acceptable by importing countries and requires the use of these pesticides and chemicals in the correct manner and to the necessary extent. It also requires the appropriate storage of agricultural chemicals to avoid environmental damage, due to e.g. contamination of irrigation water. Moreover, environmental friendly and attentive crop caring practices are promoted, proper use of harvesting and post harvesting methods and techniques are enforced including the implementation of accurate grading methods for the harvested pineapples. After introducing the GAP system to pineapple growers, the Department of Agriculture staff has monitored the farmers' practices on a regular basis. If farmers are found to have fully complied with the GAP system requirements they will be awarded a GAP certificate by the Department. This study has found that in 2003 the majority or 77.7% of the surveyed pineapple growers in the province of Prachuap Khiri Khan have already been certified.

## II. OBJECTIVE OF THIS STUDY

The objective of this study is to investigate factors affecting the adoption of Good Agricultural Practice (GAP) systems that ensure food safety and environmentally friendly production practices.

## III. METHODOLOGY

In this study, the factors leading the farmers adopt the Good Agricultural Practice (GAP) for pineapple farmers are investigated. The Logit Model is used for binary dependent variables analysis.

### *Logit Model*

In the situation where an individual makes a decision between the responses of “yes” and “no” and the choice to say “yes” is affected by a set of explanatory variables, the regression model for the  $i^{\text{th}}$  individual may be written as

$$y_i = \beta_1 + \beta_2 x_{i2} + \dots + \beta_k X_{ik} + u_i \dots\dots\dots (1)$$

or  $y_i = x_i' \beta + u_i$

where

$$y_i = 1 \text{ if the choice is yes}$$

$$y_i = 0 \text{ if the choice is no}$$

and  $x_i$  is a  $k \times 1$  vector of explanatory variables. Equation (1) is called a linear probability model since the expected value of the error term is assumed to be zero [ $E(u_i) = 0$ ]. Therefore,  $E(y_i | x_i) = x_i' \beta$ .

In other terms,

$$E(y_i | x_i) = 1 \cdot p(y_i = 1 | x_i) + 0 \cdot p(y_i = 0 | x_i)$$

i.e.  $p(y_i = 1 | x_i) = x_i' \beta \dots\dots\dots(2)$

As  $p$  is the probability of  $y_i = 1$ , and  $(1 - p)$  is the probability that  $y_i = 0$ . Equation (1) indicates that the probability that an individual will say “yes” ranges from 0 and 1.

When the ordinary least squares (OLS) are applied to equation (2), the estimates of  $\beta$ 's are inefficient due to a heteroscedasticity problem. The predicted  $y_i$  may be out of 0 – 1 limit; and the usual  $R^2$  is not applicable to assess goodness of fit (Ramanathan, 1998: 603 – 604; Johnston, 1984: 424, Menard, 1995 : 7).

Alternatives to the linear probability model are Probit and Logit models. The differences between these 2 models lie on the assumption regarding the distribution of  $u_i$ . The Probit and Logit models are applicable to  $u_i$  with standard normal distribution and the standard logistic distribution, respectively.

Given that  $F(\cdot)$  is a cumulative distribution function of the standard Logit form,  $F(\cdot)$  can be written as

$$E(y_i | x_i) = F(\cdot) = L(z) = \frac{e^z}{1+e^z} = \frac{1}{1+e^{(-x_i'\beta)}} \dots\dots\dots(3)$$

where  $Z = x_i'\beta$

Equation (4) is called the “Logit Model” and is usually expressed in the logarithmic form

$$\log\left(\frac{p_i}{1-p_i}\right) = x_i'\beta \dots\dots\dots(4)$$

The parameters in binary choice models [equation (4)] are estimated by the method of maximum likelihood (Verbeek, 2000; Maddala, 1983; and Pindyck and Rubinfeld, 1998).

While the estimated parameters in equation (4) only indicate the direction of the influence on the probability, the predicted probability can be calculated from the estimated  $\beta$ 's. Using equation (3) we obtain:-

$$p_i = F(z_i) = \left(\frac{1}{1+e^{-z_i}}\right)$$

and thus  $\hat{p}_i = \left(\frac{1}{1+e^{-x_i'\hat{\beta}}}\right)$

where  $\hat{\beta}$ 's are maximum likelihood estimates. The changes in the probability could be estimated so call the marginal effect (Maddala, 1988; Verbeek, 2000). For example, the marginal effect of  $x_2$  equals to

$$\frac{\partial p_i}{\partial x_{i2}} = \frac{e^{(\hat{\beta}_1 + \hat{\beta}_2 x_{i2})}}{(1+e^{\hat{\beta}_1 + \hat{\beta}_2 x_{i2}})} \hat{\beta}_2$$

The goodness of fit of the model is indicated by so-called pseudo  $R^2$ , the accuracy of prediction. The pseudo  $R^2$  is expressed as

$$\text{Pseudo } R^2 = 1 - \frac{1}{1 + 2(\log L_1 - \log L_0)/n}$$

Where  $\log L_1$  and  $\log L_0$  are the maximum likelihood values of unrestricted and restricted models, respectively;  $n$  denotes number of observations. An alternative measure is McFadden  $R^2$ ,

$$\text{McFadden } R^2 = 1 - \frac{\log L_1}{\log L_0}$$

This study seeks to answer the following questions.

- Have the pineapple growers adopted the Good Agricultural Practice (GAP)?
- What are the characteristics of pineapple growers who have adopted the GAP and what are other economic factors that affect the chance or probability of the adoption of GAP?

The Logit models for GAP is formed.

$$\text{Prob}(GAP = 1) = \frac{1}{1 + e^{-x_i' \beta}} \dots\dots\dots (5)$$

- where  $x_i'$  =  $x_1, x_2, x_3, \dots, x_{14}$
- GAP = 1 if the pineapple grower adopts GAP  
= 0 otherwise
  - $x_1$  = 1 if the pineapple grower is male  
= 0 if the pineapple grower is female
  - $x_2$  = age of the pineapple grower (years)
  - $x_3$  = 1 if the pineapple grower is completed at least primary education  
= 0 otherwise
  - $x_4$  = the pineapple grower's experience (years)
  - $x_5$  = average yield (kg/rai)
  - $x_6$  = average price (baht/kg)
  - $x_7$  = 1 if the pineapple grower has contracted with the canned pineapple company  
= 0 otherwise
  - $x_8$  = 1 if the farmer is an advanced grower  
= 0 if the farmer is a traditional grower
  - $x_9$  = 1 if the pineapple grower agrees with the food safety guidelines by the importing countries  
= 0 otherwise
  - $x_{10}$  = 1 if the pineapple grower has adopted GAP without the direct force of laws  
= 0 if the pineapple grower has adopted GAP due to the direct force of laws
  - $x_{11}$  = 1 if the pineapple grower has adopted GAP because of the pressure from neighbouring communities  
= 0 if the pineapple grower has adopted GAP in the absence of the pressure from neighbouring communities
  - $x_{12}$  = 1 if the pineapple grower has adopted GAP because of the pressure from NGOs  
= 0 if the pineapple grower has adopted GAP in the absence of the pressure from NGOs

- $x_{13}$  = 1 if the pineapple grower has adopted GAP because of the pressure from the Pineapple Growers' Association  
 = 0 if the pineapple grower has adopted GAP in the absence of pressure from the Pineapple Growers' Association  
 $x_{14}$  = 1 if the pineapple grower has adopted GAP because of his own environmental concern  
 = 0 if the pineapple grower has adopted GAP despite the absence of his own environmental concern  
 $\beta_0, \beta_1, \beta_2, \dots, \beta_{13}$  = parameters

#### IV. PINEAPPLE PRODUCTION IN THAILAND

##### Thai pineapple production for the global market

Pineapple is a plant that grows well in tropical zones, and since Thailand is located in such a zone, the potential to grow significant amounts of pineapple is high. Indeed, figures for pineapple exports from Thailand illustrate this. Thailand is the largest pineapple producer in the world. Table 1 provides world pineapple production figures for the 2000-2003 period. Throughout these five years, Thailand's pineapple production led the world, although it dropped from 16.2% of world production, in 2000 to 14.6% in 2001, and to 12.7% in 2003. Second and third were the Philippines and Brazil, with significantly lower percentages of world share.

**Table 1** World fresh pineapple production in million tons in the period 2000-2003

Country	Year							
	2000		2001		2002		2003	
	Quantity	Share	Quantity	Share	Quantity	Share	Quantity	Share
Thailand	2.2	16.2%	2.0	14.8%	1.7	11.6%	1.9	12.2%
Philippines	1.5	11.0%	1.5	11.1%	1.6	11.0%	1.7	11.3%
Brazil	1.3	9.6%	1.4	10.4%	1.4	9.6%	1.4	9.3%
China	1.3	9.6%	1.4	10.4%	1.3	8.9%	1.3	8.7%
India	1.0	7.4%	1.0	7.4%	1.1	7.5%	1.1	7.3%
Nigeria	0.9	6.6%	0.8	5.9%	0.9	6.2%	0.9	6.0%
Others	5.4	39.7%	5.4	40%	6.6	45.2%	6.6	44.7%
World	13.6	100%	13.5	100%	14.6	100%	15.0	100%

Sources: 1. Thailand data from Office of Agricultural Economics  
 2. Others countries data from Food and Agriculture Organization of the United Nations

Thailand's pineapple production fluctuated throughout the last eight years (Table 2). These fluctuations can be explained to a large extent by changing prices. So did the low average price of 3.3 baht/kg in 1997 induced the farmers shift to other crops resulting the following year in a very high price of 5.2 baht/kg at the farm gate. As a response the farmers expanded the planted area leading to increased pineapple production and relatively low average price in the years 1999, 2000 and 2001. This again triggered farmers to reduce the planted area. In the last three years pineapple prices were stable around 4 to 4.5 bath/kg causing an increase of 9% and 5% in the country's production to almost 2 million tons in 2004.

**Table 2** Thai fresh pineapple production during 1997 – 2004, whole kingdom

Year	Yield		Average farm price	
	(1,000 tons)	% change	(Baht/kg)	% change
1997	2,083		3.3	
1998	1,786	-17	5.2	37
1999	2,372	25	2.4	-118
2000	2,248	-6	2.0	-21
2001	1,978	-14	2.0	2
2002	1,738	-12	4.3	110
2003	1,899	9	4.0	-6
2004	1,994	5	4.5	13

Sources: Office of Agricultural Economics; own calculations

Note: 1 USD is about 41 Baht

Thailand exports pineapple in three types: canned pineapple, pineapple juice and fresh pineapple. Although the total exported amount differs slightly over the three years (Table3), canned pineapple accounted for more than three quarters of the country's pineapple product exports, while 20% is exported in the form of pineapple juice. The amount of fresh pineapple exported is stable around 6,700 tons or only 1% of the total Thai pineapple exports.

**Table 3** Pineapple export in 1,000 tons classified by products during 2002-2004

Year	Canned		Fresh		Juice	
	Quantity	Share	Quantity	Share	Quantity	Share
2002	359	78%	6.6	1%	97	21%
2003	450	76%	6.8	1%	134	23%
2004	451	79%	6.7	1%	115	20%

Sources: Office of Agricultural Economics

## V. THAI PINEAPPLE PRODUCTION AT FARM LEVEL

This section elaborates the case study at the farm level. The 350 interviewed pineapple growers all originate from the province of Prachuap Khiri Khan some 280 south of Bangkok, the major pineapple production centre in Thailand with almost half of the national production. In 2003 a little more than 250,000 rai or 40,000 hectare of pineapple was cultivated in Prachuap Khiri Khan, increasing with 16% a year later to 290,738 rai or 46,518 hectare. Within the province, a purposive random sampling is used in selecting the farmers for the interviews. Two criteria are used to include the farmers in the group that is interviewed. The first one is that farmers have to be part of the food chain. This means that they sell (the majority of) their products to a middleman or the food processing factory and do not directly sell their product to the consumers at the market or by direct sale in cities like Bangkok. However, the farmers can sell their products to the small and medium factories that are part of the national food chain and are thus not necessarily to the medium- and large sized factories that are also part of this case study. The other criteria is that farmers must be aware of the presence of environmental friendly practices. Because all pineapple farmers are visited by the staff of the Agricultural Extension office of the

province all but a few of the initially approached farmers match this requirement and were willing to be interviewed. The interviews were conducted in 2003.

### General information about pineapple growers under study

From the interviews conducted for this study, it is found that the majority of the interviewees, 80.3%, are male while the remaining 19.7% are female. More than half or 62.9% of these pineapple growers have completed primary school and 33.7% finished secondary education and the remainders have higher education as shown in Table 4. While their average age is 47 years, the age structure shows that 38.3% were 41-50 years, and 27.1% were 51-60 years old. The oldest pineapple grower was 75 years old. The average farming experience was 16 years. However, the 5 year cohorts between 6 and 20 year all are a quarter of all farmers.

**Table 4** Characteristics of Pineapple Growers in the case study (N=350)

<b>Characteristic</b>	<b>No. of farmers</b>	<b>Percentage</b>
<b>Sex</b>		
Male	281	80.3
Female	69	19.7
<b>Education</b>		
Primary	220	62.9
Secondary	118	33.7
Certificate	4	1.1
Bachelor	7	2.0
Master	1	0.3
<b>Age(year)</b>		
20-30	12	3.4
31-40	84	24.0
41-50	134	38.3
51-60	95	27.1
>60	25	7.1
Maximum age of 75	Minimum age of 25	Average age 47.3
<b>Experience (year)</b>		
1-5	26	7.4
6-10	90	25.7
11-15	89	25.4
16-20	81	23.1
>20	64	18.3
Max. experience 48 years,	Min. experience 1 year,	On average 16 years

Source: Survey

Although the average farm size was 42 rai, the largest farmer appeared to have 700 rai of pineapple land. Average yield was 4,996 kg/rai, while the maximum yield reached 10,000 kg/rai. Average gross income was 17,998 baht/rai, an extreme case earned 35,000 baht/rai. Typically, 37.1% and 31% earned gross income in the range of 15,001-20,000 baht/rai and 20,001-25,000 baht/rai respectively, while the average cost of production was 10,552

baht/rai, the majority or 59% of farmers spent 5,001-10,000 baht/rai and an extreme case invested up to 22,500 baht/rai (Table 5).

**Table 5** General farming characteristics of Pineapple Growers in the case study (N=350)

<b>Characteristic</b>	<b>No. of farmers</b>	<b>Percentage</b>
<b>Area (rai)</b>		
1-20	167	47.7
21-40	75	21.4
41-60	49	14.0
61-80	28	8.0
81-100	12	3.4
>100	19	5.4
Maximum area 700 rai	Minimum area 1 rai	Average area 75 rai
<b>Yield (kg/rai)</b>		
1,000-2,000	4	1.1
2,001-4,000	79	22.6
4,001-6,000	226	64.6
6,001-8,000	39	11.2
8,001-10,000	2	0.6
Max. yield 10,000 kg/rai	Minimum yield 1,500 kg/rai	Average yield 4,997 kg/rai
<b>Average income (Baht/rai)</b>		
5,000-10,000	25	7.1
10,001-15,000	72	20.6
15,001-20,000	130	37.1
20,001-25,000	107	30.6
25,001-30,000	12	3.4
>30,000	4	1.2
Maximum 35,000 Baht/rai	Minimum 6,000 Baht/rai	Average 17,998 Baht/rai
<b>Average investments (Baht/rai)</b>		
<5,000	6	1.7
5,000-10,000	206	58.9
10,001-15,000	111	31.7
15,001-20,000	23	6.6
20,001-25,000	4	1.2
Maximum 22,500 Baht/rai	Minimum 2,850 Baht/rai	Average 10,552 Baht/rai

Source: Survey

Note: 6.25 rai = 1 hectare

## Factors affecting adoption of the Good Agricultural Practice (GAP) system

The analysis on factors influencing pineapple growers' adoption of GAP systems is based on the Logit model estimated by maximum likelihood method yielded findings which are statistically significant at  $\chi^2 = 59.7$  level with McFadden  $R^2 = 0.16$ . This should be acceptable since Aree Wiboonpongse (2004) suggested that the value of McFadden  $R^2 = 0.14$  was accepted in the work of Armah and Kennedy (2000). This model can give a accuracy of prediction up to 78%.

Factors that show no significant relationship with the decision to implement GAP systems are found to be gender ( $X_1$ ), education ( $X_3$ ), years of experience ( $X_4$ ), absence of legal force ( $X_{10}$ ), pressure from neighboring communities ( $X_{11}$ ), pressure from NGOs ( $X_{12}$ ), and pressure from pineapple growers association ( $X_{13}$ ).

The factor that contributes to the adoption of GAP, at .01 statistically significant level, is the average farm price ( $X_6$ ) and, at .05 level, the contract with buying companies ( $X_7$ ).

Meanwhile, factors that have influence at 0.10 statistically significant level are age ( $X_2$ ), average yield ( $X_5$ ), being a progressive farmer ( $X_8$ ), food safety and food standard requirements of the importing country ( $X_9$ ), and the farmer's own environmental concern ( $X_{14}$ ) (Table 6). More details are summarized below.

**Average farm price ( $X_6$ ):** Pineapple growers who get a higher than average farm price are more likely to adopt the GAP system than those who obtain a low farm price. The value of marginal effect of 0.155 implies that an increase of 1 baht above the average price of 3.6 baht/kg will increase the likelihood of pineapple growers to adopt GAP systems by 15.5%. This price factor has the highest impact on farmer decisions. Table 2 shows that the price of pineapple at the farm gate found by the Office of Agricultural Economics in 2003 was 4 bath/kg, this is 0.4 bath/kg higher then the price found in our interviews in that year. However, the variation in the price of pineapple at farm gate found in our research is between 2 and 5.2 baht/kg, the same as the variation in price in recent years.

**Contract farming ( $X_7$ ):** Growers who have contracts with pineapple buying companies are more likely than other groups to adopt the GAP system. Any farmer who enters a contract with a pineapple processing company displays that the likelihood to implement GAP will increase by 14%, and hence the contract is the next most influential factor after price. Almost 23% of the interview farmers indicated they entered a contract in 2003 for a part or their whole pineapple crop. Obviously, the contracts have often conditions on GAP introduction.

**Progressive farmers ( $X_8$ ):** Growers characterized as progressive farmers have greater tendency than traditional farmers to adopt GAP. The value of marginal effect at 0.099 suggests that if the pineapple growers are progressive or innovative, the likelihood to adopt the GAP will increase by 9.9%. Almost 90% of the farmers interviewed were classified as progressive farmers. This is due to the fact that most of them have experience in pineapple farming and the province of Prachuap Khiri Khan is, as the major pineapple growing area, targeted as one of the first to introduce new production methods by the government as well private companies.

***Environmental concern (X<sub>14</sub>):*** Growers having environmental concern have a greater tendency than other groups to adopt the GAP system. The value of a marginal effect of 0.082 implies that farmers who got training, or gained knowledge, regarding GAP or other food safety practices, will have a higher likelihood (of 8.2%) to adopt the GAP system. Almost 90% of the farmers interviewed were classified as progressive farmers. The reasons for this are identical as previously stated for progressive farmers.

***Standard requirements of importing countries (X<sub>9</sub>):*** Growers who agree and comply with food safety and standard requirements of importing countries have greater tendency to implement GAP. The impact of this factor will be an increase in the probability of the GAP adoption by 7.8%. With 61% of the farmers that agree on this point, this is a strikingly large group in a society in which foreign influence is regarded as unwanted. This is probable due to the fact that farmers in the province of Prachuap Khiri Khan have a tradition for producing for the exporting pineapple industries.

***Age of the pineapple grower (X<sub>2</sub>):*** This factor coefficient has a negative sign, indicating that the younger the grower (but not younger than 22 years old) the more likely he/she will accept the GAP system. Based on the value of the marginal effect, any farmer who is one year younger than the average age (42 years old) will increase in likelihood to accept GAP by 0.4 %, which is quite moderate but can be large in the case of farmers in their early twenties.

***Average yield (X<sub>5</sub>):*** Growers having a higher than average yield are more likely to adopt GAP. However, the yield impact is quite low because 100 kg/rai increase in yield above the average (4,997 kg/rai) will probably lead to an increase in GAP adoption by 0.3 %.

There are a number of factors that the involved government agencies (as the Department of Agriculture and Department of Agricultural Extension) must take into account when promoting farmers to adopt the GAP system, or other food safety measures. The fact that in several cases contract farmers have to commit themselves to follow GAP to ensure food safety and standards as required by the buying companies, make the promotion of contract farming to realize more GAP. Progressive farmers can be an effective target group for policy makers because they are more ready to learn and adopt innovative practice.

The Vice-President of the Thai Pineapple Growers Association remarked that all pineapple growers would be able to pursue GAP, if they were given some time for experimenting and incorporating the Good Agricultural Practices (Vice-President of the Thai Pineapple Growers Association, 2003). According to the vice-president, organic farming remains problematic for both independent growers and those under contract farming arrangements, because farmers will always try to maximize their crop yield rather than put emphasis on low external input and sustainable agriculture. Without chemical fertilizers to control the flowering of pineapples, yields per rai (0.16 hectare) and hence farm income levels-would be significantly lower, which might jeopardize sufficient return on investments or even affect the farmers' livelihood.

**Table 6** The result of Logit model by maximum likelihood method of Thai pineapple growers' GAP adoption

Variable	Maximum Likelihood Estimates			Marginal effect		
	Coefficient	Standard Error	T-stat	Coefficient	Standard Error	T-stat
One	-4.608	1.5726	-2.93***	-0.66350	0.22426	-2.96***
X <sub>1</sub>	0.464	0.3558	1.30	0.06682	0.05112	1.30
X <sub>2</sub>	-0.031	0.0178	-1.72*	-0.00442	0.00254	-1.73*
X <sub>3</sub>	0.158	0.3132	0.51	0.02280	0.04506	0.51
X <sub>4</sub>	0.022	0.0194	1.10	0.00309	0.00279	1.11
X <sub>5</sub>	0.0002	0.0001	1.85*	0.00003	0.00002	1.86*
X <sub>6</sub>	1.075	0.3015	3.56***	0.15470	0.04188	3.70***
X <sub>7</sub>	0.972	0.3886	2.50**	0.13990	0.05532	2.53**
X <sub>8</sub>	0.685	0.4153	1.65*	0.09860	0.05975	1.65*
X <sub>9</sub>	0.539	0.3212	1.68*	0.07760	0.04596	1.69*
X <sub>10</sub>	0.091	0.3217	0.28	0.01310	0.04630	0.28
X <sub>11</sub>	0.471	0.3058	1.54	0.06774	0.04364	1.55
X <sub>12</sub>	0.013	0.4012	0.03	0.00186	0.05776	0.03
X <sub>13</sub>	-0.545	0.4494	-1.21	-0.07848	0.06465	-1.21
X <sub>14</sub>	0.566	0.3170	1.78*	0.08155	0.04558	1.79*

Source : Survey and Calculated

Note :  
 \*\*\* Significant at 1 percent level  
 \*\* Significant at 5 percent level  
 \* Significant at 10 percent level

Log-likelihood function -155.6  
 Restricted log-likelihood -185.7  
 Chi-squared 60.2  
 McFadden R<sup>2</sup> = 0.16  
 Accuracy of prediction = 78 %

## VI. CONCLUSION

From this study, it is found that most pineapple growers, particularly those under contract farming, are willing to follow the advice of canned pineapple companies or the government's agricultural extension officers. The contract farmers have had previous experience in incorporating these advices in their farming practices. Regularly, problems of GAP introduction and implementation occur among growers who have no contract agreement with the companies, and are not familiar with farm record procedures, nor with the appropriate application of agro-chemicals.

As can be derived from the previous section there is no significant pressure from outside factors, nor governmental social, that do cause the pineapple farmers to adopt GAP. The pressures that are investigated in the case study can be divided into three categories: government laws, social factors like neighboring communities and NGO's and from another social factor that is the effect the Pineapple Growers Association can have on its members to adopt GAP practices. The interviews show that 68% of the farmers do not feel that the government is forcing by laws to adapt GAP. Although there is no governmental law that regulates the introduction of GAP still 32% of the pineapple farmers do indeed feel that it is enforced by government. This is probably due the fact that the officers of the extension offices regularly visit the farmers to promote GAP, this promotion is by these 32% mistaken as "law" enforcement. Nearly the same percentage (31%) if feels the

pressure of the Pineapple Growers Association. The association has agreed with the government on the introduction of GAP. They also have the opinion that all pineapple growers would be able to pursue GAP, if they were given some time for experimenting and implementation as mentioned in the previous section. Only 31% of the farmers feel obliged to introduce GAP as agreed by their own association. This is not because they do not know the association or do not know the fact that the association agrees on the introduction of GAP; it is because the farmers have the opinion that it is their own responsibility.

Only 18% of the farmers indicate that they experience pressure from NGO's to adopt GAP. There are no NGO's active in the field of pineapple farming or processing in the province of Prachuap Khiri Khan. It might be possible that the 18% is influenced by the actions of the NGOs. Striking is that 60% of the farmers feel community pressure to adapt GAP. May be because with 78% of the farmers having already accepted GAP, this has become the standard and is perceived as normal by all farmers.

## **VII. POLICY RECOMMENNDATION**

This study found many factors that contributed to the adoption of GAP by pineapple growers. Given the government policy to promote the farmers' application of GAP, the involved government agencies have to take into account the following policy actions:

1. The government has to establish policy to raise the price for pineapples grown through GAP to be higher than those from conventional practice.
2. In promoting GAP among pineapple growers, the concerned agencies should concentrate on working with progressive or advanced farmers so that they can demonstrate the success outcome of the GAP.
3. Involved government agencies have to promote and create environmental awareness among farmers to a greater extent.
4. Involved government agencies have to publicize and inform pineapple growers about the fact that most canned pineapple importing countries stress the importance of food safety and environmentally-friendly production process.

## References

- Canadian Embassy in Bangkok. 2000. **The Market for Imported Food Ingredients in Thailand.** Available: <http://ats.adr.ca/public/htmldocs/e3021.htm>. (7/12/2001).
- FAO Yearbook 2000. "Pineapple, Canned(Exports)." Available: [http://apps1.fao.org/servlet/XteServlet.jrun?Areas=%3E801&Items=575&Elements=91&Years=1998&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Trade.CropsLivestockProducts&Language=&UserName=\(12/07/2002\)](http://apps1.fao.org/servlet/XteServlet.jrun?Areas=%3E801&Items=575&Elements=91&Years=1998&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Trade.CropsLivestockProducts&Language=&UserName=(12/07/2002)).
- FAO Yearbook 2000. "Pineapple, Canned(Imports)." Available: [http://apps1.fao.org/servlet/XteServlet.jrun?Areas=%3E801&Items=575&Elements=61&Years=2000&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Trade.CropsLivestockProducts&Language=&UserName=\(12/07/2002\)](http://apps1.fao.org/servlet/XteServlet.jrun?Areas=%3E801&Items=575&Elements=61&Years=2000&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Trade.CropsLivestockProducts&Language=&UserName=(12/07/2002)).
- FAO Yearbook 2001. "Pineapple fresh production." Available: [http://apps1.fao.org/servlet/XteServlet.jrun?Areas=%3E862&Items=574&Elements=51&Years=1999&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Production.Crops.Primary&Language=&UserName=\(12/07/2002\)](http://apps1.fao.org/servlet/XteServlet.jrun?Areas=%3E862&Items=574&Elements=51&Years=1999&Format=Table&Xaxis=Years&Yaxis=Countries&Aggregate=&Calculate=&Domain=SUA&ItemTypes=Production.Crops.Primary&Language=&UserName=(12/07/2002)).
- Foodmarketexchange.com. 2002. *Data Center.* Available: [http://www.foodmarketexchange.com/datacenter/product/fruit/pineapple/detail/dc\\_pi\\_ft\\_pineapple0407.htm](http://www.foodmarketexchange.com/datacenter/product/fruit/pineapple/detail/dc_pi_ft_pineapple0407.htm)(16/07/2003).
- Flaherty, M., Szuster, B. W., and Miller, P. 2000. "Low Salinity Inland Shrimp Farming in Thailand." **AMBIO: A Journal of the Human Environment** 29, 3: 174- 179.
- Johnston, J. 1984. **Econometric Methods.** 4<sup>th</sup> ed. New York: McGraw-Hill.
- Menard, Scott.1995. *Applied Logistic Regression Analysis.* **Sage Publications Series: Quantitative Applications in the Social Sciences,** No. 106.
- Maddala, G. 1983. **Limited dependent and Qualitative variables in Econometric.** New York: Cambridge University press.
- Maddala, G. 1988. **Introduction to Econometrics.** New York: MacMillan Publishing Company.
- Paul W. Armah and Donald Kennedy, 2000. *Evaluating Consumer Perceptions and Preferences for Pasture-Raised Pork in the Mississippi Delta of Arkansas.* **Journal of Agribusiness** 18,3(Fall 2000): 261-273.
- Pindyck, Robert S. and Rubinfeld, Daniel L. 1998. **Econometric Models and Economic Forecasts.** 4<sup>th</sup> ed. Boston: Irwin/McGraw-Hill.
- Ramanathan, R. **Introductory Econometrics,** Dryden, 1998.
- Thailand, Ministry of Commerce. 2004. **International Trade of Thailand: Export.** Available: <http://www.ops2.moc.go.th/trade2.html> (7/08/2004).
- Verbeek, M. 2000, **A Guide to Modern Econometrics,** John Wiley & Sons.
- Wiboonpong, A. 1994. **Quantitative Methods for Analysis of Factors Influencing Farmers' Adoption of Technology.** Multiple Cropping Centre, Chiang Mai University, (Agricultural Economics Report No. 37), (in Thai).