CHAPTER 3

Proposed Methodology

3.1 Motivation of Methodology Development

The Global GAP mentions about the important contents, the control in each section as well as the compliance criteria used in the consideration and the importance levels of the consideration in each topic. The levels are comprised of the major must, the minor must, and the recommendation.

Capability Maturity Model (CMM) of Carnegie Mellow University (CMU) was published in "Managing Software Process" by W. Humphrey in 1989. The concept has been widely implemented for the development of business process like system engineering, project management, information technology (IT) and human capital management. It focuses on the reduction of investment cost, the development of delivery time, and the productivity enhancement. CMM is consists of 5 maturity levels of the model, i.e.

Level 1 – Initial

Level 2 – Repeated

Level 3 – Defined

Level 4 – Managed

Level 5 – Optimizing

In each level, there will be key process areas which inform of the activities required to carried out and lead towards goals of development. There are also goals which are the targets of the respective levels which show the clarity in the development. Then the key practices are defined to explain the minor issues and practices including examples. It can be seen that CMM contains steps and explanations for clear and systematic development. Each of CMM level will explain about knowledge body as well as expected job and practice in accordance with the framework of the Global GAP standard. However, there are many versions of the Global GAP. The Global GAP specifies the framework into sections which include the principle section addressing the production issue. The principle section is subdivided into plant, livestock, and

aquaculture. The product framework will focus only vegetables and fruits whereas the subsidiary framework will consider the details of vegetation.

Both the principle and subsidiary framework will have the specifications regarding control and compliance criteria. In the all farm base, there exist 6 sections covering general farming. In the crop base, there exist 8 sections that address the basics of farming and in the fruit and vegetables there exist 5 sections altogether. However, both the principle and subsidiary framework there are similar important issues e.g. record, site history, and site management traceability. Consequently, all similar contents will be collected together in this research, which results in only 13 sections of crucial contents for good and appropriate farming.

Apart from that the theory of knowledge management can transform the tacit knowledge in the farmers to be the explicit knowledge. The knowledge capture utilizes the theory of knowledge engineering with the assistance of Common KADS. The Common KADS will analyze the knowledge and processes involved. When the tacit knowledge is transformed into the explicit knowledge via the knowledge analysis and synthesis, taking into account of the requirement and compliance with the Global GAP, the jobs expected to be performed by the farmers in each level of capability will be clearly specified, which include the steps, methods of learning, and the effects on the farmers in terms of cost and risk.

From academic researches, the development of the capability of Thai growers needs to integrate knowledge from several disciplines to develop tools as prototypes and guidelines for the grower development. Those tools should combine knowledge from many disciplines including agriculture, marketing, and other necessary matters and be transferred to the growers so that they know guidelines and needs in the development of self-capability. The development should response to the market demand too, such as the food safety, grower safety, and should preserve environment and be an acceptable international standards.

In addition, the guideline in the development of grower capability should be specific to the background of the growers. There should be the same viewpoint between the givers or promoters and the receivers or growers in the knowledge transfer. The difference in viewpoint can be an obstacle in learning. Also, the difference in

knowledge level among growers is also another obstacle that makes the learning ineffective.

When the capability or skill of growers is at the same level in their groups, the knowledge transfer from the agricultural promoters to the growers will be efficient. However, the transfer processes of different knowledge bodies need different processes too. The skill and knowledge enhancement of a subject may utilize a process but it may not suitable with the training-based knowledge enhancement in general. Moreover, training that combines knowledge of several disciplines and is simultaneously transferred to the growers may not be suitable because the growers have limited capabilities in each learning.

There are a number of learning theories in KM. The learning in action is an interesting theory and shows that there are many different methods of learning (Garvin, 2000). One method is specifically suitable to one content.

When the growers have increase skills and knowledge, the cost in business operation and risks that may occur in the supply chain of agricultural business are expected to be reduced. It is an emphasis on the sustainable development of growers.

From the above-mentioned explanation, it is necessary to develop tools to be prototypes and guidelines in developing growers. In this research, there is an introduction of tools in developing growers in an international and sustainable manner based on KM (Chakpitak, 2009), CMM, and the global GAP (GLOBAL GAP 2007; 2009; 2009a). Based on the fundamental backbones as described, this research has developed the so-called Grower Maturity Model (GMM), the details of which will be explained in the next section, as a methodology.

3.2 Grower Maturity Model (GMM)

3.2.1 GAP as An Origin of GMM

The necessity of introducing the global GAP as a framework of the development of GMM will be explained here. The global GAP is the standard of good and appropriate agricultural management. The model that follows the global GAP will focus on vegetables and fruits. The global GAP is a standard which is created by the group of

supermarkets in Europe. The big sellers specify that the goods in supermarkets must be certified for their production according to the principle of the global GAP. The supermarket group does not directly buy the agricultural goods from the growers, a small amount if any. Although the goods are bought form the wholesaler, agricultural products must be evaluated from the certify bodies authorized by the global GAP. When the wholesalers are requested by the supermarkets, they have to further the request to the sellers or exporters herein. The exporters have no choice and must follow the request, otherwise they cannot export their products. Apart from that, the exporters will have other markets, e.g. Asian and Middle East markets where the standards are not required. When the exporters are requested to show the certificate and labels for back investigation of the certification of the global GAP, the exporters need to promote growers in developing the global GAP system. The establishment of the global GAP is difficult in Thailand due to many factors, e.g. the readiness or capability of growers to understand the standard. This is because the global GAP contains many specifications and the relevant data is in English. The access by the growers is thus not trivial. However, there is an attempt to develop Thai GAP to be compatible with the global GAP by the support from Thai Chamber and Kasetsart University. Although there is the Thai GAP, it is still not popular from the exporters because the buyers have no the information of its compatibility to the global GAP. This makes the exports avoid explaining to the foreign buyers by asking the growers to certify their products based on the global GAP standard.

In asking the growers to follow the standard, the growers need the motivation from the buyers or exporters. Therefore, the exporters always start the standardization of system from the contact farming. The motivation is mostly the increase in price. The payment will be done when the certificates are obtained. By and large, the exporters must invest together with the growers. The investment includes the development of environment to be appropriate, the investment in training, the cost of analysis and certification. All of this is just a part of promotions from the exporters or buyers. Considerable costs are induced.

The global GAP has also various versions. The global GAP started its role in Thailand in 2009 when the version 3 was used. Now it turns to version 4. This kind of change is another obstacle to the learning of growers because there can be new versions or standards during the establishment of the system by the growers. The basic

knowledge in GAP makes the growers ready to different versions of GAP. This research employs the version 3.0 as the prototype in developing Grower Maturity Model. Only the parts that are relevant to the agriculture of fruits and vegetables farming will be extracted from the Global GAP 3.0. In addition, the development in terms of GMM is a holistic development and provides a means of sustainability regarding to the future development of GAP versions. The knowledge of GMM makes the growers ready to changes. GMM can be developed to comply with other standards too. This can be achieved by applying the framework to the other standards and the new maturity model is created for the respective standards.

Accordingly, if there is the utilization of GMM based on the version 3- global GAP, it is the innovation to reduce the lack of understanding in standard of growers. The use of GMM will motivate the growers from the cost and risk reduction. The growers avoid their lack of knowledge or incapability in the standard because GMM explains the topics of learning that enhance the capability of growers. The growers will not look at GMM as a tool of mistake finding. Rather, it is suggest to the growers to see the benefits from the development and application of the knowledge to reduce cost and risks as well as to create both direct and indirect benefits. The examination by GMM is not subjective, but it depends on the way the growers do at the present.

The examination by the global GAP is viewed by many sectors as a mistake finding, especially the validation with the exporters. It is normal that the evaluators will search for the issues that do not conform to the standard or lack of what the standard requires. The evaluation is also subjective, which depends on the viewpoint and experience of examiners to.

The requirements of the Global GAP are studied in the development of GMM. The conceptual framework of the study is shown in Figure 3.1. It is found that there are 20 criteria in the global GAP which are obtained from the parts of All Farm Base, Crop Base, and Fruit &Vegetables each of which contains the following topics. (GLOBAL GAP 2007; 2009; 2009a). The Global GAP Requirement (20 Practices) are as follows:

1. All Farm Base (Appendix A, B, & C: Global GAP V.3.0)

AF 1	Record Keeping and Internal Self-Assessment / Internal Inspection	1
AF 2	Site History and Site Management	2

AF 3	Workers Health, Safety and Welfare	3
AF 4	Waste and Pollution Management, Recycle ad Re-Use	4
AF 5	Environment and Conservation	4
AF 6	Complaints	5
AF 7	Traceability	6

2. Crop Base

CB 1	Traceability	6
CB 2	Propagation Material	7
CB 3	Site History and Site Management	2
CB 4	Soil Management	2
CB 5	Fertilizer Use	8
CB 6	Irrigation / Fertigation	9
CB 7	Integrated Pest Management	10
CB 8	Plant Protection Products	11

3. Fruit and Vegetable

FV 1	Propagation Materials	7
FV 2	Soil and Substrate Management	2
FV 3	Irrigation / Fertigation	9
FV 4	Harvesting (generally, lasts step of packaging)	12
FV 5	Production Management	13

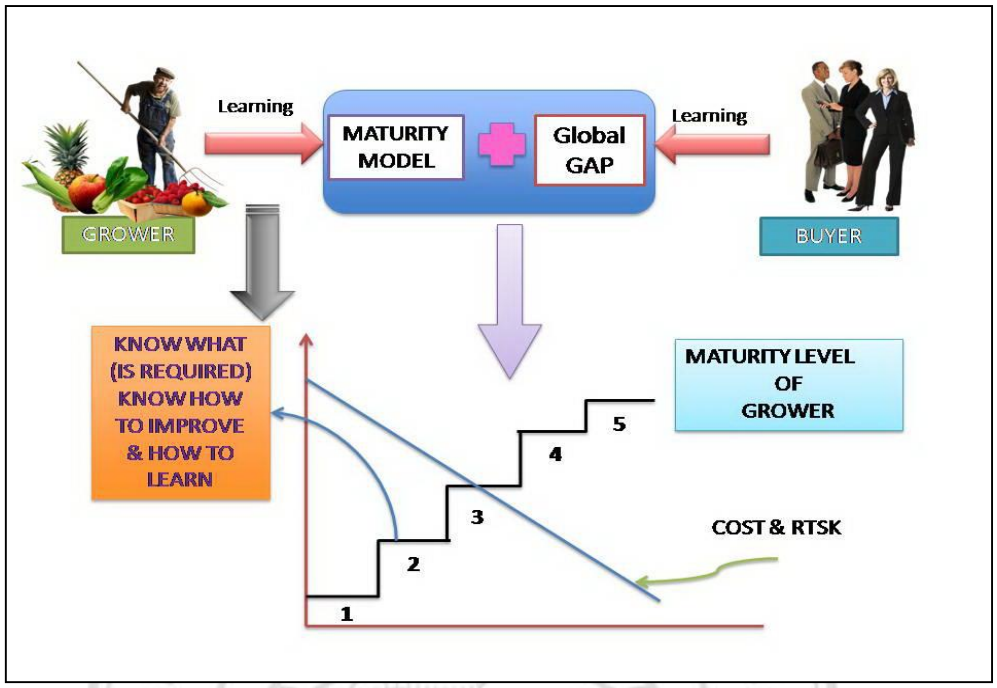

Figure 3.1 Conceptual Framework of GAP-based GMM

It can be seen that there are similarities in each section and the basics come from the same concept and practice guidelines. The similar criteria are grouping thus combine and only 13 criteria are considered in GMM. A criterion of Production Management is not seriously discussed in GMM because it is the criterion that considers only the growers having screening in farms. Since the research here is focused on the exported plant and there is no trimming or screening at farms, but under the process by the exporters of buyers, such a requirement is thus not considered herein. These 13 requirements are known as Integrated Global GAP requirements (13 Practices) which include:

1 Record Keeping and Internal Self-Assessment/Internal Inspection	(AF 1)
2 Site History and Site Management	(AF2, CB3, CB4, FV2)
3 Worker Health, Safety and Welfare	(AF3)
4 Waste and Pollution Management, Recycle and Re-Use	(AF4, AF5)
5 Complaints	(AF6)
6 Traceability	(AF7, CB1)
7 Propagation Material	(CB2, FV1)

8 Fertilizer Use	(CB5)
9 Irrigation / Fertigation	(CB6, FV3)
10 Integrated Pest Management	(CB7)
11 Plant Protection Products	(CB8)
12 Harvesting (general, latest step of packaging)	(FV4)
13 Production Management	(FV5)

At the moment, an international standard that correctly and appropriately manages farm is considered as well as the knowledge bodies that growers should have to comply with the global GAP.

3.2.2 Designation of Maturity to GMM

Maturity model is originated from CMM which is a model widely accepted that it helps facilitates organization quality and processes. CMM also increases the satisfaction of customers and communication. The strong points of CMM are thus employed to be a tool in supporting the systematic learning of growers, based on 5 levels in CMM, i.e. initial, repeated, defined, managed, and optimizing.

This research applies CMM from the Carnegie Mellon University, which divides the capability into 5 levels. Accordingly, CMM should be applicable to farmer context. The practice guidelines are adopted from the Global GAP accepted as the standards having appropriate and correct steps of practice for agriculture. This will create the acceptance from farmers, producers, and buyers. The Global GAP is also the standards that the buyers require or request to the farmers to implement and corresponding to the GAP from the government.

GMM utilizes the analysis guidelines for the capability level of growers from CMM. It is known that CMM is a standard that is recognized by many disciplines of its good ability in modeling worker capability. The measurement and development guidelines are thus applied to GMM. The 5 levels are obtained from the concept of not-knowing, recording, knowing, problem solving, and developing. This is coincident with the PDCA Model which is based on total quality management (TQM) and Balance Score Card (BSC) structure.

There is a classification of growers based on their capability when applying CMM. The classification is from the analysis of the capability in agricultural performing according to the established scopes. Purposely, it is for the growers to know of their capability levels. The development is thus focused on the low-level capabilities before directed towards other capabilities. In other words, it is a prioritization of the development process.

GMM is comprised of

1) Maturity Level : The structure of GMM contains 5 levels of development in agriculture, starting from initial, repeated, defined, managed, and to optimizing as in CMM.
2) Key Process Areas : The key process areas are the topics of consideration which are adopted from the global GAP and modified to reduce to 13 topics in GMM.
3) Global GAP Process : This part employs the compliance criteria which explains the compliance with the control in the global GAP Version 3. (Appendix A, B, &C: Global GAP V.3.0)
4) Grower Generic Practices : This part focuses on the present practices of growers and indicates good practices for attaining higher levels of capability.
5) Tasks Knowledge : This describes the knowledge required to fulfill the goals of task and to response as well as support the operation of generic practices.
6) Measurement : It shows the cost and risk at each capability level according to growers, promoters, and buyers or exporters.

Each key process area has 5 maturity levels each of which is referred to the global GAP process. This is to compare and interpret good behaviors of growers or satisfying behaviors at higher levels. The practices are in grower generic practices. The task knowledge talks about the knowledge that supports the operation of growers. This information is obtained through the study of the knowledge relevant to the grower generic practices. (Appendix D: Grower Maturity Model (GMM) Chart)

Each level in GMM exhibits the scope of work that is also divided into levels as well. Each level includes the present behavior of growers which is used for self-

examination. It is not an assessment of mistakes and aimed at visualizing the development steps for growers.

The maturity levels in GMM has the following details.

1) Initial is the fundament level of growers. The growers have not enough knowledge in farming. Past experiences are never recorded.
2) Repeated is the level that growers have recording and are successful from repeating the work. For example, if they are successful in planting specific plants, they can successfully repeat the work.
3) Defined is the level that growers can partly identify the causes of problems. The problem solving is not correct or not systematic.
4) Managed is the level that growers can control and solve problems in a systematic manner.
5) Optimizing is the level that growers are capable of fully and systematically managing the farms. There is the utilization of technology in burden reduction and in analysis. The agriculture considers environment and preserve it as well as it is a sustainable agriculture.

In measuring the capability of growers, GMM employs the guidelines of assessment by the global GAP to consider in GMM. Specifically, GMM uses the inconstancy to consider at each level of GMM. The inconsistency by the global GAP has 3 levels, i.e. major must, minor must, and recommend whose details are as follows:

Level 1 (Initial): Since it is the fundamental level of agriculture, growers may have no system. Some major and minors may be done at this level. Recommend is not performed.

Level 2 (Repeated): This is the step developed from the first level. Major must is completely fulfilled. Minor must is partly done but not much. Recommend is still not performed.

Level 3 (Defined): Major must is completely done. Minor must is mainly but not completely done. Recommend is also partly practiced. The growers that pass the certification from the global GAP start from this level.

Level 4 (Managed): Major must and minor must are completely fulfilled but recommend is not completely done.

Level 5 (Optimizing): This is the highest level of agriculture, i.e. systematic problem solving, applying technology, sustainable agriculture. Consequently, growers can fulfill all requirements in major must, minor must, recommend.

Maturity also explains the growers of the knowledge required in their works. It addresses the learning of task, bank erosion, irrigation, water quality, etc. When realizing the knowledge needs to be learned, it facilitates the growers to attain in depth information. The maturity model can also include the learning process. For examples, the discipline of water resource needs to learn the water quality.

3.2.3 The Management of Knowledge in GMM

KM plays an important role in many organizations, no matter how big or how small. Knowledge becomes a valuable asset of organizations. This is also true for agriculture. The knowledge is highly precious. The knowledge in agriculture has different forms, e.g. academic books, media, printed matters and is always one-way communication. Consequently, the capability in recognition depends on the basic knowledge of receivers or growers in such a way that how much they have capability in learning.

The knowledge, however, exists in growers. The knowledge in growers comes from the accumulation of their experiences in trial and error for a long time, which is practiced to the level of experts and becomes skills. The knowledge in growers is mainly an individual knowledge or tacit knowledge. The tacit knowledge is highly valuable in organizations but difficult to be disseminated because it specifically belongs to the individuals. Nevertheless, the transformation of the individual knowledge or expert knowledge needs to make the tacit knowledge to be the explicit knowledge so that the knowledge is transferable to the other persons. The explicit knowledge can be transformed back to the tacit knowledge to produce innovations or novel problem solving guidelines.

The theory of learning in action fits to the development of GMM. The theory utilizes working as learning and skill development processes of growers. It is suitable to the growers that they do not have to leave their routine works. The growers can work and learn together. The learning in action by D. Garvin suggests 4 types of learning as follows: (Garvin, 1993)

1. Intelligence Learning
2. Experiential Learning
3. Experimental Learning
4. Leading Learning

Intelligent learning is the investigation of the knowledge from other growers that have higher skills or are successful growers. The data can be obtained in several manners, e.g. investigation, expert interviews, or observations. The intelligent learning is suitable for learning of general matters which is a preliminary learning data to support the grower decision. The matters can be general regulations, standards, or information updating of growers. If the data is from experts, it is the truth or experiences, specific techniques, or business secret. However, if it is from observation, it is the behaviors for supporting the grower decision.

Experiential learning is the learning from self-experiences of growers. The causes and effects from the past are employed for the decision making. The advantage of the experimental learning is that it does not required high knowledge or capability in learning. Therefore, it is suitable for growers in some specific types of work because the knowledge is in the growers or the learning can be done from learning of causes and effects.

Experimental learning is knowledge from practices to find out the causes of results. It can be a simulation, a hypothesis setting, and a proof. The experimental learning is suitable with the growers when they want to prove their hypothesis or others in order to create their own knowledge bodies. This can be accomplished by investigating risky points that lead to contaminations. Another approach is to set up hypothesis and test them. The experimental learning has an advantage that it does not require high investment because it uses a low magnitude of test areas and substances for a study of pros and cons or effects based on their hypothesis.

Leading learning is the learning that employs practices and provides learning opportunity to the growers. It creates an atmosphere of common learning. For example, the learning can be in the form of meeting or workshop to open new viewpoints for growers. The knowledge may come from knowledge sharing. The knowledge giver may necessarily be the listeners to growers first in order to learn the grower data. The

atmosphere of knowledge sharing is thus created and the knowledge giver can transfer the knowledge to the growers and will be accepted by the growers. KM is employed to make the knowledge transfer appropriate in the senses of content and approach. This is to induce a common learning because there is an exchange of information, regulation, and demand. It is a continuous learning. The capability in competition of Thai growers is enhanced and becomes a sustainable development.

In terms of learning, GMM is designed to be a tool that foster learning all stakeholders in the supply chain, not just growers, because GMM can inform the capability level (maturity) of growers and major tasks in each important topic according to the global GAP. The scope, components, and knowledge required for each task also informed. Finally, what learning approach is the most suitable one is also informed. The benefits from GMM in terms of knowledge development are:

1) Growers can know their capability or maturity levels and know how to develop themselves to attain higher levels.
2) GMM identifies knowledge bodies that the promoters should be transferred to the growers (know what) in order to further study and develop. GMM also makes the promoters know the demands from the growers. The equipped growers may transfer and share their knowledge to the others. The promoters may integrate knowledge bodies to create new knowledge and continuous development.
3) GMM is a supporting tool for decision making of buyers or exporters in selecting growers to be the members of contract farming. This reduces cost and risk due to low maturity or capability growers in some topics. The buyers also know how to develop growers, which knowledge bodies the growers need, and the way of transferring knowledge to growers. In addition, the buyers or exporters can input knowledge, requirements, and regulations to growers.

Knowledge transfer from the viewpoint of systems thinking assists organization of knowledge and demonstration of commitment and knowledge required to be conducted by the task to be done and learned by Growers. Figure 3.2 shows the systems thinking of Okra growers.

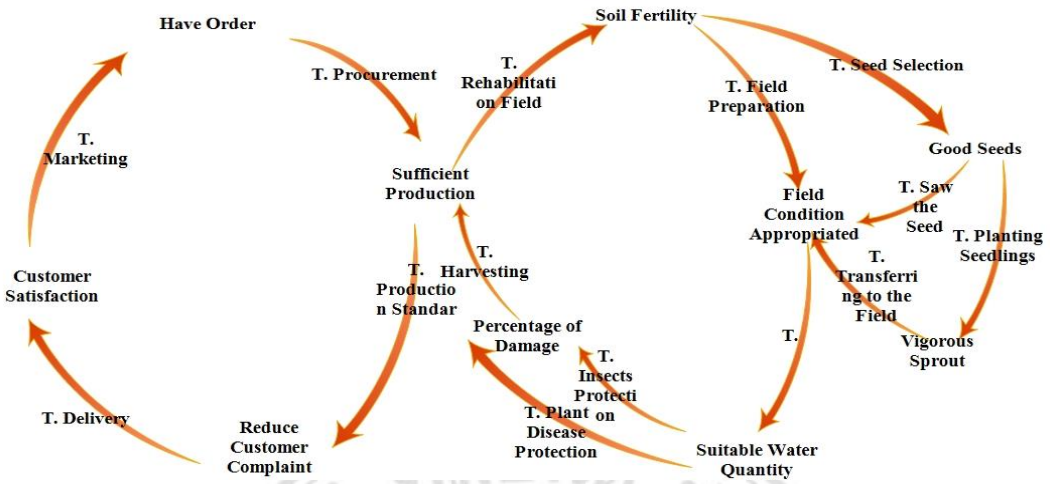

Figure 3.2 The Systems Thinking of Okra Growers

The task knowledge of grower based on KM and KE are given below:

Inference Knowledge:	Input	Principles to practice.
	Process	Practices or implementation guidelines or experiential.
	Out Put	Precautions / work / techniques.
Domain Knowledge:	Know-How	Knowledge of techniques and methods in practice.
	Know-Why	Know the cause and effect of the work task.
Knowledge Base:	Who	Source experts who know how to perform the task
	Document	Record, manual and various reports.
	Information	Data and Information

The improvement of GMM using systems thinking is shown in Table 3.1 .

Table 3.1 Systems Thinking for GMM Improvement

Maturity Level	What to Think (Inference)			Know How	Know Why	Knowledge Base		
	Input	Process	Output			Who	Doc	Inf.
LV 1	-	-	-	-	-	-	-	-
LV 2	-	/	-	/	-	-	-	-
LV 3	-	/	/	/	-	-	/	-
LV 4	/	/	/	/	/	/	/	-
LV 5	/	/	/	/	/	/	/	/

The systems thinking for a specific task are given in Table 3.2. Appendix 6 shows the Systems Thinking Learning for Grower Capability Improvement.

Table 3.2 Systems Thinking for a Specific Task

Task 1 Rehabilitation Field					
Level	Inference Knowledge			Know How	Know Why
	Resources	Process	Output		
1	N/A	N/A	N/A		
2		IP 1 The way to rehabilitation		H1 Add fertilizer H2 Turning over the soil H3 Plant Rotation H4 Flood over soil	

Table 3.2 Systems Thinking for a Specific Task (Continued)

Task 1 Rehabilitation Field					
Level	Inference Knowledge			Know How	Know Why
	Resources	Process	Output		
3		IP 2 The way to record	IO1 Might cause soil salty IO2 Disease might b reduce and may lack of soil nutrient IO3 Plant Rotation will help to increase soil nutrient and have income IO4 Flood over soil will help to reduce disease and insects and increase soil nutrient	H1 Record according to the form H2 Do Soil Mapping H3 Plant Rotation H4 Soil Test	

Table 3.2 Systems Thinking for a Specific Task (Continued)

Task 1 Rehabilitation Field					
Level	Inference Knowledge			Know How	Know Why
	Resources	Process	Output		
4	II1 Fertilizer II2 Machine to turning over soil II3 Plant to Rotated II4 Water pump for flood and drainage II5 Person in charge		IO5 Soil enrich with nutrients IO6 Records and Tasks have been performed effectively	H1 Type of chemicals, Nutrients in the fertilizers, Heavy matters, Certificated H2 The ability to dig of machines H3 Planting Por or nut during rotation H4 Consider how to do flood over and the way to drain water out after flood over period H5 Person in charge has to be trained such as record and soil type, fertilizer nutrients	W1 Will cause reliable and quality fertilizers W2 effective turning soil over W3 Increased soil nutrients and have income from production during plants rotation W4 Reduce the energy cost W5 Increase ability to do they task
5	II6 Information How to do field rehabilitation		IO7 Product yield increase and sustain	H1 Searching information from internet, book, expert, or success story	W1 Effective on field rehabilitation, applied knowledge for sustainable development

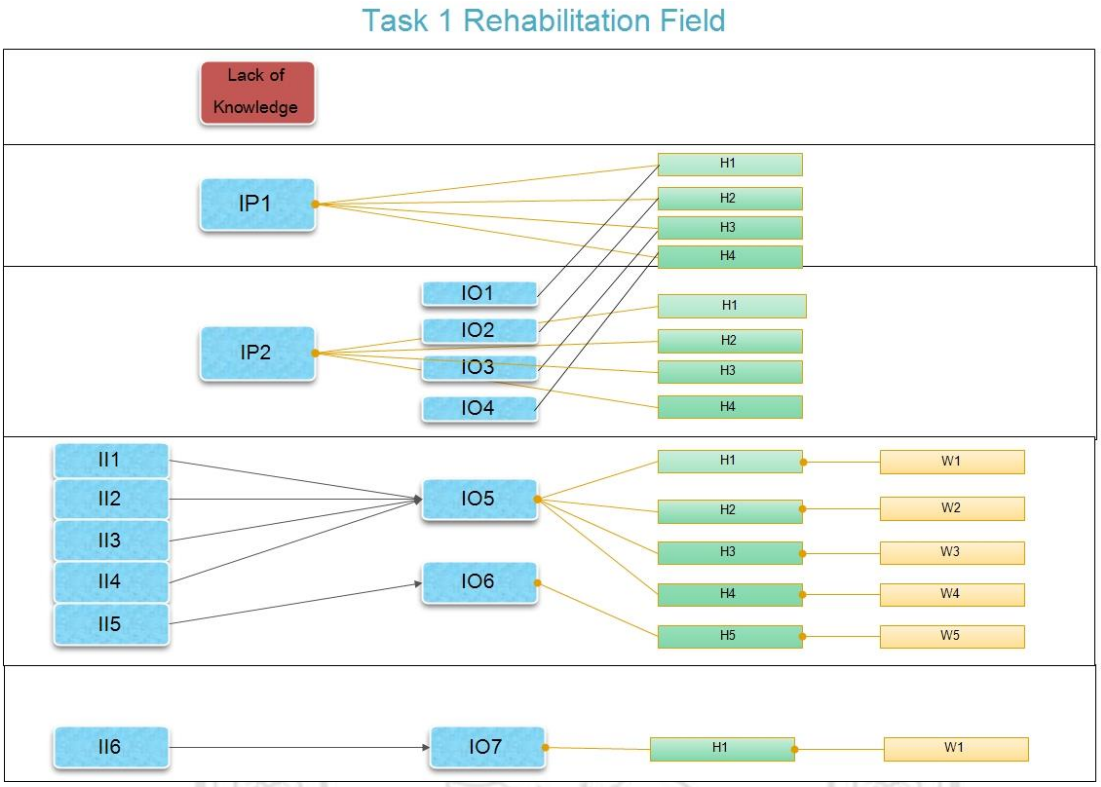

Figure 3.3 Shows the Systems Thinking Knowledge Linkage

It should be noted that the systems thinking as a maturity improving can have more than 1 criteria for each task, which indicates that each task may require knowledge of many aspects to help grower development to enhance the capacity of Growers. As in the example of the field rehabilitation, the required knowledge of the criteria of site history and site management and fertilizer use was involved. The criteria of involvement in several task view are recorded because they are the foundation of data and statistics to be utilized in the further development.

3.2.4 The Resulting GMM

The three components, i.e. the global GAP, the CMM and the KM are combined and result in the GMM. Figure 3.4 illustrates the schematic GMM from such a combination.

Global G.A.P Criteria to GMM	Global GAP		
	Major	Minor	Recommend
Optimizing	Y	Y	Y
Managed	Y	Y	Y/N
Defined	Y	Y/N	Y/N
Repeated	Y	Y/N	N
Initial GMM	Y/N	Y/N	N

Figure 3.4 The Construction of GMM

The development of knowledge in GMM motivates growers to long for the development to higher levels. There are several levels. Thus it seems not so difficult for the growers in developing their maturity levels, i.e. it is practical for them. When the growers accept the assessment format and the development in terms of GMM, common learning can be expected. There will be knowledge sharing. When the knowledge comes from the growers, they are willing to follow and continuously perform to achieve a sustainable development of agriculture. Table 3.5 shows the structure of GMM.

Table 3.3 Structure of GMM.

Structure	Source of Idea	Contents
Level	CMM	5 Levels
Criteria	Global GAP	20 to 13 Criteria
Knowledge	Systems Thinking	Task and Domain knowledge
Motivation	Risk in Agriculture	Production, Marketing, Financial, Legal, Human

The development framework of GMM based on three components are illustrated in Figure 3.5

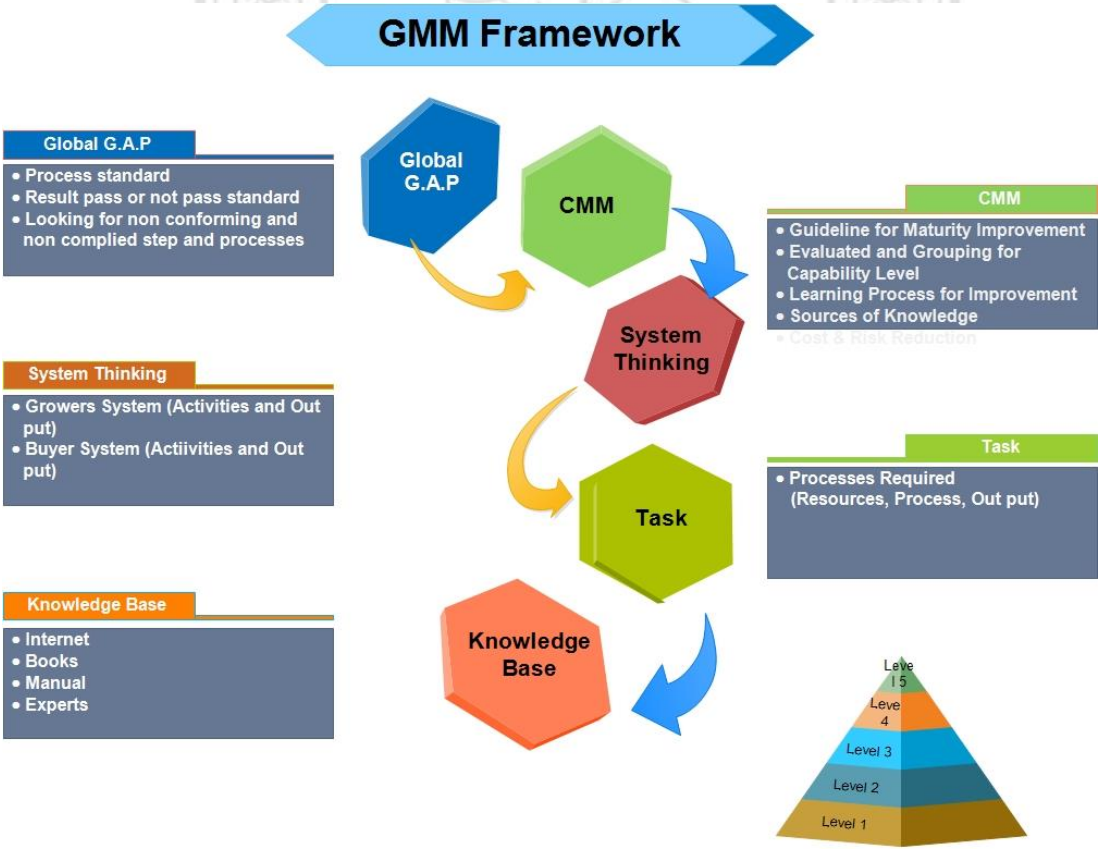

Figure 3.5 Schematic Development Framework of GMM

The task evaluation can also be accomplished by GMM. An example is given in Table 3.4

Table 3.4 The Task Evaluation by GMM

No	Tasks	Measurement	Target	Indicator/Innovation				
				L1	L2	L3	L4	L5
1	**Record Keeping and Internal Self -assessment / Internal inspection**	Type of record or frequency of audit	Have audit more than once a year	0	0	1	2	>2
		Quality of record and audit	Have no N/C on record and self-assessment	>1	1	0	0	0
2	**Site History and Site Managemen t**	Quality of record	Have site history record	No	No	Yes	Yes	Yes
		Land Utilization and management	never let the land vacant for none reason	No	No	Yes	Yes	Yes
3	**Workers Health, Safety and Welfare**	Frequency of labor sickness or go to hospital and No. of accident	No. of time per year cause from working in the farm	>3	3	2	1	0
		Worker turnovers	< 1 person resign or change job	>2	2	1	0	0
4	**Waste and Pollution Managemen t, Recycling and Re-use**	Quantity of waste	No. of waste reduced (%)	0	0	5	10	15
		Empty containers	No empty container been reused	No	No	Yes	Yes	Yes

Table 3.4 The Task Evaluation by GMM (Continued)

No	Tasks	Measurement	Target	Indicator/Innovation				
				L1	L2	L3	L4	L5
5	**Complaints**	No. of complaints	20% less than before learning by GMM	0	<5	<10	<15	<20
6	**Traceability**	Capability to trace back (speed)	Able to Trace back within 24hr.	No	No	Yes	Yes	Yes
7	**Propagation Material**	Certificated of propagation material (or test result)	Certificated or test results	No	No	Yes	Yes	Yes
8	**Fertilizer Use**	Knowledge, cost, contamination, storage	>20% reduce on cost of fertilizer used	0	>5	>10	>15	>20
		Cost per Rai	Baht/Rai		>13%	13%	<13%	<15%
9	**Irrigation / Fertigation**	water quality, cost of energy, land moisture	Water test result	No	No	Yes	Yes	Yes
10	**Integrated Pest Management**	No. Prevention activities	>/=1 activities	No	No	1	2	>2
		Cost of chemical use per tai	<13%	>15%	>14%	13-14%	<13%	<10%
11	**Plant Protection Products**	Frequency of residual report	Residual test >/= once a year	No	No	1	>1	>2

Table 3.4 The Task Evaluation by GMM (Continued)

No	Tasks	Measurement	Target	Indicator/Innovation				
				L1	L2	L3	L4	L5
12	**Harvesting (lasts step before packaging)**	Clean container	Container been cleaned after used	No	No	Yes	Yes	Yes
		Hygiene and safety, toilet and washing area	Able to reach toilet and wash equipment within 5 minute from farm	Yes/ No	Yes/ No	Yes	Yes	Yes
13	**Production Management**	Not applicable for most of Thai farmer		N/A	N/A	N/A	N/A	N/A

3.3 Cost and Risk Assessment

There are risk assessments relevant to growers and stakeholders in the supply chain when using GMM. The risk assessment considers the cost in doing agriculture and the relevant business and what may happen to growers, buyers, or exporters.

Cost at each level of capability will be considered both direct and indirect. The direct cost is the expenditures of growers from farming including chemicals, fertilizers, seeds, fuels, or labors. These costs are visible and can be analyzed by the growers.

The indirect cost is the cost that is more difficult to analyze because this cost can yield consequences. Examples are the cost in losing opportunity of selling products, the cost in managing future farms, or the cost from hospitalizing due to long time hazardous chemical exposures. This cost is tacit and difficult to explain to growers because its effect cannot clearly seen at the present.

The exemplified costs are just the agricultural costs. Other costs in the supply chain have not been addressed, like costs occurring with buyers or exporters. These costs will be analyzed in conjunction with the capability level in GMM.

Risk is the same as cost. Risk happens with growers or stakeholders in the supply chain of agricultural business. Risk of failure in agriculture, risk of contamination, and risk of opportunity losing are considered, including their risk factors. The risk factors are analyzed by the stakeholders, especially the growers and the buyers or exporters.

Growers always encounter uncertainties, e.g. uncertainty in climate condition, uncertainty in price and market. These uncertainties are the main cause of the farmer lost. Therefore, every time the Growers must make the decision of farming, they need to consider risk factors and manage the risk for the success of their agricultural business. The risks in the agricultural business can be divided into 5 types.

1) Production
2) Marketing
3) Financial
4) Legal
5) Human

For the production risk, the producers consider the costs and resources that are input for the agriculture. They wait for the harvest with the hope having fruits more than the invested resources. However, the Growers must face the risks that are unpredictable, e.g. climate condition, too much rain, draught, or forest fire, plant destruction due to animal, insect, plant disease, etc. These are the unpredictable factors and directly affect the production rate. Therefore, the Growers should recognize and understand the risks and try to manage them.

The marketing risk can be viewed as the price list because the change of marketing directly affects the price of the products. The Growers are slightly able to control the risk. The production level influences the demand that makes the price higher or lower. In addition, other effects on the marketing and price include the change in the revenue of consumers, the robustness of economy, the government policy on trade and energy, and the rate of exchange. Therefore, there should be the market risk management.

The financial risk is related to the risk of investment for running business, cash flow, and ability in paying loan. These factors are necessary for running the agricultural

business. The above-mention risks directly affect the financial risk. Therefore, it is necessary to understand the links among these risks and the levels of risks in order to manage the risks.

The legal risk is a latent risk in every risk because every business needs to comply with law and regulations. The violation of law leads to damages. They can be asset and personal damage. The management of legal risk is thus the top priority for the success and sustainability in doing agriculture business (Drollette, 2009).

When there is an involvement of human, there is always a risk. This is also true in the agricultural business. The risks of lost, no matter the lost of organs, death, or the impairment of workers, will affect the benefits and agricultural business in terms of new recruitment, training, illness, and treatment. These risks cannot be overlooked and they are successful factors for the organizations that have the risk management.

3.4 Robustness Tests

To test the reliability of GMM, the researcher introduces GMM to the exporter companies. The exporters nowadays play several roles in the supply chain, i.e. buyers, promoters, and financial and knowledge promoters. This research is tested with 3 exporters of vegetables and fruits in Thailand. They are the members of Association of Thai Vegetable and Fruit Entrepreneur. Each company understands the global GAP very well. They have their own growers in contract farming system and those growers are assessed and certified to comply with the standard of the global GAP. The 3 companies buy the agricultural goods from growers and have 10 years of experiences. The companies have their own packing house and are certified for hygiene and production standards. The characteristics of those exporters show that they are important and directly involved with the standard system of the global GAP. The responses from the 3 companies are shown as bellow.

The process of test is in the form of interviewing each exporter and the results are summarized. There is presentation of GMM to the exporters so that they understand the model both before and after the interview. Their comments are also summarized for the reliability of GMM. The interview results are shown in the following tables.

Table 3.5 Questionnaires for Exports or Producer that have Perspective to Grower Maturity Model by Company #1 CCW

No.	Description of Question	Measurement		Remark
		Yes	No	
1	Do you recognize Global GAP	x		
2	Are you in Supply chain of fresh produce	x		
3	Do you have cooperate farms under Global GAP certified	x		
4	Do you think Global GAP audit like to find mistake from grower	x		
5	Do Global GAP have offered learning method for improvement at the farmer		x	Too much details and not suitable for Thai growers
6	Can Global GAP reduce risk and cost in supply chain of fresh produce?		x	Not for the cost
7	Do you understand about Grower Maturity Model (GMM)?	x		
8	Do you think the farmer should be classified in to different of maturity level?	x		
9	Do you agree that GMM can be as a guideline of improvement for growers?	x		
10	Do you think if the Growers have higher in maturity level will reduce cost or risk in each level?	x		
11	Do you agree that different in criteria and different maturity level may require different knowledge and tasks?	x		
12	Do you agree that different maturity level may need different kind of learning method and tools?	x		

Table 3.6 Questionnaires for Exports or Producer that have Perspective to Grower Maturity Model by Company #2 KAEC

No.	Description of Question	Measurement		Remark
		Yes	No	
1	Do you recognize Global GAP	x		
2	Are you in Supply chain of fresh produce	x		
3	Do you have cooperate farms under Global GAP certified	x		
4	Do you think Global GAP audit like to find mistake from grower		x	not really. It is just the nature of the standards
5	Do Global GAP have offered learning method for improvement at the farmer		x	Learning will be supported by the company staff Learning environment is not suitable for learning
6	Can Global GAP reduce risk and cost in supply chain of fresh produce?		x	Some help but not for Thai growers.
7	Do you understand about Grower Maturity Model (GMM)?	x		
8	Do you think the farmer should be classified in to different of maturity level?	x		
9	Do you agree that GMM can be as a guideline of improvement for growers?	x		Help staff to evaluated the growers
10	Do you think if the Growers have higher in maturity level will reduce cost or risk in each level?	x		

Table 3.6 Questionnaires for Exports or Producer that have Perspective to Grower Maturity Model by Company #2 KAEC (Continued)

No.	Description of Question	Measurement		Remark
		Yes	No	
11	Do you agree that different in criteria and different maturity level may require different knowledge and tasks?	x		
12	Do you agree that different maturity level may need different kind of learning method and tools?	x		

Table 3.7 Questionnaires for Exports or Producer that have Perspective to Grower Maturity Model by Company #3 PP

No.	Description of Question	Measurement		Remark
		Yes	No	
1	Do you recognize Global GAP	x		
2	Are you in Supply chain of fresh produce	x		
3	Do you have cooperate farms under Global GAP certified	x		
4	Do you think Global GAP audit like to find mistake from grower		x	Not really. Actually, it will be depend on Auditors
5	Do Global GAP have offered learning method for improvement of the farmer	x		It has learning at appendix
6	Can Global GAP reduce risk and cost in supply chain of fresh produce?		x	Might reduce risk of some contamination but not about cost
7	Do you understand about Grower Maturity Model (GMM)?	x		

Table 3.7 Questionnaires for Exports or Producer that have Perspective to Grower Maturity Model by Company #3 PP (Continued)

No.	Description of Question	Measurement		Remark
		Yes	No	
8	Do you think the farmer should be classified in to different of maturity level?	x		
9	Do you agree that GMM can be as a guideline of improvement for growers?	x		
10	Do you think if the Growers have higher in maturity level will reduce cost or risk in each level?	x		
11	Do you agree that different in criteria and different maturity level may require different knowledge and tasks?	x		
12	Do you agree that different maturity level may need different kind of learning method and tools?	x		

The results are in the same way. The global GAP cannot reduce the cost of growers but may reduce the risk. It is the risk of contamination. The global GAP seems to be a mistake finding, i.e. finding the points inconsistent with the requirements and do not provide alternative practices to growers. GMM is the tool that can divide the capability or maturity of growers. The growers needed to be measured for their maturity so that their status is known and the development can be carried out accordingly. GMM is considered a handbook in developing capability of growers. If the growers gain higher maturity levels, they have higher capability. The capability enhancement helps the growers in reducing cost and risk as well as the others in the supply chain. Regarding the learning of tasks at each level in GMM, the exporters agree that at each maturity level and each subtopic there should be different procedures in learning so that the learning is effective and efficient. The learning should be appropriate. Tools and media should also be different according to the needs and appropriateness of growers.

Regarding risk reduction in the supply chain, the reliability in reducing risk in selection of growers to contract farming is tested. The selections following the existing method and GMM are compared. The following results are obtained.

1) It is found that the selection according to the existing method is prone to failure because it is lack of considering the grower maturity or capability. When there is farming, the occurring problems may not be solved or incorrectly solved. Moreover, the growers may not recognize the problems. These are risk factors for exporters or promoters. Regarding costs, the promoting companies need to support the growers in all aspects from seeds, investment, chemicals, fertilizers, and technology. These are all costs. Promotion of growers with low maturity or capability results in inefficient and ineffective production. The cost per unit product becomes higher. The growers also have costs, not only the exporters or promoters. High costs may occur with growers and exporters or promoters. Apart from those, the reputation and confidence are also important. The failure with low capability growers is the debt incurred to the growers. They will say that the farming from the company is not worth and should not join the system. This results in the company problem and leads to difficulty in recruiting future growers to their contract farming system.

2) GMM is employed to assess the grower capability before selecting growers to the contract farming system. The growers with high maturity levels are selected. The costs due to the failure of farming are eliminated due to their ability in understanding and systematic problem analysis. The problem solving and prevention are done correctly and efficiently. The growers earn from their farming satisfactorily. The success is transferred by words of mouth and the reputation of the promotion company is disseminated.

It is clear that the application of GMM to the contract farming system reduces the cost from low capability growers, risk due to failure in performing agriculture, and risk from contamination. It increases the reputation of company through the benefits the growers obtain from company. In addition, it creates confidence to abroad buyers that they will obtain quality goods and timely delivery. The results from the experiments are shown in Table 3.8

Table 3.8 Comparisons of Ordinary Method and GMM Method

Consideration	Ordinary Method	Level	GMM Method	Level
Risk	-Crop Failure	Medium	-High potential on crop success	High
	-High potential on contamination	High	-Reduce production fluctuation	Medium
	-Reputation lose	Medium	-Prevent initial contamination	High
	-Potential on reject or ban	Medium	-Gain buyer confident	High
			-Eliminate risk on productions reject or ban	High
Cost	-Frequently residual analysis	High	-Reduce no of sample and cost of residual analysis	High
	-Potentially fail on investment	Medium	-Effective on investment	High
Opportunity & Learning	-Not success in extend contracting farming members	Medium	-Reduce grower bias	High
	-Fail in Training	Medium	-Effective learning by grouping grower as maturity model	High
	-High Grower Bias	High	-Successful contract farming extension	High

3.5 Benefits from GMM

GMM not only consists of application, control, compliance and consideration issue from the Global GAP, it also considers the best practice of farmers. It does not want the farmers to feel error monitoring like other standard inspection systems which always look at the issues of compliance. GMM, however, will consider the natures and the present practice of the farmers as a supplementing part. The model shows that the farmers can develop their capability just only when they have the knowledge necessary for higher maturity levels and apply such knowledge to their practice. GMM also provides the recommendation of the knowledge types the farmers are expected to have for further development. Not only the body knowledge, GMM further recommends the learning approaches following the framework of KM with KE technique application. Importantly, GMM indicates the farmers of the cost and risk factors that can be reduced if the farmers have higher capability or maturity levels. Such reductions are in accordance with both the viewpoints of the farmers and the buyers. The afore-mentioned descriptions show that the level classification makes the development to become clearer, prioritizes the development issues, identifies the contents expected to be developed, learned, or transferred as well as the approaches thereof, and finally informs of the rewards from the development towards higher maturity levels.

The implementation of GMM will reduce the problem of the misunderstanding with the examiners because it shows the farmers of the worthiness and the rewards of the development instead of the mistake monitoring process. The development is systematic and can be follows in steps. In addition, the concept of GMM also solves the problems of having several standards or versions thereof. The implementation of GMM results in the systematic development suitable for the present globalization.

The application of GMM is thus effective and efficient, and becomes a tool in promoting the standardization of the Global GAP in farmers. The concept of GMM is applicable to other disciplines or standards where changes always occur. In addition, the stakeholders in the food supply chain also have benefits from the application of GMM because when the upstream of the chain is knowledgeable and capable, the risk due to lacking of knowledge can be reduced. When producers and farmers know and learn and develop together, risk and cost can be reduced. The business opportunity is also increased as well as the competitiveness. GMM also reduces risk in many aspects

including contamination, goods rejecting, price, and hygiene and safety of farmers. It can be seen that GMM is tremendously beneficial to Thai economy and farmers if GMM is widely disseminated and applied, which is good for the economic system throughout food supply chain of vegetable and fruit production in Thailand.

The application and benefits of GMM will be demonstrated in the next chapters.