

## **Introduction**

Organic food industry is becoming popular and growing in Thailand and all over the world. Government support agricultural business in Thailand (Roitner-Schobesberger et al., 2008). Study showed that area of agriculture in Thailand were ranked 48th in the world, but using insecticides were ranked fifth in the world and using herbicides is ranked 4th in the world. Moreover we import agricultural chemicals in the amount of 30,000 million baht per year (Sinueng, 2012). Many people give concern more on the food since we usually eat foods that do not know the quality of its which it can be contaminated with chemical. Food insecurity threat farmer and consumer and it create negative externality such as contamination in food lead to health and ecosystem problem. Of course, the impact of these may not happen in the short term but will accumulate and affect long-term health. Moreover Thai farmer still face inadequate use of pesticide in which it lead to the problem, i.e. farmer use pesticide over the recommended level in label and do not propriety use protection during using pesticide. Ones that will help you to reduce chemical accumulation is organic food, product manufactured by a non-toxic manufacturing process at every stage. Organic food is one of the approaches to better health coupled with environmental sustainability. But we may have difficulty in purchasing organic products due purchasing power to reach the high price that normally higher than conventional vegetable by large amount. Since the price that quite high relative to conventional food, this paper want to analyze the effect of certification and distribution channel affect the price of organic food. Because of this problem, firstly this paper will compare and contrast each kind of vegetable product Secondly, we observe certification in organic product on how it affect the cost of production. Lastly, we compare the process in distribution channel of Chinese kale organic since production process to end customer to figure out the price transformation in term of production cost selling price in department store that sell organic food.

## **Organics food**

Form the observation, knowledge of people in Thailand toward organic product still mislead. Many people still confuse the definition of Organic, Non-toxic, Hydroponic, and

Hygienic vegetable. They usually think that these products not include chemical in all production process. For example, in supermarket and fresh food market, we can find the label or packaging that says non-toxic, organic and hygiene label. This diversity can cause confusion for consumers as well. Many people do not understand the difference of these products with the amount of certifications that exist now. Thus, consumers rely on these words it would be safe in all of these types of product but it is not totally true.

**Table 1: The different of production system in vegetable**

Chemical	Production Process			
	Organic	Non-toxic	Hydroponics	Hygienic
Chemical Fertilizer	✓	✓	✓	✓
Insecticide	×	×	×	✓
Herbicide	×	×	×	✓
Hormone	×	✓	✓	✓

Source: Greennet.com

This table explain that organic product not include chemical fertilizer, insecticide, herbicide and hormone but the others could use chemical in production process. In standard measurement, International Federation of Organic Agriculture Movement (IFOAM) presented the definition of organic agriculture as

*“A production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.” The resolution at 2008 IFOAM General Assembly in Italy*

The National Bureau of Agricultural Commodity and Food Standards of Thailand state that

*“Organic Agriculture is a holistic system of agriculture advocating the ecological, biological cycles and biological diversity. By focusing on the use of natural materials and avoid synthetic materials derived from plants, animals or microorganisms which are derived from genetic modification or genetic engineering. To handle with the product by focusing on*

*processing with caution for maintain its status as organic and quality of the products at every stage. ”*

Moreover, organic products are more secure than conventional product and also benefits to health from the consumption of organic product. The study of Worthington (2001) found that the nutrition of organic product significantly higher than conventional product such as vitamin c, magnesium and iron.

Organic production systems in Thailand is divided into two categories which are Self-reliance organic farming and organic agricultural certification. For self-reliance organic, this farming has not been certified by the certifying agency. They mainly want to reduce production costs by reducing imported from outside such as chemical fertilizers, pesticides and growth hormone. For Organic Agriculture Certification, It is made with certified organic farming. They focus on distribution through the market such as supermarket or export purpose. Once certified organic standards already consumers would consider buying from a reliable seal of approval. This paper focus on organic certification (Report of Organic intelligence center, 2007).

## **Methodology**


This paper analyze price transfer in supply chain of organic vegetable by using in depth interview organic farmers and employee of fresh market section in department store. Also, paper use literature review to compare cost of organic and nonorganic to figure out which part of production cost that significantly effect on high price of Chinese kale vegetable. In term of farmer, we use in depth interview to know the production process of organic vegetable which drive the cost and price of organic vegetable. We use samples size for 7 farmers for observe information. For the department store, the last supply chain before reaching end customer, there is only one department store that we can access the data in approximately term to figure out the percentage of department store received from producer where it use department as a store to distribute organic vegetable product. In term of literature review, we use the production cost of farmer where grow Chinese kale organic and nonorganic to find out the cost and yield of Chinese kale. Moreover, we observe the market price of organic and nonorganic Chinese kale in compare

and contrast between this two kinds to figure out the certification or distribution channel that really drive the high price of organic in department store in Bangkok area.

### **Certification of Organics vegetable**

The certification process is to verify that products and services to meet the requirements of the standard. For organic certification is a system that combines products with certified quality system together because the heart of certified organic farming is accreditation and manufacturing processes. Bezawada and Pauwels (2013) said that consumers have increasing positive aspects toward organic products when favorable dietary or healthy element add on the package including product labeling and certification logos. In Thailand, we have two main popular certifications which are Organic Thailand and Organic Agricultural Certification Thailand (ACT) and most farmer use this two brands for vegetable organic farming.

**Table 2: Major organic certification labels in Thailand**

Label Title of the label	Origin and description
	Organic Thailand Brand is the official organic label by the Department of Agriculture. It indicates that the product has been produced according to the organic farming standards set by the Department of Agriculture



These products are certified organic by Organic Agriculture Certification Thailand (ACT), a private certification body accredited with IFOAM since 2001

Organic Thailand Brand, these no fee charge for certification but there are some hidden cost such as transaction and time cost to get certification. Organic Agriculture Certification Thailand (ACT), the fundamental structure is different from Organic Thailand. These is cost of certification account for 6,500 Baht per one year. If land area is large and take more than one day to check the land and products, they plus 5,500 Baht per one day. Moreover the travel food and residence expense are not include where use Bangkok as a start point.

ACT Organic Agriculture Standards are prepared by ACT Standards Committee in line with IFOAM Basic Standards and approved by ACT General Assembly since 1999 and has amendment in several times. ACT Standards now cover crop production, handling and processing, wild production, input production and aquaculture production organic menu in restaurant which enable ACT to give certification service for organic crops produced from farm up to organic processed products(Organic Agriculture Certification Thailand, 2012).

From interviewing the farmer, we found that costs that actually cause the high price of organic products in the view of farmers are entry cost, cost of covering higher loss and cost of soil rehabilitation for 12 month in certification regulation for case of Chinese kale. This means they cannot use organic certification in this period and revenue during this period usually lower than after get certification. Farmer know that organic vegetable has high price premium and they have more incentive to change or convert production from conventional to organic farming (Oberholtzer, Dimitri, and Greene, 2005). However the period of covert from conventional growing to organic is hard task because the land is not proper. According to Land Development Department research state that the land used for farming for a long time is lack of management and proper maintenance cause their soil degradation. Also organic matter is low and dense clay

soil is acidic makes yield decrease. Therefore, they need to improve the soil for growing plants. To increase productivity, higher by improving soil physical and biological bond as well as increase the fertility rate. From interviewing, the first year of growing organic vegetable has low yield for one half compare to second year until second year the yield will more stable. Hence, the certification itself do not affect the cost of production that much if producer use Organic Thailand Brand and producers that Organic Agriculture Certification Thailand brand have farm larger than the first brand or they produce to export. The real cost is the conversion period that reduce the yield of product should be concern.

### Cost of production

Chinese kale (*Brassica alboglabra*) is a leaf vegetable and an important crop in the Thailand. People usually consumer it in daily life but it is one of the vegetable that vulnerable to plant and insect disease. This study aim to investigate the cost of production. We use three types of Chinese kale which are conventional, non-toxic and organics Chinese kale to analyze the cost of production.

**Table 3: The cost of conventional Chinese kale**

List	Variable cost	Average cost	Average cost	percentage
		Baht/Rai	(Baht/Ngan)	
Cost of seeding	7,125.00	375.00	93.75	5.79%
Tillage labor	14,250.00	750.00	187.50	11.58%
Shear labor	2,400.00	126.32	31.58	1.95%
Distributing seed	1,900.00	100.00	25.00	1.54%
take caring fram labo	10,500.00	552.63	138.16	8.54%
Havesting labor	12,000.00	631.58	157.89	9.75%
Chemical fertilizer	23,500.00	1236.84	309.21	19.10%
Lime	265	13.95	3.49	0.22%
Insecticide	35,625.00	1875.00	468.75	28.96%
Plastic cover	8,550.00	450.00	112.50	6.95%
Repair tool	1,500.00	78.95	19.74	1.22%
Fuel for sprayer	3,000.00	157.89	39.47	2.44%
Electricity	2,400.00	126.32	31.58	1.95%
Total	123,015.00	6474.47	1618.62	100.00%

Note: Adapted from “The comparison of Costs and Returns in Pesticide-Free Vegetables with Chemical Use: Case Study of Tambon Bungphra, Phitsanulok Province” by Choksiriwatchara, T. (2011)

For conventional Chinese kale, we see that the average cost is 6,474 Baht per Rai. The cost of chemical fertilizer and insecticide are chemical cost accounted in high percentage in cost of production comparing to the other costs. Normally Chinese kale has is one of vegetable which use high level of chemical in production process. It has risk of residual chemical product that harm to customer health. According to research of (Supantee 2012) that cost of chemical usage in Chinese kale in Mahasarakham Province is 48 % of total cost and labor cost is 37% of total production cost.

**Table 4: The cost of non-toxic Chinese kale**

List	Variable cost	Average cost	Average cost	Percentage
		Baht/Rai	(Baht/Ngan)	
Cost of seeding	7,125.00	395.83	98.96	5.35%
Tillage labor	14,250.00	791.67	197.92	10.71%
Shear labor	4,500.00	250.00	62.50	3.38%
Distributing seed	1,800.00	100.00	25.00	1.35%
Harvesting labor	9,600.00	533.33	133.33	7.21%
Package	10,500.00	583.33	145.83	7.89%
Organic fertilizer	8,700.00	483.33	120.83	6.54%
Dolomite	8,550.00	475.00	118.75	6.42%
Insecticides	2,100.00	116.67	29.17	1.58%
Plastic cover	8,550.00	475.00	118.75	6.42%
Repair tool	1,000.00	55.56	13.89	0.75%
Fuel for sprayer	2,700.00	150.00	37.50	2.03%
Fuel for transportation	36,000.00	2000.00	500.00	27.05%
Electricity	4,200.00	233.33	58.33	3.16%
Total	133,075.00	7393.06	1848.26	100.00%

Note: Adapted from “The comparison of Costs and Returns in Pesticide-Free Vegetables with Chemical Use: Case Study of Tambon Bungphra, Phitsanulok Province” by Choksiriwatchara, T. (2011)

For non-toxic Chinese kale, we see that the cost structure is different from conventional one due to lowering the chemical usage but average cost higher than convention if we exclude the fuel for transportation cost the average cost per Rai will be lower. This fuel for transportation cost occurs due to distribution channel where different between these two ways of production. The distribution channel for non-toxic has far distance from their farm and farmers have to sell product by themselves so this fuel cost is high.

**Table 5: The cost of organic Chinese kale**

List	Rainy season	Cold season	Dry season	Average cost		Percentage
	(n = 0)	(n = 3)	(n = 2)	per Ngan	Per Rai	
Tillage labor		310.00	420.00	365.00	1,460.00	12.9%
Plant labor		266.34	287.81	277.08	1,108.30	9.8%
Cost of seeding		61.48	76.56	69.02	276.08	2.4%
Watering labor		250.00	412.50	331.25	1,325.00	11.7%
Labor for organic fertilizer		80.00	45.00	62.50	250.00	2.2%
Organic fertilizers		455.00	572.50	513.75	2,055.00	18.2%
Labor for organic water fertilizer		106.30	33.75	70.03	280.10	2.5%
Organical water fertilizer		213.33	200.00	206.67	826.66	7.3%
Sprayed insecticides labor		70.00	72.50	71.25	285.00	2.5%
Extracts of insecticides, fungicides		252.00	288.00	270.00	1,080.00	9.5%
Shear labor		360.00	390.00	375.00	1,500.00	13.2%
Value dolomite			52.50	26.25	105.00	0.9%
Harvesting and transport workers		175.00	210.00	192.50	770.00	6.8%
Average Cost		2,599.45	3,061.12	2,830.29	11,321.14	100.0%
Yield (kg)		140.00	123.00	131.50	526.00	
Cost /kg		18.59	25.07	21.83	21.83	
The standard deviations (SD).		0.75	5.73	3.24		
Weighted Average Cost (THB / kg)		18.62	24.99	21.81		
Standard deviation (SD)		0.02	5.78	2.90		

Note: Adapted from “Organic Vegetable Production Cost of Farmers at Royal Project Development Center in Annual Cultivating 2005-2006” by Moohammadaree, L. (2005)

For organic Chinese kale, this table show that cost of production per Rai is highest compare to conventional Chinese kale and non-toxic Chinese kale even though there is no chemical cost. They cannot use pesticide and herbicide in organic product but nature of plant usually still has disease and pests so the farmer has to use manual method to deal with this



problem by labor which it take longer time and higher cost. Therefore, the percentage of labor cost is higher relative to other cost. Correspond to interview with producers that labor cost is significantly affect the production cost. Moreover, labors or employees in organic farm are important part of organic farming since organic vegetable require more take care than other production system.

**Table 6: Yield of each type of production and average cost**

Type	Yield per Rai(kg)	Cost (Baht per kg)
Conventional	4000	1.62
Non-toxic	2550	2.9
Organic	526	21.83

Note: Adapted from “Organic Vegetable Production Cost of Farmers at Royal Project Development Center in Annual Cultivating 2005-2006” by Moohammadaree, L. (2005) and “The comparison of Costs and Returns in Pesticide-Free Vegetables with Chemical Use: Case Study of Tambon Bungphra, Phitsanulok Province” by Choksiriwatchara, T. (2011)

In term of productivity and cost of production, conventional has highest productivity or yield per Rai. Yield of conventional production Chinese kales are 4,000 kilogram per Rai and the average cost is 1.62 Baht per kilogram. For non-toxic Chinese kales, the yield drop from 4,000 to 2,500 kilogram per Rai or 36.25%. In case of organics, yield is 526 kilogram per Rai which is the lowest compare to conventional and non-toxic product but cost is highest accounted for 21.83 Baht per kilogram. The cost higher than conventional Chinese kale 13.47 times and higher than non-toxic Chinese kale 7.53 times. Adversely, cost of chemical reduction of organic convert to labor wage has positive effect to local people in term of creating jobs. This is one of the reason show that price of Chinese kale organic is more expensive than conventional and non-toxic because the higher cost of production and lower yield of organic Chinese kale. Next we will look at the distribution channel organic vegetables and how organic vegetable reach to consumer hand.

## **Distribution Channel**

Organic products market is still small compared to general markets, so the producers try to find ways to cut the costs and to make the most profit through various distribution channels (Chang, 2000). For case of Thailand, the market for organic products is small. People who consume organic have high purchasing power and care more about health. In terms of distribution channels Atănăsoaie (2011) pointed out the importance of the channel for the distribution of the various alternatives. There are both advantages and disadvantages depending on the size of the farm that the system of internal management. For example, small farms should have a distribution channel directly to the end customer. Therefore, producer in organics vegetable have to choose the appropriate distribution channel to meet the target group of customer. In Thailand, the distribution channel roughly classify in 4 main channels.

### **1.) Membership system Market**

This is one of the market that benefit to both consumer and producer. They can direct connect between farmers and consumers thought out this market. For example Community Support Agriculture (CSA) is a system that market consumer make agreement with farmers by consumers pay in advance money to farmers to get seasonal organic product. Consumer cannot directly choose the kind of product. After harvested, organic products will be sent to the sub-distribution points as agreed. Consumers who are already members have to come to place and get their product. This system will ensure financial security to farmer and farmer have the opportunity to communicate directly with consumers. Consumers can visit the farm to see the production. In this system, the market has performed well in terms of the close relationship between farmers, and consumers, but the limitation of this is the distance. Farmers have to have a farm where it not far from the group of customers.

### **2.) Flea Market**

Most are located in the local market or major cities in the province. This market placed in crowded or dense of people like hospitals or it may be other place where convenient for consumers to buy products. This market usually open only on certain days but not open every day, like every Friday or Saturday and it be sold only half a day. The producers or sellers come from a variety of groups in order to produce a wide variety of goods. For example, there is flea market for organic product open in Thammasat hospital, Phatumthani province.

### 3.) Specialized organic stores

The market is operated by entrepreneurs who have a policy in the field of organic product and health concern. Consumers can find special organic products that not provide in other channels. The market can reach more consumer than membership system. Usually this market will provide more products than other market and it has processed product like shampoo and soap organic. For example OTOP and Lemon farm shops.

### 4.) General Market

This distribution channels play an important role for organic products in Thailand. In many countries that the organic market has developed to a certain level, producer will find channel to provide more organic products to get more market share (Atănăsoaie, 2011). Especially in modern trade, supermarket and department store like Big C, Tesco lotus and Central food hall play an important role for producer. This paper will emphasize more in this distribution channel focusing in Bangkok area.

From farm to fork approach



The food supply chain begin with input supply toward farming, intermediate stages, and consumption and end with waste. In this paper we already shown the production cost of Chinese kale where it stop at farming. In intermediate stages, there are a lot of intermediates between farmers and consumer such as post-harvest process, storage, transport, distribution, wholesale, processing, packaging, retailing

In this paper, we will analyze the supply chain in department store because this market is large and easily accessible to most people. From interview with department store we found that before organic vegetables will put onto the shelf, producer has to have the certification to meet the department store requirement. For vegetables, organic must be certified by a trusted organization such as Organic Thailand brand, Organic Agriculture Certification Thailand and other international standard. This process incur some costs to producer as well. The department store act like a provider on shelves only. If the organic vegetable do not sold out, the department did not has a duty to bear cost but sellers have duty to bear this cost. Department store markup price 25-30% in addition both organic and non-organic vegetable. In this rate, a department store

does not include freight charges and storage fees to the cooling vegetable all the time but department have to hire a specialist to check the vegetable products for every 6 months to check counterfeit of vegetable products. Vegetables both organic and non-organic cannot see the counterfeit product although there is a certification given, it required the lab test to prove the product so department store has to bear this checking cost. The department store charge no difference between organic and non-organic vegetables they charge the same rate. The producer or intermediary has to deliver the products to the storage center before distribute to branch of department store.

**TABLE 7: price transfer form farmer to customer**

Price transfer	Organic		Non-toxic	
	n=3	Percentage	n=3	Percentage
Average selling price	182.8	100.00%	123	100.00%
Average department share(27.5%)	50.27	27.50%	33.825	27.50%
Intermediates cost	110.7	60.56%	86.275	70.14%
Production Cost	21.83	11.94%	2.9	2.36%

Source: From observation and interviews

From the table we can be seen that cost of Chinese kale vegetable at the farm is 21.83 baht per kilogram that mentioned earlier and we collect the average selling price for 3 organic Chinese kale brands at shelf in department store is 182.8 Baht per kilogram. The organic Chinese kale mainly sold as a pack, the pack assorted about 200 grams per one package. The average profit margin that department store get is 27.5 percent so it account for 50.27 Baht. Therefore we can find the intermediates cost. The intermediate cost is 110.7 Baht or 60.56 percent of average selling price. This intermediate cost include the marketing, transportation, packaging, retailing and middle man cost. In case of non-toxic Chinese kale, the production cost is very low compare with organic but the average selling price in department store still high but the majority of price is intermediate cost accounted for 70.14 percent.

### **Policy implication toward organic vegetable**

In order to promote organic products to become popular in Thailand we divide into 3 main terms.

1. In demand side, we have to create value for customer. Since many customer still do not know the different of organic, non-toxic and hygienic vegetable. Government and private firm need to encourage to the general public knowledge about the difference between organic and non-organic products. To make people awareness the importance of organic product. Shepherd et al. (2005) stated the consumer behavior factor related to organic food which important and influence people to purchasing organic food is health factor more than environment and other factors. Therefore we need to encourage the knowledge of organic product and benefit of organic product to health issue to create customer value.

2. In production process, the cost of Chinese kale organic is higher than conventional Chinese kale and maintenance cost significantly affect the high cost. Government or agricultural department should help the farmer especially in period before acquire the certification when the yield per Rai is low and lack of sufficient knowledge. Kanjanamangsak et al. (2010) said that most farmer planting Chinese kale are not able to follow the proper the planting because Chinese kale plants are has vulnerable to epidemics of the pest. It seem like the infant firm that do not strong enough to flight with outside. Public sector should take care them by giving the knowledge of production system and market to deliver the product to customer or retailer. Therefore public or private sector should support the farmer in conversion period. For example, Bank for Agriculture and Agricultural Cooperatives (BAAC) provide the low interest rate loan for farmer in conversion period and agriculture department should provide the knowledge to farmer.

3. In distribution channel, Horrigan et al. (2002) explains that the profits from small producers benefit the community and can be extended to the local economy. Small farmers that low field area for growing organic vegetable have less option on distribution channel. The promotion campaign for organic agriculture by government agencies should focus on partnerships with the private sector to supply the market. Moreover the distribution channels where do not have much intermediaries such as flea market that farmer can directly sell product to consumer is satisfy because it reduce expenses of intermediaries. The price in flea market

usually cheaper than wholesale or department store price and it can expand the market size of organic vegetable since lower price and consumer can easily access the market.

## **Conclusion**

Certification for organic products do not affect to farmers that much because The National Bureau of Agricultural Commodity and Food Standards (ACFS) provide the certification with no free charge. It incurs a little cost such as transaction cost but the impact of certification is the rule requirement for farmer. The real cost is the changes in the production from non-organic to organic farming where production reduce in the first 2 years. This result affects to income and some farmer give up for organic farming during this period. Therefore, the government should help farmers during this period in order to encourage more widespread organic farming. In term of production cost, Chinese kale organic has higher cost per kg than conventional and non-toxic Chinese kale so it is not surprising that the selling price of organic vegetables will be higher. However, the distribution channels play an important role for producer. Selling price of organics in department store is high not because of production cost itself but the intermediaries cost as well so producer should distribute product in appropriate distribution channel depending on the size of the farm.

## Reference

- Atănăsoaie, G. (2011). Distribution channels on the organic foods market. JOURNAL Of Horticulture, Forestry and Biotechnology, Volume 15(3), 19-25.
- Bezawada, R., & Pauwels, K. (2013). What Is Special About Marketing Organic Products? How Organic Assortment, Price, and Promotions Drive Retailer Performance. Journal of Marketing, Volume 77(1), 31-51.
- Chang, M. (2000). Understanding the Organic Foods Supply Chain: Challenges and Opportunities from Farm Gate to End Consumer.
- Choksiriwatchara, T. (2011). The comparison of Costs and Returns in Pesticide-Free Vegetables with Chemical Use: Case Study of Tambon Bungphra, Phitsanulok Province.
- Dimitri, C. and L. Oberholtzer (2005). Organic Price Premiums Remain High. Amber Waves 3(4), 2.
- Horrihan, L., R. Lawrence and P. Walker (2002) How Sustainable Agriculture Can Address the Environmental and Human Health Harms of Industrial Agriculture. Environmental Health Perspectives Volume 110, Number 5
- Jeensorn, Warunee (2011). Factors Affecting Purchase Decision toward Non-toxic Vegetables of Consumers in Bangkok.
- Kanjanamangsak, P., W. Benjapong Muangsrichan, N. Muangsrichan, and W. Karnpanit (2010). Factors on Improper Pesticide Application in Chinese Kale Cultivation. Thai J Toxicology 25(2), 133-43.
- Moohammadaree, L. (2006). Organic Vegetable Production Cost of Farmers at Royal Project Development Center in Annual Cultivating 2005-2006.
- Roitner-Schobesberger, B., Darnhofer, I., Somsook, S., & Vogl, C. R. (2008). Consumer perceptions of organic foods in Bangkok, Thailand. Food Policy, 33, 112-121.

Shepherd, R., Magnusson, M., & Sjöden, P. (2005). Determinants of Consumer Behavior Related to Organic Foods. *AMBIO: A Journal of the Human Environment*, Volume 34, No. 4-5, 352-359.

Sinueng, P. (2012). *Textbook of Organic Agriculture*, 6.

Supante, M. (2012). Case studies of commercial vegetable growing: Tambon Ponngam Amphur Kosumpisia Maha Sarakham Province. *Conference Papers in Order to Warn Chemical Pesticides usage*, 94-101.

Worthington, Virginia (2001). Nutritional Quality of Organic Versus Conventional Fruits, Vegetables, And Grains. *Journal of Alternative and Complementary Medicine* Volume 7, 161-73.

Organic Agriculture Certification Thailand (ACT). (2012). *Organic Agriculture Certification Thailand (ACT)*. Retrieved December 21, 2014, from <http://www.actorganic-cert.or.th/download/organic-standards>

Recommendations to improve the soil to increase crop productivity and sustainability. (n.d.). Retrieved December 22, 2014, from [http://www.ddd.go.th/web\\_ord/OldData/Web\\_ord/Technical/pdf/P\\_Technical10024.pdf](http://www.ddd.go.th/web_ord/OldData/Web_ord/Technical/pdf/P_Technical10024.pdf)

Report of Organic intelligence center under Ministry of Commerce (2007). *Thai Organic Agriculture*. Thailand Department of Commerce. Retrieved December 18, 2014, from [http://www.organic.moc.go.th/sites/default/files/publication\\_productivity/ekstrinthriiy1.doc](http://www.organic.moc.go.th/sites/default/files/publication_productivity/ekstrinthriiy1.doc)  
<http://www.actorganic-cert.or.th/download/organic-standards>