Supply Chain Management of Safe Vegetables from Residue Chemicals of Producers and Consumers

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Abstract- **Supply chain management was the action that producer and consumer have done the process to safe vegetable from residue chemicals, i.e., how producer plant and clean before transfer, how consumer select and clean. Research aims were to investigate participation behavior of producers and consumers to vegetable residue chemicals before transfer to market and to propose a model examination. Quantitative method with 400 respondents through semi structured questionnaire who were producer and consumer vegetable. Structural equation model was used to analyze factors influence to vegetable washing treatment. The result findings revealed that demography (age and marriage status), attitude, and information awareness can predict vegetable consumption behavior. Attitude and information awareness identified strongest influence significance to predict vegetable consumption behavior while demography was a bit significance influence. Besides, pesticides were residue that harmful to humans for information awareness. Buying organic vegetables was worthwhile for attitude and a year previous received information and introduction to consume organic vegetables for information awareness. Some misunderstanding issues in knowledge for people were discussed while factors influence to producers and consumers for safe vegetable transportation about washing residue from producer to consumer indicated how good condition people were. Moreover, supply chain management will be discussed based on findings to guide private and government arranging any policy to encourage the right factor in the future.**

Keywords: *supply chain management, safe vegetables, residue chemicals, producers and consumers*

1. Introduction

Food safety is the absence, safe, acceptable levels of hazards in food that may harm the health of consumers food without any residue chemicals. food safety plays an important role in ensuring that food is safe at all stages of chain, i.e., production to harvest, processing, storage, distribution as well as preparation and consumption [5]. Due to production and harvest into market and consumer, producers have to strive improving effectiveness of supply chain [8] and effective supply chain management capabilities for increasing performance of the firm [9] of the food product as vegetables.

Supply chain management of vegetables without any residue chemicals was not easy to handle consequence consumers who were the end of chain. Thailand was a country in the world that was potential area to produce agricultural food. While nowadays was found many kinds of agricultural food contaminated with many chemical particular pesticides, i.e., Acaricide, Insecticide, and Fungicide. Due to the case, Pathum Thani province area has found Maximum Residual Levels (MRL) from random sampling 56 percent while in Japan and Europe have found only 3- 5 percent. Those residue chemicals have exhibited effect to consumer especially the cause of cancer. The number of patients increased from 2007 to 2014 by cancer disease to make people die average 3.9 percent a year [22]. Some of investigation from Thaipubica [22] displayed that the cause of getting sick was they cannot search safety food within community which related to the research in Columbia university. It identified residue chemical namely Chlorpyrifos in vegetable and fruit affect to a child's brain development leading to a low level of intelligence and brain structure system [10].

Due to Thai people food, the majority consume vegetables on daily basic along with rice as the same to Sri Lanka environment [7]. There identified that understanding the behavior to make decision along supply chain and development policies was important [7]. The safety food considering included input process and output, i.e., 1) raw material cover to planting, pest – harvest, good agriculture practice, monitor and test kit, 2) production process including Good Manufacturing Practice: GMP or Hazard Analysis Critical Control: HACCP, 3) after packaging have been inspected and certified safe by Thai food and drug administration ISO 17025). Pathum Thani province was an area that has market export trade of agricultural products in Southeast Asia namely Talad Thai. It was the independent exchange place between buyer and seller which all agricultural products transfer in from all over the world.

Transportation was the process to ship product

from producer to consumer. Stakeholder were person participation behavior in vegetable washing process to be safe food. Therefore, the research objectives were investigation behavior of producers and consumers to safe vegetable in residue chemicals washing before transferring to market and to propose a model examination. The finding can be basic data in the future to adopt as a guideline application model in development and encourage to eliminate residue chemical from both producers and consumers. On the other hand, public and private sector can utilize the model into market strategic planning leading to response policies and those who are interested. Moreover, it will be a tool to reduce the cost of health in the future and helping strengthen in Thai society for understanding food safety choices.
Research questions were designed following:
Q1: how do producers and consumers behave to safe vegetable based on residue chemicals?
Q2: what are those factors influence to producers and consumers behavior of safe vegetable?

2. Literature Review

Supply chain management of vegetable produce and consume was how producers and consumers treatment since producing to consuming. Recognition was stimulation from five sense, i.e., visibility, smell, hearing, taste, and touch [6] then Solomon [21] supported that the process by which a person choose to manage and interpret what is perceived by the 5 senses. Besides, each individual has received the same process in senses but they interpreted stimulation difference meaning depending on individual valuable needs and expectation [19; 18]. On the other hand, recognition of benefits was the strongest key in Pakistan case that influenced to technology. Moreover, the information application of farmers in China have found that factors influence the intension, i.e., to recognize benefits, easy to use, and intend to use [24].
Due to basic above, hypothesis is derived:
H1: recognition has effect to behavior of producers and consumers to safe vegetable.

In addition, attitude was perspective working out as well, previous findings referred that those ordinary vegetable consumers could not separate safe and unsafe vegetable in the markets [1]. Besides, there were labeling, visual appearance, freshness, and availability significant influence to consumers' willingness to pay for safety vegetable higher prices [1]. Some point was found as ref. [15] mentioned to characteristics, e.g., freshness, color, spotless leaves. They were considered by consumers when buying vegetable. Furthermore, it may depend on the preferences of consumers that producers participate in various practices in order to produce marketable vegetable [16].
How different meaning was referred that consumer behavior comprised searching, buying, usage, assessment, and service [10] while Schiffman and Kanuk [19] proposed what, why, when, how, where, and how often to buy. According to Asia country, e.g., 8 percent of household expenditure on food and drink was spent on vegetables [7]. Buying decision of fruits and vegetables depended on cognition analysis and emotional factors from neither a bit advertising or other promotions [14].
Hypothesis is designed as follow:
H2: attitude has effect to behavior of producers and consumers to safe vegetable.

Organic vegetable was valuable thing for healthy but consumers have not known exactly market place where produced and sold so that why they can consume rarely [7]. They were aware safety food, i.e., price, health factors, vegetables quality, and home gardening [7]. Analysis based on cognitive and emotional elements best were found by consumers who decided to buy fruits and vegetables at the best price and best option [14]. On the other hand, awareness about organic food had influence more effective factors. i.e., gender, education, income, occupation, and age [13]. Household size referred small households as well as women and older consumers with higher societal status are more likely to purchase organic alternatives [2] contrast to consumer in Australia that there were no any indicator clear understanding particular health benefits derived from vegetable consumption so health labelling has capacity to enhance knowledge of vegetable consumers [17].
According above, hypothesis is proposed [12]:
H3: information awareness has effect to behavior of producers and consumers to safe vegetable.
H4: demography has effect to recognition, attitude, information awareness, and behavior of producers and consumers to safe vegetable.

Due to previous mentioned, this article concept can be presented in order to factors that effected to behavior of producers and consumers to safe vegetables, i.e., recognition, attitude, information awareness, and demography.

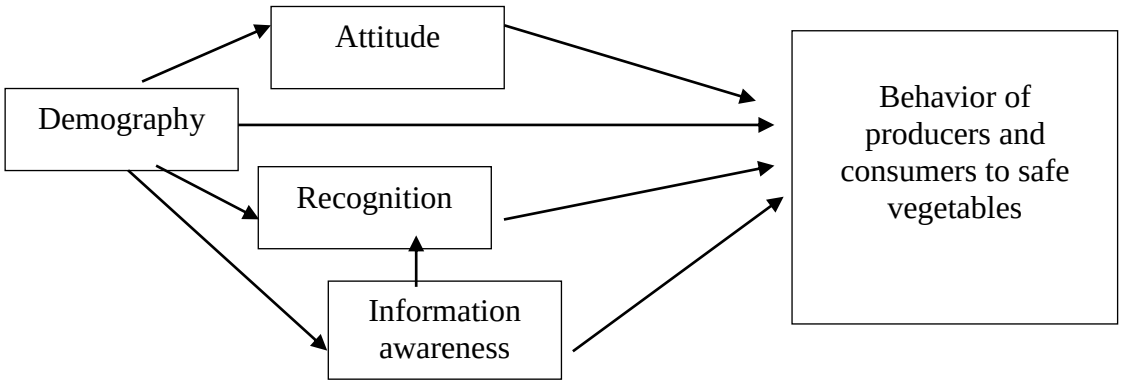

Figure 1. Research Conceptual Framework

3. Methodology

Data were collected through a questionnaire, which created, to five parts, i.e., demography, attitude, recognition, information awareness, and participation behavior of vegetable washing. Sample group was 400 individual vegetable producer and consumer in Thanya buri district, Pathum Thani province, Thailand with accidental sampling. Thanyaburi district was an area that grown vegetable to sell consequence transferring to Talad Thai. Measurement reliability of questionnaire were analyzed via IBM SPSS version 24.0 and data analysis were analyzed to prove hypotheses using LISREL version 8.0 along structural equation modeling (SEM) [20].

Measurement reliability exhibited as: 0.67 for attitude, 0.40 for recognition, 0.60 for information awareness, 0.66 for behavior of participating, and 0.68 for total.

4. Results

The variations in demographic factors can influence on the participation behavior of vegetable washing as table 1. The majority of the respondents were male with age group of 41-50 years old. They were marriage status and primary school level education. they had family number 3-4 persons along merchant occupation and household income 330-660 USD.

Table 1. Demography investigation

Demography	%
Gender	
Male	66.25
Female	33.75
Age (year old)	
Less than 30	20.25
31-40	14.25
41-50	27.25
51-60	24.25
60 up	14.00
Marriage status	
Marriage	61.75
Single	26.00
Divorced/ separated	12.25
Education level	
No educated	2.50
Primary school	35.75
Secondary school	28.75
Diploma/certificate	8.00
Bachelor	23.00
Higher than Master	2.00
Family member	
1-2	12.75
3-4	56.50
5 up	30.75
Occupation	

Merchant	29.50
Farmer	18.75
General employee	13.75
Public servant	12.75
Private officer	12.00
Individual business/state enterprise officer	10.25
No career	3.00
Household income	
Less than 330 USD	19.25
330-660 USD	25.75
661-990 USD	23.00
990-1,320 USD	14.50
More than 1,320 USD	17.50
*1 USD = 30.30 THB	

Descriptive analysis results displayed follow four parts can be identified follow:

Firstly, using pesticide chemicals causes residues to be harmful to humans was the highest (87.50%) in recognition issue following by vegetable safety is vegetables that do not use any chemicals at all stages of production or vegetable that still contain some toxic residuals levels which are not harmful to health (84.00%). Secondly, while attitude perspective, overview was positive attitude agree to consumption of vegetables safe from toxins ($\overline{x}$=3.80). There were three statements highest respectively, i.e., the value of buying safe vegetables and reduce the illness risk ($\overline{x}$=4.09), organic vegetables are Eco friendly ($\overline{x}$=4.08), organic vegetables that are certified by government organization are reliability ($\overline{x}$=4.01). Thirdly, information awareness, there were two highest points such as 83.25% has been received dangerous from vegetable residuals or safe vegetable consumption from media and 78.25% has been received information guidelines about safe vegetable consumption from family member. Lastly, participation behavior of vegetables consumption of stakeholder concluded they did usually boil or blanch with hot water ($\overline{x}$=4.00), choose clean vegetables that are no soil or white stains or unusual pungent odor ($\overline{x}$=3.94), eating local vegetables ($\overline{x}$=3.88) respectively.

Due to figure 2 examination via structural equation modeling revealed that age (r=0.83) and marriage status (r=0.56) were strongest associated to demographic factor while education, job, and household income displayed no associated. Recog2 (r=0.60) concluded how producer and consumer have done vegetable washing and growing. Attit2 (r=0.82) comprised price of safe vegetables, how difference between supermarket and local market selling, and the belief of unsafe vegetables and nutritional value. Info2 (r=0.66) was getting advice and information from public officer and friend. Vet_beh1(r=0.59) was the strongest factor that identified how consumer and producer belief to make vegetable clean without any residue chemicals.

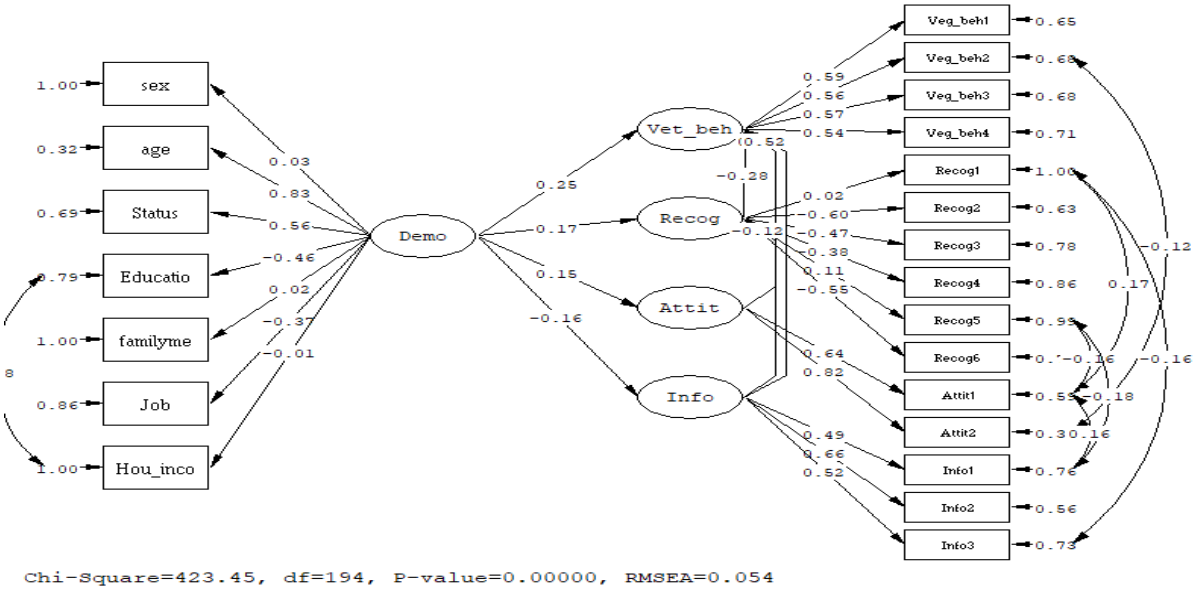

Figure 2. Path analysis of behavior of participating

In addition, the result findings can conclude the influence among independent valuables, i.e., demography, recognition, attitude, and information awareness to participation behavior of vegetable washing of producer and consumer as table 2. Direct effect and indirect effect that influence to behavior of participating factor exhibited it was directly significant influenced by information awareness, attitude, and demography with 1.73, 0.57, and 0.12 respectively. Besides, behavior of participating was indirectly influenced by information awareness with no statistical significance. In addition to direct effect that influence to behavior of participating, there was another variable that is influenced by direct effect, i.e., attitude with 0.05 significance 0.05 level.

Considering matrix among variables revealed that there was positive relationship for six pairs (r=0.03-0.51) while four pairs had negative relationship (r=0.02-0.30). The highest relationship pair was information awareness and behavior of participating with 0.51. Moreover, R-square of structural equation model identified 0.57 that meant all factors can explain variation of behavior of participating 57 percent.

Table 2. The effect of demography to vegetable washing behavior of producer and consumer

Factors	Demo			Recog			Attit			Info		
	TE	IE	DE	TE	IE	DE	TE	IE	DE	TE	IE	DE
Vet_beh	0.09*	-0.03	0.12**	-20.28		-20.28	0.57**		0.57*	1.85**	0.12	1.73**
	(0.04)	(0.03)	(0.04)	(53.86)		(53.86)	(0.11)		(0.11)	(0.36)	(0.08)	(0.35)
Recog	0.00	0.00	0.00	-	-	-	-	-	-	-0.01		-0.01
	(0.00)	(0.00)	(0.00)	-	-	-	-	-	-	(0.02)		(0.02)
Attit	0.05*	-	0.05*	-	-	-	-	-	-	-	-	-
	(0.02)	-	(0.02)	-	-	-	-	-	-	-	-	-
Info	-0.02	-	-0.02	-	-	-	-	-	-	-	-	-
	(0.01)	-	(0.01)	-	-	-	-	-	-	-	-	-

Chi-square = 427.24, df = 194, p = 0.00, GFI = 0.91, AGFI = 0.89, RMR = 0.039

Factor:	Demo	Vet_beh	Recog	Attit	Info
Reliability (composite, AVE)	0.11, 0.19	0.71, 0.39	-0.16, 0.17	0.70, 0.54	0.58, 0.32

Structural equation	Vet_beh	Recog	Attit	Info
R^2	0.57	0.05	0.02	0.02

	Vet_beh	Recog	Attit	Info	Demo
Vet_beh	1.00				
Recog	-0.30	1.00			
Attit	0.43	0.03	1.00		
Info	0.51	-0.15	-0.02	1.00	
Demo	0.18	0.19	0.15	-0.16	1.00

*p<0.05 **p<0.01

Note: Demo=demography, Recog=recognition, Attit=attitude, Info=information awareness, Vet_beh= behavior of participating

According to model developing of factors that effects to behavior of participating found that attitude was the highest effect to behavior of participating following by information awareness and demography respectively as figure 3.

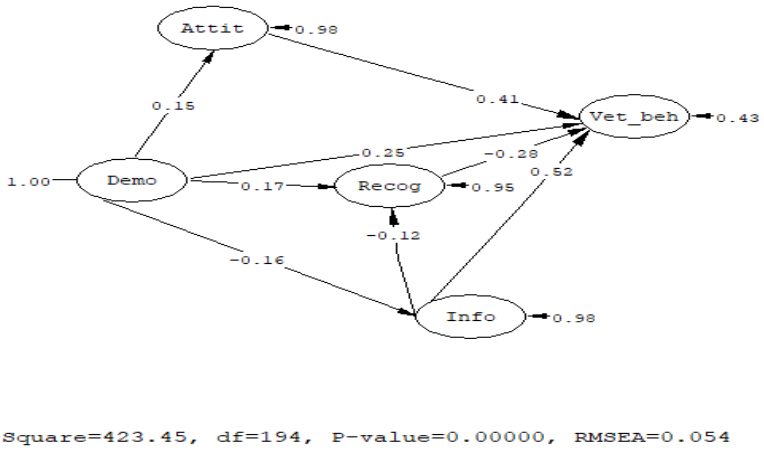

Figure 3. Structural equation modeling of the factors influenced

5. Discussion

Due to research purposes, the findings can answer them as:

First, investigation behavior of participating stakeholders in residue chemicals washing of vegetables before transferring to market, consumer and producer have known how dangerous from residue chemicals be therefore it was good news to promote how better for health if they can avoid using pesticides [24; 7]. As the same thoughtful to ref. [1] mentioned that consumer was willing to pay higher price to safe vegetables but the big problem was hard to find the exactly market place [7]. Otherwise, ref. [14] argued that the best price and best option can be taken into consideration to consumers.

Further, recognition in Eco friendly of organic vegetable meant those consumer and producer realize and related to information awareness that was the best predicted stakeholder behavior in the model examination. Characteristics of vegetable were found, e.g., clan vegetables mean no soil or white stains, and eating local vegetables [11; 15; 1; 6; 21] so that opposite to Thaipublica reporting [23] referred some kind of local vegetables have had residue chemicals such as basil in top ten ranking. Media channels from public officer and friend have had in accordance with ref. [10] and [19] to support them that those factors were influenced by information awareness. Educational and marriage status were those factors considering deeply therefore the making decision to buy vegetables should be encouraging proper point.

Second, propose an examination model figure 4 below, behavior of participating stakeholders can be predicted by age and marriage status in demography, attitude, and information awareness both direct and indirect effect. It meant that information awareness was the most influence factor that organization or company should realize taking into consideration if they plan to create any equipment that involves to those circumstances [14; 7; 1; 10; 24]. The most important point, they should focus on information awareness because total effect was the strongest predicted. It could be creating via technology as advertisement [14].

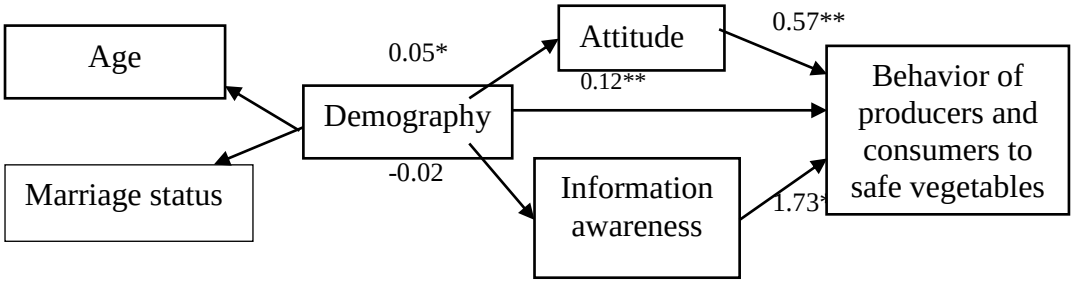

Figure 4. Examination model of behavior of participating stakeholders

Supply chain management for safe vegetable can say that depends on information awareness so that means one of the process to safe vegetable was try to encourage people more how they can act for themselves safety from harmful. It could be through rule of law related to having weak or strength, it depends on opportunities behavior by members of supply chain [4; 3]. In addition, attitude also should take into consideration for supply chain management if people do realize how dangerous they are going to reach and providing law to producers, it is possible to help perfect process of produce into safe food as vegetables.

6. Conclusion and Recommendation

Behavior of producers and consumers to safe vegetables can be identified by those factors direct influence and indirect influence in term of consumption and production before transportation. There were some factors influenced to behavior of participating both direct and indirect effect, i.e., demography (age and marriage status), attitude, and information awareness for direct effect, demography and information awareness for indirect effect. Furthermore, attitude also was directly influenced by demography. Overview, supply chain management of safe vegetables tend to be information awareness the most predicted factor to behavior of producers and consumers to make them clan and safe.

Due to characteristics of demography in educational and household income term, it could be impact to research finding especially primary school level that was majority of respondents with negative associated result. Besides, recognition perspective revealed most of those factors negative therefore it should be taken into next case that different environment area to insist examination and can predict other point in supply chain management.

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