CHAPTER 4
Case Studies

4.1 General

A number of case studies are provided here in order to verify the proposed methodology. The case studies consider 4 following aspects.

1) GMM can evaluate the farmer capability. The capability is divided into levels and complied with the agricultural industry standard. Maturity level is comparable with the Global GAP standard and shows the consistency in results.
2) In case of standard evaluation in the industry, i.e. the Global GAP, the farmers that cannot pass the certification may not be interested for further development. However, the evaluation system using GMM enables the farmers to develop themselves and to eventually increase the maturity to the level equivalent to or beyond that of the Global GAP.
3) The case study determines cost and risk from using GMM.
4) It is the study of farmer learning through the evaluation using the Global GAP and that using GMM and also of the learning promotion.

The sample group of the case

Since the grower maturity model is process improvement and working together with Global GAP standard. Which try to support the grower to achieve the standard by apply process reference model to support the grower for their knowledge improvement. Therefore, the sample group in all case studies are growers who must be involved in Global GAP standard.

Moreover, the Global GAP in Thailand is very limited applied. It will be concerned ad been applied only the grower who is grow their crop for export especially to European and Japan. The major crop of exporting product will be couple kind of fruits and vegetables. The fruits are very short season crop and not popular to certified the Global GAP by Thai's grower. The vegetables crop is seems to be more popular and widely applied the standard. However, the most valuable and apply the Global GAP are

for Okra, Asparagus, and Babycorn. Therefore, the sample group in all case studies are the grower who grow okra for export.

The okra's growers are mostly small family business work. Some of grower may have their own land and some may just rent the land to do their crop. Growing okra is daily working base. Hence, only family worker could not do the crop which has the area bigger than they ability. Therefore,the case is limited to be the farm size approximately of 5 rai. At the farm area of 5 rai will be able to take care by family.

The case is required experience in okra business for minimum of 5 years and have also contact farming members, due to the growers and buyer have more confidence and have enough knowledge to apply the Global GAP standard.

Therefore all of case studies in this thesis are used the same sampling group. The number of growers in each case study will be varied by the appropriated and available data by the time of thesis is being tested.

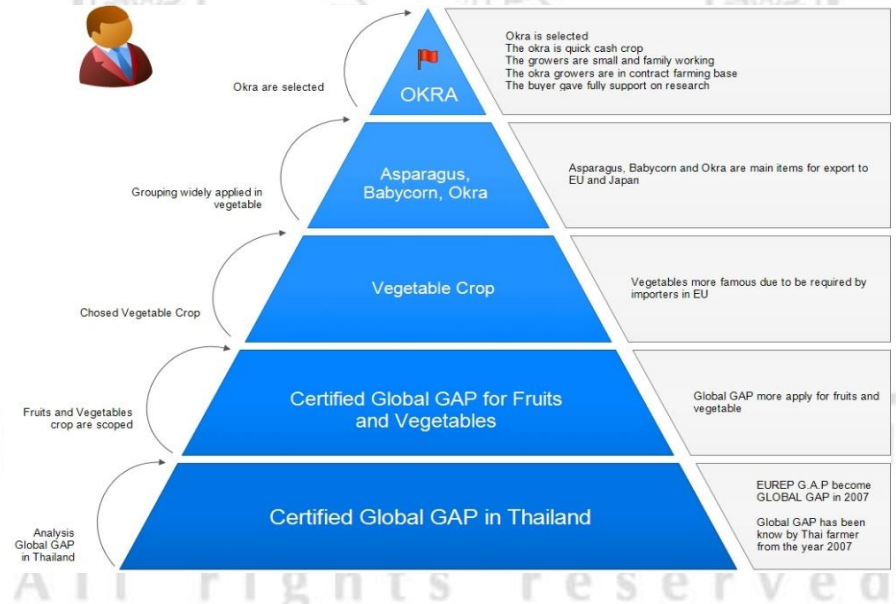

Figure 4.1 Selection of Sample Group for Case Studies

4.2 Case Study #1

4.2.1 General Description

Case study #1 studies the format of farmer evaluation using the Global GAP standard with the selected farmers. In the first case study used 3 farmers to be as sample of the case. Afterwards, the same farmers will be reassessed by using GMM. The selected farmers will be the group of farmers that do the contract farming with an export

company. The group may not be certified by the Global GAP but it should be in process of applying the standard. They carry out family businesses which employ the family members in farming on the areas less than 2 acres (5 rais). Those farmers need to be experienced in doing agricultural business not less than 10 years. Two evaluations have been analyzed to find out the consistency which will be described in Chapter 5 later on.

4.2.2 Research Process

- Select 3 farmers that have the qualifications as mentioned above.
- Evaluate those farmers using check list in order to evaluate them according to the Global GAP, following Table 4.1 (Appendices A, B, & C).

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GG_EG_IFA_protected_CL_CB_ENG_V3_0_3_Feb09

GG_EG_IFA_protected_CL_FV_ENG_V3_0_2_Sep07

- Evaluate those farmers again using GMM, following Table 4.2 GMM Evaluation Chart (APPENDIX D).
- The results from those 2 evaluations are used for the analysis of the consistency.

Table 4.1 GMM Evaluation Chart

1 Record Keeping and Internal Self- Assessment/Internal Inspection		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Grower has kept invoice, delivery note, income statement	
Level 3 (Defined)	Evaluate performance benchmarked with other producer or producer group regularly	
Level 4 (Managed)	Corrective action have implemented and recorded	
Level 5 (Optimization)	Preventive actions have written implemented and exposed	
2 SITE HISTORY AND SITE MANAGEMENT		
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Do crop rotation and/or use to have soil analysis	
Level 3 (Defined)	Record has been updated regularly and sufficient details such as planting date and/or plant protection product application. Soil has been analysis and managed such as crop rotation, draining, mulching, trees or bush border.	
Level 4 (Managed)	Have farm location or mapping. Have risk assessment on new crop. Crop rotation and no soil compaction activities. The activities have been recorded included on name of operator, date, active ingredient, dosage and treatment method.	
Level 5 (Optimization)	Have strategic for soil management. Soil testing regularly. Use innovation help to improve soil quality and not polluted to environment. Have written evident for all activities	

Table 4.1 GMM Evaluation Chart (Continued)

3 WORKERS HEALTH, SAFETY AND WELFARE		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	Working without safety and understanding	
Level 2 (Repeated)	Ware protective clothing to protect from direct contact with chemical very time of applied chemical and wash separately after used protective clothing from private clothing.	
Level 3 (Defined)	Have record about worker who operate task and worker must be trained. Have hygiene instruction display in place. All workers must be trained on hygiene and have first aid kits to be available at site. Protective clothing are use and in good conditions. Have the facilities, rest area or shelter for workers during rest period.	
Level 4 (Managed)	Have the person who has trained about first aid, Have risk assessment regularly on health, safety and hygiene. Emergency contact medical service is available at the farm, Have record for the worker who has work at the farm and period of working.	
Level 5 (Optimization)	Have open discussion about health, safety and welfare with worker and keep records. For subcontractor, must follow the rule or working compliant with Global GAP requirement	

Table 4.1 GMM Evaluation Chart (Continued)

4 WASTE AND POLLUTION MANAGEMENT, RECYCLING AND RE-USE (AF4)		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	collected empty container and waste in certain area wait for eliminate	
Level 3 (Defined)	Manage all waste in the farm by separate material of empty container. The storages are cleaned and do not litter chemical or waste on the ground.	
Level 4 (Managed)	Identify and store different type of waste separately. Have plan on wastage reduction, pollution, and waste recycling. Have plan to use biodiversity on the farm	
Level 5 (Optimization)	Plan for reduction of waste pollution are implemented. Environmental impacted has been considered.	
5 COMPLAINTS (AF6)		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Accept the claim or complain from customer without evidence	
Level 3 (Defined)	Accept the claim or complain from customer but cannot solve problem	
Level 4 (Managed)	Have the complaint document and action plan and solving problem systematically	
Level 5 (Optimization)	The complaint and problem, solutions have been improved to prevent reoccurred situation	

Table 4.1 GMM Evaluation Chart (Continued)

6 TRACEABILITY (AF7, CB1)		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Have record on delivery date and details about their products such as sales invoice or delivery noted	
Level 3 (Defined)	Have record and complied with traceability system. Which the producer can trace back to the raw material and process that has been used in the crop and also able to trace forward to the customer	
Level 4 (Managed)	Have fully traceability, product recall or withdraw procedure. The procedure must be tested annually	
Level 5 (Optimization)	The result of product recall or withdraw have been discuss for improvement and prevent of accident situation occurred	
7 PROPAGATION MATERIAL		
Level 1 (Initial)	Do their crop as they use to not serious check on propagation material	
Level 2 (Repeated)	Using reliable source of propagation material.	
Level 3 (Defined)	Using propagation materials that have been tested for resistance on pets and diseases. Have record of propagation material (sowing planting, method, rate and date), and any sign during growing period.	

Table 4.1 GMM Evaluation Chart (Continued)

7 PROPAGATION MATERIAL		
Maturity Level	**Grower Generic Practices**	**Results**
Level 4 (Managed)	Using propagation material that complied to the national registration and have record available for any treatment on propagation material	
Level 5 (Optimization)	Have registered the farm and have good system to prevent product contamination with conventional products, in case of growing GMO plant.	
8 FERTILISER USE (CB5)		
Level 1 (Initial)	Use fertilizer as they been used or advice from others to used without consider on necessity	
Level 2 (Repeated)	Have attended the training or seminar about fertilizers. Understand about fertilizers	
Level 3 (Defined)	Have record about fertilizer application in the farm. The record must indicated date of apply, trade mane, type of fertilizer, amount that has been applied, Method or applied, operator name, balancing at storage, storage area is safety from contamination.	
Level 4 (Managed)	The growers have record about their soil nutrient and fertility. The worker have been trained and have knowledge about fertilizer	
Level 5 (Optimization)	Organic fertilizer have applied and been analysis for nutrients	

Table 4.1 GMM Evaluation Chart (Continued)

9 IRRIGATION/FERTIGATION (CB6, FV3)		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	water quality check by own vision (Eye judgment)	
Level 3 (Defined)	Not use untreated sewage water in irrigation and fertigation	
	Analysis risk of microbial contamination, and polluted to the environment. Have corrective action and decision taken plan.	
Level 4 (Managed)	Sourcing secure sufficient water during growing crop. Resource of water must be obey the law	
Level 5 (Optimization)	Water consumption has been calculated and have recorded on water supplied to the crop. Water quality has been test by the lab which has standards.	
10 INTEGRATED PEST MANAGEMENT (CB7)		
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Using chemicals from advise of chemical store or other sources	
Level 3 (Defined)	The technical worker on farm has been trained about IPM, The grower have knowledge about reduce intensity of pets attacks and able to identify the situation of enemies pets coming in to the farms and able to manage. All plant protections that applied to the farm have been record	

Table 4.1 GMM Evaluation Chart (Continued)

Maturity Level	Grower Generic Practices	Results
Level 4 (Managed)	The grower has considered on using non chemical when pest attack When applied the chemical, the growers have consider on resistance and applied chemical follow the recommendation as indicated at label	
Level 5 (Optimization)	The grower have use other technic to control enemy pest like close system, baits, or biological technic	
11 PLANT PROTECTION PRODUCTS		
Level 1 (Initial)	N/A	
Level 2 (Repeated)	The grower may use any kind of chemical without considered on legal, and may not follow label instructions.	
Level 3 (Defined)	Applied suitable plant protection products for pest, disease, and weed. The plant protections have applied follow instruction. Those products must be registered. The plant protections chemical must be follow or complied with the regulation of importing country. The growers have been trained by qualify advisor. It could be by government, university, etc.	
	The growers have fully record about plant protection such as crop location, date of applied, trade name, pets, disease, or weed name.	

Table 4.1 GMM Evaluation Chart (Continued)

Maturity Level	Grower Generic Practices	Results
	The grower have document record on plant production product that have been applied in the farm and give the period before harvest according to the label indicated	
	The equipment in plant protection has been maintenance appropriately and ready to be used	
	The farmer or buyers have tested the product for residual and able to trace back to the farm.	
	Plant protection products have been kept and stored properly and secured. The container must have original label attached.	
	The grower do not reused empty container and disposal appropriated	
Level 4 (Managed)	Document of plant protection have kept and available for trace back. Have the list of plant protection that has been used in the farm available	
	Plant protection products which have bee applied have been record on person in charge, reason of using, volume, method applied,	
	The machines of plant protection application have been record for maintenance and repaired	

Table 4.1 GMM Evaluation Chart (Continued)

Maturity Level	Grower Generic Practices	Results
	Have eliminate surplus plant protection products by spray with the plant that have not been sprayed or applied	
	The grower or buyer able to identify the Maximum Residual (MRL) of the importing country. The grower or buyer also able to manage when found the chemical over residual appropriately. The analysis for MRL has been analysis by the laboratory which have certified standard ISO17025	
	Plant Protection Products have storage appropriately and secured, suitable conditions. Able to protect it from fire, air circulation, have all supporting equipment available and have record.	
	The grower have procedures for regulate re-entry interval has been applied according to the label indicated. The accident care area is near operator area and has emergency contact information.	
	Empty container have been clean and disposal according to the regulation. Cleaning water have been treated not contaminate to the environment.	
	Obsolete plant protection has been disposed by official authorised	
Level 5 (Optimization)	The surplus plant protections have been treated appropriately and record same as treated in the crop. The workers have medical check annually. Have instruction to clean empty container with pressure water for 3 times for disposal	

Table 4.1 GMM Evaluation Chart (Continued)

12 HARVESTING (general, latest step of packaging)		**(FV4)**
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Harvest product as they have been doing and not consider on improve product condition	
Level 3 (Defined)	The growers have been trained about product and personal hygiene. Hygiene equipment and tools are in place and ready to be used. Product have been remove from the file and store with protection to prevent contamination	
Level 4 (Managed	Have risk assessment analysis, Product have stored according to the product requirement conditions	
Level 5 (Optimization)	Have applied technology for harvesting, packing and storage	
13 PRODUCTION MANAGEMENT (FV5)		
Level 1 (Initial)	N/A	
Level 2 (Repeated)	The producer have preselected and wash the product before delivery	

Table 4.1 GMM Evaluation Chart (Continued)

Maturity Level	Grower Generic Practices	Results
Level 3 (Defined)	Have done product hygiene, risk, analysis and assessment	
	Workers have been train on personal, product hygiene and production flow have been managed to avoid risk of contamination.	
	Storage the product in suitable and good condition for the products suitable condition for temperature and moisture	
	Using clean water to wash the product. Water quality is suitable to apply with direct contact with the product and has been analysised to comply with the standard. In case of recirculate water must be clean filter and manage PH and prevent infected	
	The grower will use only biocide and wax that have been register with official registrations and use according to the label. The chemical is allowed to use by importing country. The technician or worker have been train and certified. Treatment or chemical applied have recorded included date of applied, treatment method, trade name, amount, and consider on control points.	
Level 4 (Managed)	The grower or workers have awareness on hygiene and prevent of contamination. The storage facilities are cleaned and prevent contamination.	
	The worker using cleaning agent and lubricant ask label indication and kept at designate area to prevent contamination with produce	

Table 4.1 GMM Evaluation Chart (Continued)

13 PRODUCTION MANAGEMENT (FV5)		
Maturity Level	**Grower Generic Practices**	**Results**
	Rejected and waste material are kept in specific are separate from produce	
	Glass and clear hard plastic breakage has been managed properly to avoid contamination with produce	
	Do not let animal come in to the process area	
	The produces are packed according to the standard and agreement. The equipment and have been calibrated regularly	
	The grower have visual assessment for pest and have pest control have been applied in the process area	
	The chemicals (Biocide, wax and plant protections) has been update regularly	
	The name of operator, common name of pest, disease are recorded	
Level 5 (Optimization)	The worker ware outer garment to protect from contamination and safety. The stocks are rotated to have maximum product quality and safety. Water has been analysis by reliable and certified laboratory.	

4.2.3 Results and Discussion

Comparison of the capabilities according to the GMM and the Global GAP shows the consistency in the results. Three farmers that are evaluated by the Global GAP are mostly in the categories of minor must and recommend. The major must in each area is practiced by the farmers. The evaluation of the farmers using GMM shows that the capability levels are mainly at the level 3 defined and the level 4 managed, except the areas of worker health, safety, and welfare. The farmers with highest capability level in view of the Global GAP will focus on risk evaluation, document and handbooks, training, implementation, equipment, and communication. The GMM viewpoint concentrates on real practice or behavior of workers. There is a division of capability levels for the same area of requirement as the Global GAP. For example, at the level 1 initial farmers or workers may work without knowledge and understanding of personnel and other safeties. At level 2 repeated, the farmers or workers start to understand and recognize their own safety. They wear protections against hazards due to direct contacts with chemicals. At level 3 defined, the farmers are trained and record activities. At level 4 managed, there is responsibility and evaluation of risk related to hygiene and safeties. There is recording and operational guidelines when accidents happen. Finally, at level 5 optimization, it focuses on sustainable prevention. There are open discussions about hygiene and safety of workers in order to take them as corrective or practical guidelines for worker safety. This also includes the record of safety and hygiene.

In the area of fertilized use, those 3 farmers have different capability levels. The farmer #3 has the 2nd capability level of repeated where the farmer is trained for the fertilized use. The trained knowledge is not seriously applied. The farmer does not examine the minerals in soil and what the soil needs. The use of fertilizers is not appropriate and there is no calculation of use doze, which is the case of the Global GAP evaluation. The farmer is not satisfying the fertilized use, i.e. at the level of minor must. This means that the requirement is not fulfilled and the farmer needs to adjust the amount of the fertilizer used so that it corresponds to the need of soil and plants. The inconsistent point is reduced at the level of minor must to be minimal so that the farmer passes the standard and can be certified by the Global GAP.

The farmer #1 is at the level 3 defined according to the GMM model. It is found that the farmer passes training and has sufficient knowledge and understanding in fertilized use. The fertilizer is appropriately stored and not mixed with chemicals which can lead to contamination. However, there is no analysis of minerals in soil, which makes the capability level of the farmer at the level 3. The evaluation of this farmer using the Global GAP shows that the capability level is of the minor must which requires correction.

The farmer #2 has the capability level 4 managed according to the GMM model. It is found that the farmer #2 has a good behavior, i.e. analysis of minerals in fertilizers. This makes the farmer able to appropriately manage the ratio of use and the need of fertilized use. When the Global GAP is employed and compared, the farmer passes the minor must and remains at the recommend. The Global GAP is consistent with the capability level specification of the GMM model. The GMM capability is at the level 4 managed. The farmer has the ability in appropriately managing the fertilizers according to the acquired knowledge.

The evaluation by the GMM, however, cannot substitute the Global GAP evaluation because the objectives in the respective models are different. The Global GAP standard concentrates on the consistency or inconsistency in each requirement and standard area. The importance of level is also different. The evaluation that focuses on the passing or the unavoidable consistency may lead to the practice with the objective of just passing, not with the recognition and intention of sustainable development. If there is no examination, farmers will turn back to their old practices. In other words, their practices are not voluntarily or lack of motivation.

On contrary, the GMM may not be as in details as the Global GAP and cannot replace the Global GAP. The GMM is a tool that works in parallel with the Global GAP because the GMM studies the behaviors of farmers, looks at the present capability levels, is a supplementary tool for farmers. The GMM makes the farmers to know of the motivation in cost and risk that can be reduced if the farmers can develop their own capability levels. The cost and risk will be addressed in the case study 3. Apart from motivating farmers, the GMM can be a tool for supplying skills, knowledge, and capability that are necessary for systematically enhancing capability. The farmers can clearly prioritize the preferences of learning. The details and comparison of the maturity levels among three growers are shown in Tables 4.2 – 4.4 and Table 4.5 is comparison of the cases.

Table 4.2 Grower #1

Grower #1	Mr. Chanon
Criteria	
1 Record Keeping and Internal Self-Assessment/Internal Inspection	
Level 3 Defined	Evaluate performance benchmarked with other producer or producer group regularly
Finding	Grower kept related record documents and have discussed with other growers about their performance
2 Site History and Site Management	
Level 3 Defined	Record has been updated regularly and sufficient details such as planting date and/or plant protection product application. Soil has been analysis and managed such as crop rotation, draining, mulching, trees or bush border.
Finding	Have record of soil analysis
3 Workers Health, Safety and Welfare	
Level 5 Optimizing	Have open discussion about health, safety and welfare with worker and keep records. For subcontractor, must follow the rule or working compliant with Global GAP requirement
Finding	Have safety equipment and first aid provide for workers
	Workers have been trained for hygiene basic
4 Waste and Pollution Management, Recycling and Re-Use	
Level 4 Managed	Identify and store different type of waste separately. Have planning on wastage reduction, pollution, and waste recycling. Have plan to use biodiversity on the farm
Finding	The grower has stored empty container and other waste separately and clean area at working site
5 Complaints	
Level 4 managed	Have the complaint document and action plan and solving problem systematically
Finding	The grower can trace back to the lot that might got complaint

Table 4.2 Grower #1 (Continued)

6 Traceability	
Level 4 Managed	Have fully traceability, product recall or withdraw procedure. The procedure must be tested annually
Finding	Have record that able to traced back to the activities
7 Propagation Material	
Level 3 Defined	Using propagation materials that have been tested for resistance on pets and diseases. Have record of propagation material (sowing planting, method, rate and date), and any sign during growing period.
Finding	The grower used only the seed which supplied by the buyer
8 Fertiliser Use	
Level 3 Defined	Have record about fertilizer application in the farm. The record must indicated date of apply, trade mane, type of fertilizer, amount that has been applied, Method or applied, operator name, balancing at storage, storage area is safety from contamination.
Finding	Have completed record on fertilizer used in the farm
	Storage fertilizer in appropriated area and separate from chemical
9 Irrigation/Fertigation	
Level 4 Managed	Sourcing secure sufficient water during growing crop. Resource of water must be obey the law
Finding	The grower used water from canal which suitable for agricultural used
10 Integrated Pest Management	
Level 4 Managed	The grower has considered on using non chemical when pest attack When applied the chemical, the growers have consider on resistance and applied chemical follow the recommendation as indicated at label
Finding	Grower mainly used organic pesticide and herbs, which provide by the buyer
	In case of chemical applied will be under advisory of buyer's farm extension team

Table 4.2 Grower #1 (Continued)

11 Plant Protection Products	
Level 3 Defined	Applied suitable plant protection products for pest, disease, and weed. The plant protections have applied follow instruction. Those products must be registered. The plant protections chemical must be follow or complied with the regulation of importing country. The growers have been trained by qualify advisor. It could be by government, university, etc.
	The growers have fully record about plant protection such as crop location, date of applied, trade name, pets, disease, or weed name.
	The grower have document record on plant production product that have been applied in the farm and give the period before harvest according to the label indicated
	The equipment in plant protection has been maintenance appropriately and ready to be used
	The farmer or buyers have tested the product for residual and able to trace back to the farm.
	Plant protection products have been kept and stored properly and secured. The container must have original label attached.
	The grower do not reused empty container and disposal appropriated
Finding	Grower mainly used organic pesticide and herbs, which provide by the buyer
	In case of chemical applied will be under advisory of buyer's farm extension team
	Grower have completed record and continually
	The equipment in good condition and ready to be used
	Empty containers have been store appropriated

Table 4.2 Grower #1 (Continued)

12 Harvesting	
Level 3 Defined	The growers have been trained about product and personal hygiene. Hygiene equipment and tools are in place and ready to be used. Product have been remove from the file and store with protection to prevent contamination
Finding	At the farm has rest area and have equipment for cleaning
	Product has store at rest area in shade and leverage from the ground
	Product contained in plastic baskets
13 Production Management	
Level 2 Repeated	The producer have preselected and wash the product before delivery
Finding	The product has been pre-grading by the time of harvesting

Table 4.3 Grower#2

Grower #2	Mr. Chuchart
Criteria	
1 Record Keeping and Internal Self-Assessment/Internal Inspection	
Level 3 Defined	Evaluate performance benchmarked with other producer or producer group regularly
Finding	Grower kept related record documents and have discussed with other growers about their performance
2 Site History and Site Management	
Level 3 Defined	Record has been updated regularly and sufficient details such as planting date and/or plant protection product application. Soil has been analysis and managed such as crop rotation, draining, mulching, trees or bush border.
Finding	Have record of soil analysis
	Have soil mapping

Table 4.3 Grower#2 (Continued)

3 Workers Health, Safety and Welfare	
Level 5 Optimizing	Have open discussion about health, safety and welfare with worker and keep records. For subcontractor, must follow the rule or working compliant with Global GAP requirement
Finding	Have safety equipment and first aid provide for workers
	Workers have been trained for hygiene basic
4 Waste and Pollution Management, Recycling and Re-Use	
Level 4 Managed	Identify and store different type of waste separately. Have planning on wastage reduction, pollution, and waste recycling. Have plan to use biodiversity on the farm
Finding	The grower has stored empty container and other waste separately and clean area at working site
5 Complaints	
Level 4 managed	Have the complaint document and action plan and solving problem systematically
Finding	The grower can trace back to the lot that might got complaint
6 Traceability	
Level 4 Managed	Have fully traceability, product recall or withdraw procedure. The procedure must be tested annually
Finding	Have record that able to traced back to the activities
7 Propagation Material	
Level 3 Defined	Using propagation materials that have been tested for resistance on pets and diseases. Have record of propagation material (sowing planting, method, rate and date), and any sign during growing period.
Finding	Using the seed that has been proved for quality by grower experience and group of growers
8 Fertiliser Use	
Level 4 Managed	The growers have record about their soil nutrient and fertility. The worker have been trained and have knowledge about fertilizer
Finding	Fertilizers has been analysed

Table 4.3 Grower#2 (Continued)

9 Irrigation/Fertigation	
Level 4 Managed	Sourcing secure sufficient water during growing crop. Resource of water must be obey the law
Finding	The grower used water from canal which suitable for agricultural used
10 Integrated Pest Management	
Level 4 Managed	The grower has considered on using non chemical when pest attack When applied the chemical, the growers have consider on resistance and applied chemical follow the recommendation as indicated at label
Finding	Grower mainly used organic pesticide and herbs, which provide by the buyer
	In case of chemical applied will be under advisory of buyer's farm extension team
11 Plant Protection Products	
Level 3 Defined	Applied suitable plant protection products for pest, disease, and weed. The plant protections have applied follow instruction. Those products must be registered. The plant protections chemical must be follow or complied with the regulation of importing country. The growers have been trained by qualify advisor. It could be by government, university, etc.
	The growers have fully record about plant protection such as crop location, date of applied, trade name, pets, disease, or weed name.
	The grower have document record on plant production product that have been applied in the farm and give the period before harvest according to the label indicated
	The equipment in plant protection has been maintenance appropriately and ready to be used
	The farmer or buyers have tested the product for residual and able to trace back to the farm.
	Plant protection products have been kept and stored properly and secured. The container must have original label attached.
	The grower do not reused empty container and disposal appropriated

Table 4.3 Grower#2 (Continued)

11 Plant Protection Products	
Finding	Grower mainly used organic pesticide and herbs, which provide by the buyer
	In case of chemical applied will be under advisory of buyer's farm extension team
	Grower have completed record and continually
	The equipment in good condition and ready to be used
	Empty containers have been store appropriated
12 Harvesting	
Level 3 Defined	The growers have been trained about product and personal hygiene. Hygiene equipment and tools are in place and ready to be used. Product have been remove from the file and store with protection to prevent contamination
Finding	At the farm has rest area and have equipment for cleaning
	Product has store at rest area in shade and leverage from the ground
	Product contained in plastic baskets
13 Production Management	
Level 2 Repeated	The producer have preselected and wash the product before delivery
Finding	The product has been pre-grading by the time of harvesting

Table 4.4 Grower #3

Grower # 3	Mr. Krisana
Criteria	
1 Record Keeping and Internal Self-Assessment/Internal Inspection	
Level 3 Defined	Evaluate performance benchmarked with other producer or producer group regularly
Finding	Grower kept related record documents and have disuceesed with other growers about their performance

Table 4.4 Grower #3 (Continued)

2 Site History and Site Management	
Level 3 Defined	Record has been updated regularly and sufficient details such as planting date and/or plant protection product application. Soil has been analysis and managed such as crop rotation, draining, mulching, trees or bush border.
Finding	Have record of soil analysis
	Have sign of soil compact
3 Workers Health, Safety and Welfare	
Level 5 Optimizing	Have open discussion about health, safety and welfare with worker and keep records. For subcontractor, must follow the rule or working compliant with Global GAP requirement
Finding	Have safety equipment and first aid provide for workers
	Workers have been trained for hygiene basic
4 Waste and Pollution Management, Recycling and Re-Use	
Level 4 Managed	Identify and store different type of waste separately. Have planning on wastage reduction, pollution, and waste recycling. Have plan to use biodiversity on the farm
Finding	The grower has stored empty container and other waste separately and clean area at working site
5 Complaints	
Level 4 managed	Have the complaint document and action plan and solving problem systematically
Finding	The grower can trace back to the lot that might got complaint
6 Traceability	
Level 4 Managed	Have fully traceability, product recall or withdraw procedure. The procedure must be tested annually
Finding	Have record that able to traced back to the activities
7 Propagation Material	
Level 3 Managed	Using propagation materials that have been tested for resistance on pets and diseases. Have record of propagation material (sowing planting, method, rate and date), and any sign during growing period.
Finding	Using the seed from buyer, which has been tested?

Table 4.4 Grower #3 (Continued)

8 Fertiliser Use	
Level 2 Repeated	Have attended the training or seminar about fertilizers. Understand about fertilizers
Finding	Grower attended training on fertilizer but seem not applied knowledge, do not have soil nutrient analysis
9 Irrigation/Fertigation	
Level 4 Managed	Sourcing secure sufficient water during growing crop. Resource of water must be obey the law
Finding	The grower used water from canal which suitable for agricultural used
10 Integrated Pest Management	
Level 4 Managed	The grower has considered on using non chemical when pest attack When applied the chemical, the growers have consider on resistance and applied chemical follow the recommendation as indicated at label
Finding	Grower mainly used organic pesticide and herbs, which provide by the buyer
	In case of chemical applied will be under advisory of buyer's farm extension team
11 Plant Protection Products	
Level 3 Defined	Applied suitable plant protection products for pest, disease, and weed. The plant protections have applied follow instruction. Those products must be registered. The plant protections chemical must be follow or complied with the regulation of importing country. The growers have been trained by qualify advisor. It could be by government, university, etc.
	The growers have fully record about plant protection such as crop location, date of applied, trade name, pets, disease, or weed name.
	The grower have document record on plant production product that have been applied in the farm and give the period before harvest according to the label indicated
	The equipment in plant protection has been maintenance appropriately and ready to be used
	The farmer or buyers have tested the product for residual and able to trace back to the farm.

Table 4.4 Grower #3 (Continued)

11 Plant Protection Products	
	Plant protection products have been kept and stored properly and secured. The container must have original label attached.
	The grower do not reused empty container and disposal appropriated
Finding	Grower mainly used organic pesticide and herbs, which provide by the buyer
	In case of chemical applied will be under advisory of buyer's farm extension team
	Grower have completed record and continually
	The equipment in good condition and ready to be used
	Empty containers have been store appropriated
12 Harvesting	
Level 3 Defined	The growers have been trained about product and personal hygiene. Hygiene equipment and tools are in place and ready to be used. Product have been remove from the file and store with protection to prevent contamination
Finding	At the farm has rest area and have equipment for cleaning
	Product has store at rest area in shade and leverage from the ground
	Product contained in plastic baskets
13 Production Management	
Level 2 Repeated	The producer have preselected and wash the product before delivery
Finding	The product has been pre-grading by the time of harvesting

Table 4.5 Comparison of Grower Maturity Level

Criteria	GG criteria Code	Level 1	Level 2	Level 3	Level 4	Level 5
1 RECORD KEEPING AND INTERNAL SELF-ASSESSMENT/INTERNAL INSPECTION	(AF 1)			Farm 1, Farm 2, Farm3		
2 SITE HISTORY AND SITE MANAGEMENT	(AF2, CB3, CB4, FV2)			Farm 1, Farm 2, Farm3		
3 WORKERS HEALTH, SAFETY AND WELFARE	(AF3)					Farm 1, Farm 2, Farm3
4 WASTE AND POLLUTION MANAGEMENT, RECYCLING AND RE-USE	(AF4, AF5)				Farm 1, Farm 2, Farm3	
5 COMPLAINTS	(AF6)				Farm 1, Farm 2, Farm3	
6 TRACEABILITY	(AF7, CB1)				Farm 1, Farm 2, Farm3	
7 PROPAGATION MATERIAL	(CB2, FV1)			Farm 1, Farm 2 Farm 3		
8 FERTILISER USE	(CB5)		Farm3	Farm	Farm	

				1	2	
9 IRRIGATION/FERTIGATION	(CB6, FV3)				Farm 1, Farm 2, Farm3	
10 INTEGRATED PEST MANAGEMENT	(CB7)				Farm 1, Farm 2, Farm3	

Table 4.5 Comparison of Grower Maturity Level (Continued)

Criteria	GG criteria Code	Level 1	Level 2	Level 3	Level 4	Level 5
11 PLANT PROTECTION PRODUCTS	(CB8)			Farm 1, Farm 2, Farm3		
12 HARVESTING (general, latest step of packaging)	(FV4)			Farm 1, Farm 2, Farm3		
13 PRODUCTION MANAGEMENT (Not been applied with the farmer)	(FV5)		Farm 1, Farm 2, Farm3			

4.3 Case Study # 2

4.3.1 General Description

The case studies the farmers that are evaluated by the Global GAP but cannot pass the evaluation or be certified However, those farmers may have the maturities or capabilities that can be developed and later pass the Global GAP evaluation. The Global GAP evaluation looks solely at the results or documents, which results in the failure of the farmers. When the GMM is used for the evaluation, it shows that the farmers may have the capabilities and behaviors that can be developed to pass the evaluation.The GMM evaluates and studies the present mean capability and thus reflects the present state or status and the

future one which will enhance the capabilities of the farmers when they are developed using the GMM model.

The farmers in this case study did not pass the Global GAP evaluation and are under the contract farming of exporting companies. The companies produce goods to supply foreign markets and are certified according to the Global GAP standard. The farmers must have at least 10 years of experience in agriculture and have more than 5 Rais (2 Acres). They must live in the areas promoted by the exporting or promoting companies. The sample in this case is only 1 farm. Since, most of the farm support by the exporting company and have farm supporting team to prepare and should be pass the audit. Anyhow by the time of doing research found that one farmer has not pass the standard. Therefore, the sample in this case is only one sample.

4.3.2 Research Process

- Select the farmers for evaluation and study.
- Evaluate the farmers using the Global GAP standard. The evaluation example is shown in Table 4.7 GG Audit Result.
- Reevaluate the same group of farmers using the GMM model using Table 4.2.
- Analyze and compare the results from two evaluations. Base on GMM results, the farmers are informed of what skills, knowledge, capability and their sequence should be developed for the farmers. The farmers with low capabilities need to be developed first.
- Analyze and summarize the evaluation results and the possibility in developing the farmers to the target required, i.e. passing the evaluation by the Global GAP standard.

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Globalgap IFA V3 Auditreport

Project information APPROVED Version GAP.IFA.V3.sep 2011\V21 C

1.1 Company information

control adm. 3231249

Licensee number	810393
GGN / GLN number	4049928986238
Company name	CHATCHAWAL ORCHID CO.,LTD.
Contact person	Mr. Thitipong Telavanich
Address	298 M1 Laksam Banphaeo, Samutsakorn 74120
Postal code	74120
City	Samutsakorn
Country	Thai Land
Tel. No.	(+66-)0 -3448-0082
Mail address	art@qualitygreen.com, okra@qualitygreen.com
Audit report	SOMPKIT-GLOBALGAP-HVD-07-12-2011

Control Union Certifications
Member of Control Union World Group

1.2 Location information

Number of production locations (PMU) 1

	Company name	Address	Postal code	City	Type of company	GGN / GLN
F-01	Mr. Sompol Kittiwiriyakan	116 Moo 7 Tungkhang, Kampangsean, Nakronpatom	116	Nakronpatom	Agricultural	4050373715595
F-02						
F-03						
F-04						
F-05						

Number of processing locations (PHU) 1

	Company name	Address	Postal code	City	Type of company	GGN / GLN
D-01	CHATCHAWAL ORCHID CO.,LTD.	298 M1 Laksam Banphaeo, Samutsakorn 74120	74120	Samutsakorn	Agricultural	4049928986238
D-02						
D-03						
D-04						
D-05						

1.3 Product information

First select products before the audit. The report will be generated automatically, based on the products

Number of products 1

	Product	Type of production	Ha.	Production location	Processing	Processing location
P-01	Asparagus	Non-covered	1.9	Mr. Sompol Kittiwiriyakan	yes	CHATCHAWAL ORCHID CO.,LTD.
P-02						
P-03						
P-04						
P-05						
P-06						
P-07						
P-08						
P-09						
P-10						
P-11						
P-12						
P-13						
P-14						
P-15						

	Product	Start 1st harvest	Start 2nd harvest	Harvest exclusion	Country of destination	Yield (t)
P-01	Asparagus	year round	year round	Yes	Japan and EU Countries	
P-02						
P-03						
P-04						
P-05						
P-06						
P-07						
P-08						
P-09						
P-10						
P-11						
P-12						
P-13						
P-14						
P-15						

1.4 Other information

1 van 7

Figure 4.2 GG Audit Result

Which crops will not be included for certification:

He has about 0.02 hecta for Taro and mango.

1.5 Audit information

Certification related information

Producer of Option 2 (PMO) (assessment of QMS separately)

Member of producer organisation	10
Name of producer organisation	Chatchawal Orchid Co., Ltd.
Name of producer group	Mr. Sompol Kittiwiriyakan

Audit related information

X	All Farm Base			Audit type	Survailance	
X	Crops Base			Announcement	Announced	
X	Fruit & Vegetables			Audit date	7/12/11	
	Combinable Crops			Audit duration	3.5	
	Flowers & Ornamentals			Auditor	Mr. Ho Van Dong	Initials: GB
	Coffee (Green)	Separate Chain of Custody audit is required		Reporting language	English	
		Separate Chain of Custody audit is required		Local interpretation	English	In English
	Livestock Base					
	Cattle & Sheep		Do the producer also process products for other producers?		no	
	Dairy					
	Pigs					
	Poultry					
	Aquaculture base					
	Tilapia	Separate Chain of Custody audit and GRASP assessment is required				
	Pangasius					
	Shrimp					
	Salmon	Separate Chain of Custody audit and GRASP assessment is required				

Comments during audit (eg comments in relation to audit duration, level of preparation)

The producer didnt implemented some requirement of the standard. He need to correction it and report to CUC before 4 January 2012.

Assessed production and processing units;

See attached the QMS report

1.6 Service related agreements (to undersign by the producer)

By signing this report we agree with :	The Terms of contract with Control Union Certifications
	Sublicense and Certification agreement with Food Plus which is valid for the current production year
	The signed offerletter and contract with Control Union Certification
By signing this report we confirm that:	We are familiar with the above documents and agreements.
By signing this report we declare that	All related units are applied to Control Union Certification, for Globalgap certification
	All related units are indicated in this report and are subjected to the assessment for Globalgap certification
Payment are done via :	Produce Management Organisation

1.7 Audit results

summary of the N.C.'s

number of major must NC	**2**
number of minor musts NC	**12**
minor musts not applicable	**47**
calculation	
Number of minors minus n.a. minorsx 5%	**(125 minus 47) x 5% = 3**
The number of Minor non-conformities must be redused to	**3**
Unless the certifier decide different, the Major non-confortimies must be settled before	**4/01/12**
Number of Major non-conformities	**2**
All Major non-conformities must be settled.	
Unless the certifier decide different, the Major non-confortimies must be settled before	**4/01/12**

Foodplus Calculatie	in ha.	
Costs of certification		€25.00
Open air area	1.9	€ 4.00
Geenhouse of covered area		
Total	1.9	€29.00

1.8 Control Points and Compliance Criteria

Figure 4.2 GG Audit Result (Continued)

AF.2.1.2	Is a reference system for each field, orchard, greenhouse, yard, plot, livestock building or other area/location used in production established and referenced on a farm plan or map?	Compliance must include visual identification in the form of a physical sign at each field/greenhouse/plot/livestock building/pen or other farm, or a farm plan or map that could be cross referenced to the identification system. No N/A.	Minor Must		X		
			Number of parcels:				2 lote
			Type of identification:				didnt identified in the field
			Type of reference system:				the map
			Findings:				The map didnt mention numbe ro fthe lote and didnt identified in the filed.
AF.3.2.1	Is there a record kept for training activities and attendees?	A record is kept for training activities including the topic covered, the trainer, the date and attendees. Evidence of the attendance is required.	Minor Must		X		
			Record are stored in:				they have training record for one worker and the owner. The rest worker didnt have any training record.
			Records are stored of:				his house and the head office of company
			Verified evidence :				no training record for 5 worker
			Records stored of:				his house and the head office of company
			Findings:				They have 6 permanent worker in the farm but didnt have training record of 5 worker.
AF.3.2.2	Do all workers handling and/or administering veterinary medicines, chemicals, disinfectants, plant protection products, biocides or other hazardous substances and all workers operating dangerous or complex equipment as defined in the risk assessment in AF.3.1.1 have certificates of competence, and/or details of other such qualifications?	Records must identify workers who carry out such tasks, and show certificates of training or proof of competence. No N/A	Major Must		X		
			Verified evidence				training how to used PPP, IPM and Globalgap.
			Records stored of:				his house and head office
			Findings:				they have 2 person for mixed and sprayed the PPP but only one person has training how to used PPP, IPM and Globalgap.
AF.3.2.6	Have all persons working on the farm received basic hygiene training according to the hygiene instructions in AF.3.2.5?	Both written and verbal training are given as an induction training course for hygiene. Training are provided by qualified people. All new workers must receive this training and confirm their participation with a signature. All instructions from AF.3.2.5 must be covered in this training. All workers, including the owners and managers, at any time of the year have reviewed and signed for the farm's hygiene instructions.	Minor Must		X		
			Training is given on:				the field and verbal training to all worker
			Training is given by:				Mr. Sompol Kittwiriyakan
			Training is given to:				all worker
			Findings:				The owners didnt have review and all training didnt record in this year.
AF.3.3.2	Are potential hazards clearly identified by warning signs and placed where appropriate?	Permanent and legible signs must indicate potential hazards, e.g. waste pits, fuel tanks, workshops, access doors of the plant protection product / fertiliser / any other chemical storage facilities as well as the treated crop etc. Warning signs must be present. No N/A.	Minor Must		X		
			Potential hazards:				area.
			Warning sign (s):				area.
			Findings:				the potential hazard didnt identification the waming sign in the mixing PPP area.

Figure 4.2 GG Audit Result (Continued)

AF.3.5.2	Do regular two way communication meetings take place between management and workers ? Are there records from such meetings?	Records show that the concerns of the workers about health, safety and welfare are being recorded in meetings planned and held at least once a year between management and workers at which matters related to the business and worker health, safety or welfare can be discussed openly (without fear or intimidation or retribution). The auditor is not required to make judgments about the content, accuracy or outcome of such meetings.	Recom		X		
			Frequency of meeting (s):				no meeting between the owner and worker
			Last meeting :				no meeting between the owner and worker
			Participants:				no meeting between the owner and worker
			Findings:				no meeting between the owner and worker
AF.3.5.3	Is there information available that provide an accurate overview over all workers of the farm?	Records demonstrate clearly an accurate overview over all workers (including seasonal workers) and subcontractors working on the farm. Information must be available of full names, date of entry, the period of employment and, the regular working time and overtime regulations. Records of all workers (also subcontractors) which provide the required information must be kept for the last 24 months from the date of first inspection. See AF.3.6.1 as requirement for subcontractors.	Minor Must		X		
			Number of workers:				6
			Reviewed files:				no have accurate overview over wokers of the farm
			Findings:				no have accurate overview over wokers of the farm
AF.4.2.1	Is there a documented farm waste management plan to avoid or reduce wastage and pollution and avoid the use of landfill or burning, by waste recycling? Are organic wastes composted on the farm and utilised for soil-conditioning, provided there is no risk of disease carry-	A comprehensive, current, documented plan that covers wastage reduction, pollution and waste recycling is available. Air, soil, water, noise and light contamination must be considered.	Recom		X		
			Date of managementplan:				no documented waste management plan
			Managementplan contains:				no documented waste management plan
			Findings				no documented waste management plan
AF.4.2.2	Has this waste management plan been implemented?	There are visible actions and measures on the farm that confirm that the objectives of the waste and pollution action plan are being carried out.	Recom		X		
			Date if implementation:				no documented waste management plan
			Verified spots, verified on implementation:				no documented waste management plan
			Findings:				no documented waste management plan
AF.4.2.4	Do the premises have adequate provisions for waste disposal?	The farm has designated areas to store litter and waste. Different types of waste are identified and stored separately.	Recom		X		
			Location of collecting:				the farm dint designated area to store liutter and waste.
			Collected waste types:				the farm dint designated area to store liutter and waste.
			Findings :				the farm dint designated area to store liutter and waste
AF.5.1.2	Has the producer considered how to enhance the environment for the benefit of the local community and flora and fauna?	There should be tangible actions and initiatives that can be demonstrated by the producer either on the production site or by participation in a group that is active in environmental support schemes looking at habitat quality and habitat elements.	Recom		X		
			Undertaken actions by the producer:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
			Findings:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna

Figure 4.2 GG Audit Result (Continued)

AF.5.1.3	Is this policy compatible with sustainable commercial agricultural production and does it minimise environmental impact of the agricultural activity?	The contents and objectives of the conservation plan imply compatibility with sustainable agriculture and demonstrate a reduced environmental impact.	Recom		X		
			Results of implementation:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
			Findings:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
AF.5.1.4	Does the plan include a baseline audit to understand existing animal and plant diversity on the farm?	There is a commitment within the conservation plan to undertake a base line audit of the current levels, location, condition etc. of the fauna and flora on farm so as to enable actions to be planned. The effects of agricultural production on fauna and flora should be audited and serve as the basis for the action plan. Refer to points CO.10.1 for Coffee and TE.11.1 for Tea certification.	Recom		X		
			Date of base line audit:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
			Done by:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
AF.5.1.5	Does the plan include action to avoid damage and deterioration of habitats on the farm?	Within the conservation plan there is a clear list of priorities and actions to rectify damaged or deteriorated habitats on the farm. Refer to points CO.10.1 for Coffee and TE.11.1 for Tea certification.	Recom		X		
			Action list is made on:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
			Actions are done by:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
			Findings				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
AF.5.1.6	Does the plan include activities to enhance habitats and increase bio-diversity on the farm?	Within the conservation plan there is a clear list of priorities and actions to enhance habitats for fauna and flora where viable and increase bio-diversity on the farm. Refer to points CO.10.1 for Coffee and TE.11.1 for Tea certification.	Recom		X		
			Results of undertaken actions on the farm:				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
			Finding :				no have any acton and to enhance the enviroemnt for benefit of local community and flora and fauna
CB.4.1.1	Have soil maps been prepared for the farm?	The type of soil is identified for each site, based on a soil profile or soil analysis or local (regional) cartographic soil-type map.	Recom		X		
			Findings:				no have soil map
CB.4.2	**Cultivation**						
CB.5.3.1	Have all applications of soil and foliar fertilisers, both organic and inorganic, been recorded including field, orchard or greenhouse reference?	Records are kept of all fertiliser applications, detailing the geographical area, the name or reference of the field, orchard or greenhouse where the registered product crop is located. Also applicable for hydroponic situations and where fertigation is used. No N/A. Refer to TE.4.3.1 for Tea certification.	Minor Must		X		
			Way of registration:				record in the application book
			Verified applications:				fertilizer in 2011
			Findings:				The fertilisers application record didnt mention the filed (number of lote)
CB.5.3.5	Have all applications of soil and foliar fertilisers, both organic and inorganic, been recorded including the method of application?	Detailed in the records of all fertiliser applications are the application machinery type used and the method (e.g. via the irrigation or mechanical distribution). No N/A.	Minor Must		X		
			Verified applications:				2011
			Findings:				The fertilisers application record didnt mention the method of applications
CB5.7.2	Are purchased inorganic fertilisers accompanied by documentary evidence of chemical content, which includes heavy metals?	Documentary evidence detailing chemical content, including heavy metals, is available for all inorganic fertilisers used on crops grown under GLOBALGAP within the last 12-month period.	Recom		X		

Figure 4.2 GG Audit Result (Continued)

			Verified fertilizers:				no evidence detailing chemical content including heavy metals
			Findings :				no evidence detailing chemical content including heavy metals
CB.6.11	Have systematic methods of prediction been used to calculate the water requirement of the crop?	Calculations are available and are supported by data records e.g. rain gauges, drainage trays for substrate, evaporation meters, water tension meters (% of moisture in the soil) and soil maps.	Recom		X		
			Findings :				the calculatiosn method not availabe
CB.6.2	**Irrigation/Fertigation Method**						
CB.6.2.2	Is there a water management plan to optimise water usage and reduce waste?	A documented plan is available which outlines the steps and actions to be taken to implement the management plan. Refer to CO.5.1.1 for Coffee and TE.5.1.1 for Tea certifications.	Recom		X		
			Findings :				no have documented water management plan
CB.6.2.3	Are records of irrigation/fertigation water usage maintained?	Records are kept which indicate the date and volume per water meter or per irrigation unit. If the producer works with irrigation programmes, the calculated and actual irrigated water should be written down in the records. Refer to TE.5.1.2 for Tea certification.	Recom		X		
			Findings :				they have record the irrigation but didnt mention the volume per water meter.
CB.7.5	Where plant protection products have been used, has protection been achieved with the appropriate minimum input?	All plant protection product inputs are documented and include written justifications. No N/A.	Minor Must		X		
			Verified period:				2010-2011
			Substances which are reduced, compared with previous year(s):				didnt have the analysis the PPP reduced used compared with previous year.
			Findings :				didnt have the analysis the PPP reduced used compared with previous year.
CB.8.2.2	Have all the plant protection product applications been recorded including the application location?	All plant protection product application records specify the geographical area, the name or reference of the farm, and the field, orchard or greenhouse where the crop is located. No N/A.	Major Must		X		
			Verified applications and period:				Asparagus and 2011
			Findings:				verifed the applied record book didnt mention the location because the field has 2 lote.
CB.8.2.7	Have all the plant protection product applications been recorded including the technical authorisation for application?	The technically responsible person making the plant protection product recommendation has been identified in the records. No N/A.	Minor Must		X		
			Verified applications and period:				Asparagus and 2011
			Findings :				the technically responsible person didnt didentifed in the record book.
CB.8.2.9	Have all the plant protection product applications been recorded including the application machinery used?	The application machinery type, for all the plant protection products applied (if there are various units, these are identified individually), and the method used (i.e. knapsack, high volume, U.L.V., via the irrigation system, dusting, fogger, aerial, or another method), are detailed in all plant protection product application records. No N/A.	Minor Must		X		
			Verified applications and period:				Asparagus and 2011
			Findings :				they has used the hand sprayer but didnt mention detail in the applied PPP record book.

Figure 4.2 GG Audit Result (Continued)

CB.8.4.1	Is plant protection product application machinery kept in good condition and verified annually to ensure acurate application?	The plant protection product application machinery is kept in a good state of repair with documented evidence of up to date maintenance sheets for all repairs, oil changes, etc. undertaken. See guideline (Annex CB.3) for compliance with visual inspection and functional tests of application equipment. The plant protection product application machinery (automatic and non-automatic) has been verified for correct operation within the last 12 months and this is certified or documented either by participation in an official scheme (where it exists) or by having been carried out by a person who can demonstrate their competence. No N/A.	Minor Must		X	X		
			Verified machinery:				handl sprayer	
			Last maintainance:				after used it in last months.	
			Maintainance is done by:				the operator	
			Findings :				The opretor has checked before and after used but they didnt have the documented evidence of up to date maintenance for all repair.	
CB.8.4.2	Is the producer involved in an independent calibration-certification scheme, where available?	The producer's involvement in an independent calibration certification scheme is documented.	Recom		X			
			Name of scheme:				no independent calibrition - certification scheme	
			Findings :				no independent calibrition - certification scheme	
CB.8.6.6	Is the laboratory used for residue testing accredited by a competent national authority to ISO 17025 or equivalent standard?	There is clear documented evidence either on the letter headings or copies of accreditations etc. that the laboratories used for plant protection product residue analysis have been accredited, or are in the process of accreditation to the applicable scope by a competent national authority to ISO 17025 or an equivalent standard. In all cases the laboratories must show evidence of participation in proficiency tests, e.g. FAPAS must be available. Refer to Annex CB.4.	Minor Must		X			
CB.8.8.1	Are all workers who have contact with plant protection products submitted voluntarily to annual health checks?	All workers who are in contact with plant protection products are voluntarily submitted to health checks annually. These Health checks must comply with national, regional or local codes of practice and use of results respect the legality of disclosure of personal data.	Recom		X			
			Number of workers involved:				2 person	
			Last check:				no annual healthy checked	
			Findings :				no annual healthy checked	

1.9	**Undersignment**	
	Signature auditor	**Signature licensee**

Figure 4.2 GG Audit Result (Continued)

4.3.3 Results and Discussion

This study shows the difference of evaluation pattern between the Global GAP and the GMM. The Global GAP determines the issues that are inconsistent with the requirements, or mainly looks at the results or documents. When a requirement is not met, the farmers are lack of capability and needs correction to fulfill the requirement within the timeframe assigned by the evaluator. The evaluation according to the GMM does not concentrate much on the details of document but focuses on the level of farmer behavior and capability. The farmers then know their capability levels, guidelines of self-development, and motivations that lead to such a development.

The analysis of the evaluations by the Global GAP and the GMM shows their differences and what needs to be considered as follows.

1) The evaluation by the Global GAP yields the results:

The farmers have the major must in 2 requirements.

The farmers have the minor must in 12 requirements.

The farmers have the recommend in 47 requirements.

The farmers must correct in the major must until such inconsistency disappear.

The farmers must correct in the minor must and reduced number of inconstant requirements to be less than 3.

For the recommend level which is a suggestion for the farmers to practice as a supplement, most farmers will give importance to major practices and then consider the supplementary practices. However, the correction of the inconsistent requirements must be in the timeframe assigned by the evaluators.

2) The evaluation by GMM finds the following information.

Table 4.6 The evaluation by GMM finds the following information

Capability Level of Farmer	Number	Involved Area
Level 1	1	#3 "Worker Health Safety and Welfare"
Level 2	2	# 8 "Fertilized use" # 13 "Production Management"
Level 3	7	# 1 "Record Keeping and Internal Self-Assessment/Internal Inspection" # 2 "Site History / Site management" # 4 "Waste and pollution Management, Recycling and Reuse" # 7 "Propagation Material" # 10 "Interacted Pest Management" # 11 "Plant Protection Products" # 12 "Harvesting"
Level 4	3	# 6 "Traceability" # 5 "Complaints" # 12 "Irrigation / Fertigation"
Level 5	0	-

It can be from the study of the farmer behavior that the item which requires an urgent development is "Workers Health, Safety and Welfare". This item is not consistent with the global gap at the level of major must. Another inconsistent item is at the level of major must for the scope of plants protection products. The latter when evaluated by the GMM is at the level 3, i.e. defined. The justification will be later elaborated.

3) At the level 1 which contains the scope of work health, safety, and welfare, the evaluation with the global gap or GMM yields similar and consistent results. However, if the evaluation is based on the global gap, the farmer is considered not taking the worker safety seriously and there is no complete record. The evaluation by

GMM finds the same characteristics. When the inconsistent item is investigated in details, it is found that the farmer has capability and passes the training. The assistants, however, have not passed any training from the training organization. Consequently, the farmer has inconsistency in the item of non-trained workers. The GMM informs that some workers do not wear protective devices against chemical contacts. Thus, the level of this farmer is downgraded to the level 1 – initial.

When considering the understanding, the farmer has the capability at higher levels or is eligible to be at the level 3 (defined) if the consideration and evaluation has not been carried out in details according to the global gap.

4) The evaluation with the global gap for the scope of plants protection products shows another inconsistency at the level of major must, which requires corrections to be consistent and comply with the requirements. From the observation of the examiner using the global gap, it is found that the examiner focuses on the document mistakes. The examiner notes that the record does not specify the location or farm of the farmer because the farmer has two pieces of land. The record does not inform the list of responsible persons. There is no record of equipment maintenance and no annual health check-up.

The evaluation by the GMM yields different results. Since the farmer has inconsistency at the level of major must, the farmer should be evaluated to have inconsistent capability at the level 1 or initial. On contrary, since the GMM is the evaluation which considers the capability and good practice of the farmer, the GMM evaluates this farmer for the scope of plant protection products to be at the capability level 3 (defined). This is because the farmer has understanding and intention to practice. The farmer has thus knowledge and capability. However, when evaluated by the global gap, the farmer may not have complete record. If the farmer is suggested, the farmer can correctly practice and comply with the requirements without any difficulty.

5) As a whole, the farmer has the capability and maturity level at the level 3 (defined), which is considered good but needs urgent improvement and development for the scope of workers health, safety, and welfare. The scope is evaluated to be at the level 1. The development is then focused on the fertilizer use which is at the level 2 (repeated). The scope of production management is not taken into account for the capability improvement because this scope is not carried out at the farmer site. The

farmer simply screens the basic quality for the buyers. Other managements and fine screening will be carried out again by the buyers.

It can be observed that the evaluation using the global gap seems to be finding of mistake and the evaluation is subjective to the examiner. The result is of the passing or failure type. The evaluation by the GMM focuses on the capability level of farmers. The result does not say anything about passing or failure. The result is the guideline for the farmers to know their capability levels and the guidelines for future sustainable development.

Table 4.7 Grower

Grower	
Criteria	
1 Record Keeping and Internal Self-Assessment/Internal Inspection	
Level 3 (Defined)	Evaluate performance benchmarked with other producer or producer group regularly
Finding	Grower kept related record documents and have discussed with other growers about their performance
2 Site History and Site Management	
Level 3 (Defined)	Record has been updated regularly and sufficient details such as planting date and/or plant protection product application. Soil has been analysis and managed such as crop rotation, draining, mulching, trees or bush border.
Finding	Have record of soil analysis
3 Workers Health, Safety and Welfare	
Level 1 (Initial)	Working without safety and understanding
Finding	Worker been trained but not all person
	Have record but record was not complete
4 Waste and Pollution Management, Recycling and Re-Use	
Level 3 (Defined)	Manage all waste in the farm by separate material of empty container. The storages are cleaned and do not litter chemical or waste on the ground.
Finding	The grower has stored empty container but no management plan and record not complete

Table 4.7 Grower (Continued)

5 Complaints	
Level 4 (Managed)	Have the complaint document and action plan and solving problem systematically
Finding	The grower can trace back to the lot that might got complaint
6 Traceability	
Level 4 (Managed)	Have fully traceability, product recall or withdraw procedure. The procedure must be tested annually
Finding	Have record that able to traced back to the activities
7 Propagation Material	
Level 3 (Managed)	Using propagation materials that have been tested for resistance on pets and diseases. Have record of propagation material (sowing planting, method, rate and date), and any sign during growing period.
Finding	Have soil analysed but no soil mapping
8 Fertiliser Use	
Level 2 (Repeated)	Have attended the training or seminar about fertilizers. Understand about fertilizers
Finding	Grower attended training on fertilizer but do not have soil nutrient analysis
	Record not complete information (lot area no. and application method)
9 Irrigation/Fertigation	
Level 4 (Managed)	Sourcing secure sufficient water during growing crop. Resource of water must be obey the law
Finding	The grower used water from canal which suitable for agricultural used
	Some information should be added in record
10 Integrated Pest Management	
Level 3 (Defined)	The technical worker on farm has been trained about IPM, The grower have knowledge about reduce intensity of pets attacks and able to identify the situation of enemies pets coming in to the farms and able to manage. All plant protections that applied to the farm have been record
	Chemical applied under advisory of buyer's farm extension team
	No plan to reduce usage of chemical

Table 4.7 Grower (Continued)

11 Plant Protection Products	
Level 3 (Defined)	Applied suitable plant protection products for pest, disease, and weed. The plant protections have applied follow instruction. Those products must be registered. The plant protections chemical must be follow or complied with the regulation of importing country. The growers have been trained by qualify advisor. It could be by government, university, etc.
	The growers have fully record about plant protection such as crop location, date of applied, trade name, pets, disease, or weed name.
	The grower have document record on plant production product that have been applied in the farm and give the period before harvest according to the label indicated
	The equipment in plant protection has been maintenance appropriately and ready to be used
	The farmer or buyers have tested the product for residual and able to trace back to the farm.
	Plant protection products have been kept and stored properly and secured. The container must have original label attached.
	The grower do not reused empty container and disposal appropriated
Finding	Chemical applied under advisory of buyer's farm extension team
	The equipment in good condition and ready to be used
	Record not complete identified because grower has 2 sites
Remark	Evaluated by Global GAP will be have N/C on Major Must
12 Harvesting	
Level 3 (Defined)	The growers have been trained about product and personal hygiene. Hygiene equipment and tools are in place and ready to be used. Product have been remove from the file and store with protection to prevent contamination
Finding	At the farm has rest area and have equipment for cleaning
	Product has store at rest area in shade and leverage from the ground
	Product contained in plastic baskets

Table 4.7 Grower (Continued)

13 Production Management	
Level 2 (Repeated)	The producer have preselected and wash the product before delivery
Finding	The product has been pre-grading by the time of harvesting

4.4 Case Study # 3

4.4.1 General Description

The case study of the growers who grows okra for exporting to Japan is considered here. The growers are in the contract farming system with the exporting company and have the experience more than 5 years for okra farming. All of growers are had attended only primary school. All the crops in case study are compiled to Global GAP standard. Moreover, the growers have the experience in agriculture more than 10 years and has the farming site of okra more than 2 acres (5 rais). There are 10 growers in this case study and divided in 2 groups, group A was not applied but group B did apply GMM.

4.4.2 Research Process

The research comparatively studies the reduction of cost and production risk management of those 2 grower groups. The growers have cost and expense that are input of the okra farming, including soil preparation, chemicals (pesticide, fungicide, hormones), fuel cost, labor cost for operation and product harvesting. The output is the product amount per rai.

Grower Group A

General Description: Five growers have qualified to be the samples of the case study. Initially, the growers were satisfied with the business with the company because the amount of products and their prices were satisfactory. However, the growers have grown the okra at the same planting site and there are successive reductions of products. The growers have been encouraged because the okra farming does not yield the production rates as expected.

Research Process: The data is collected using interviews. The growers did the farming as usual and have only support on contract farming. The growers are Global GAP certified. The data is evaluated according to the framework of cost and risk.

Results & Analysis:

Table 4.8 Expense and Revenue of Base Case Group A

Activities	Descriptions	Details	Grower Group A (Baht/Rai)				
			A1	A2	A3	A4	A5
Expense	Site Preparation	1 Rai	500	500	500	500	500
	Cost of Seed	1 Rai	2,300	2,300	2,300	2,300	2,300
	Fertilizer	7 times x 15-25kg x20Baht	2,100	3,000	2800	3,500	3,000
	Pesticides	17 times x 125 Baht	2,125	2,125	2,125	2,125	2,125
	Fungicide	9 times x 119 Baht	1,072	1,072	1,072	1,072	1,072
	Fish Fertilizer	10 times x 128 Baht	1,280	1,280	1,280	1,280	1,280
	Fuel for Watering	35 times x 20 Baht	700	700	700	700	700
	Fuel for Pesticides & Fungicides	26 times x 20 Baht	520	520	520	520	520
	Harvesting Labor	60 Days x 300 Baht	18,000	18,000	18,000	18,000	18,000
	Total Expense	B	29,497	29497	29297	29997	29497
Revenue	Yield x Price x Day of Harvest	(? x 22 x 60) =A	19,800	21120	23760	26400	22440
Summary	Revenue - Expense	A-B	-9697	-8377	-5537	-3597	-7057

The result from the case study shows as table 4.8 that there are deficit for all growers. The major costs lie in the labor cost which is more than 60% of expenses. Apart from that, they are cost of seed and costs of chemicals for plant nurturing, and plant disease and insect control. Those costs are the same due to support and control by contract farming company. The growers are still sustainable because the own hiring cost is not taken into account.

However, when considering the revenue, the production per rai is low. This makes the revenue not enough for the expense, which leads to the deficit and increases the production risk and financial risk. The interview with the growers reveals that the growing of the same plants at the same sites tends to reduce the production per rai.

Grower Group B

General Description: This case utilizes five growers, which qualified to the requirements. The growers were learnt about GMM to improve capability level in June (end of export season). The demand of the okra from Japan is in November to the next May. The delivery of goods from Thailand is thus very high in that period. The knowledge transfer is carried out in the non-harvesting season. The evaluation of the capability in cost and risk reduction is when the new harvesting season starts.

Research Process: Grower group B has been assessed by the proposed GMM and all are categorized in level 2 and GMM results indicate that site management and site history need improving. These relates to rehabilitation field at this learning system. Hence, prior to the actual plating, the rehabilitation field has been transferred to grower group B by multimedia (VDO) and manual. The knowledge has been successively transferred to the grower after considering the information from the GMM evaluation. The grower starts learning and employed growing the okra in the harvesting season from September to December. The growers had been interviewed again to study the enhancement of the cost and risk reduction capability.

Table 4.9 Expense and Revenue of Base Case Group B

Activities	Descriptions	Details	Group B (Baht/Rai)				
			B1	B2	B3	B4	B5
Expense	Site Preparation	1 Rai	1,500	1,000	800	500	800
	Cost of Seed	1 Rai	2,300	2,300	2,300	2,300	2,300
	Fertilizer	7 timesx15-25kg x20Baht	2,100	2,100	2,380	3,500	2,100
	Pesticides	17 times x 125 Baht	2,125	2,125	2,125	2,125	2,125
	Fungicide	9 times x 119 Baht	1,072	1,072	1,072	1,072	1,072
	Fish Fertilizer	10 times x 128 Baht	1,280	1,280	1,280	1,280	1,280
	Fuel for Watering	35 times x 20 Baht	700	700	700	700	700
	Fuel for Pesticides & Fungicides	26 times x 20 Baht	520	520	520	520	520
	Harvesting Labor	60 Days x 300 Baht	18,000	18,000	18,000	18,000	18,000
	Total Expense	B	30,497	29,097	29,177	29,997	28,897
Revenue	Yield x Price x Day of Harvest	(? x 22 x 60) =A	36,960	26400	33000	35640	29040
Summary	Revenue - Expense	A-B	6,463	-2,697	3,823	5,643	143

From the both groups, it can be seen that learning by application of the GMM and systems thinking result grower has higher in maturity and capability in mange cost and risk. The case studies show that the growers should be developed for the site improvement which requires the knowledge bodies in terms of minerals, nutrients in soil, and alternatives in managing soil improvement. The growers group B realizes the increase of minerals and nutrients in soil and the use of germicides and biological in soil that the grower can increase the production when compared with the growers in group A. lack of suitable soil preparation. The knowledge transfer and learning from the GMM and systems thinking help increase the revenue of the growers, which are due to the increase in the production per rai and thus mostly solves the deficit problem. However grower B2 still has deficit result, it may cause from other factors such as insects, plant diseases and weather condition.

From group B, after the growers have learnt and used the knowledge for the development, it can be seen that the growers have the ability in increasing the production, when compare with non GMM learning group. From the systems thinking, growers have learnt and performed site preparation. The growers used different methods for site improvement and preparation. It was impacted to soil quality and cause increased different yield rate of production. Although there is a small increase in the expense or cost due to the site improvement, the improvement results in higher production yield.

The growers have more capability to manage to balance cost and performance. It seems that the growers have spent and invested more on site preparation but it worth for investment. Since, it could boost production yield. This could be present that the production risk could be managed. Once the production yield increased, financial risk which has related to the production risk on outcome and investment also could be managed. However, if there are analyzes and developments of the grower capabilities in other areas, the cost should be further reduced or the production should be even increased too. Regarding marketing risk, it seems that the growers have already managed after joined the contract farming program with the exporter company. The production price has agreed before growing, period of harvesting has been clarified. Therefore, the grower do not need to concern about the price fluctuation and consumer

demand changed. Since, contract faming system should be written down the details and conditions which should be agreed by both party, grower and buyer.

4.4.3 Results and Discussion

This case selects two farmers and evaluates them using the GMM to determine the readiness of the farmers in joining the project. The selected farmers have the maturity level 3 for the scope of IPM and PPP. The reason of using the farmers with the maturity level 3 is that the farmers are under the contract farming of the company and required to have knowledge and capability in IPM and PPP to a certain degree. However, although the capability level is at the level 3, there is a risk to detect the chemicals higher than the standard level of 20%. The random examination is carried out once a week and every week because the farmers use the insecticide once a week. Consequently, the farmers use the insecticide about 4-5 times a month. From the preliminary chemical examination using the GT Test Kit by the exporting company, it is found that the detection rate is at 20%, i.e. 1 time per month. The detected level is still at a safe level. The detection may come from the use of hormone or other chemicals with the chemical structure similar to dangerous chemicals. The detected chemicals include nitrogen for example.

After obtaining samples, the additional and detailed knowledge of possible chemical detection is transferred to the farmers in order to reduce the risk and cost. There were discussions with the farmers for the chemical-free practices or the practices that can lead to the contamination or the chemical detection. The knowledge transfer was organized in March and the change in the detection rate has been weekly monitored as usual. It is found that the chemical detection rate has reduced from more than 20% to less than 10% or even equal to 0% after transferring knowledge to the farmers. The reason of null percent is that there are 4 random examinations per month and the results are thus at the level of 0, 25, 50, 75, and 100% However, the detection rate at the safe level can be higher than 0% if the sample size is larger.

The reduction in the detected chemicals shows that the farmers have more knowledge and understanding about the chemicals and IPM. This can be understood that the risk of detecting chemicals can be reduced from more than 20% to less than

10% after transferring knowledge to the farmers with the level 3. The low rate of detection makes the exporting company more confident in joining the fast track project of the government for the reduction of the cost of chemical examination by the government organizations. The cost will be charged with the examinees or the exporters here. The examination fee by the government organization will be at 3,500 Baht per sample. The valid period of the examination is 7 days from the certified date. Consequently, the exporting companies will have the cost of 3,500x4 = 14,000 Baht per month when there is exporting every week.

To reduce such a cost, the exporters will join the fast track project. However, to attend the project, the companies must be confident in the farmers and the validation systems because the government sector will send the officers to evaluate, sample, and follow closely the operations. Therefore, the exporting companies must be highly confident to attend the fast track system. When the companies are highly confident in the validation system, they will then join the fast track project. This results in the reduction of the chemical examination. If the certificate has a valid period of one month, the exporters will have the expense once in a month, i.e. 3,500 Baht instead of 14,000 Baht per month. The cost is reduced to be 14,000-3,500 = 10,500 Baht/moth, which is 75% and is a high rate.

Consequently, it can be concluded that when the farmers have higher knowledge and maturity levels, the risk can be reduced. In addition, the cost with the stake-holders in the supply chain can be reduced too.

4.5 Case Study # 4

4.5.1 General Description

This case tests learning, data sources, and data application. The farmers are selected by exporting companies that necessarily export goods abroad. Farms that can supply goods must be the farms that are evaluated and attempt to be certified by the Global GAP. Consequently, the companies need to support the farmers for the examination using the Global GAP standard. This can be started from transferring the knowledge of requirements and practices according to the standard areas to the farmers. However, there are several areas in the Global GAP standard. This case study considers

only the area of integrated pest management. The prospect farmers must be in the contract farming system of the exporting companies and have at least 10 years of agricultural experiences. The farmers that are eligible to the evaluation by the Global GAP must be at the level 3 of maturity, i.e. defined. This case study shows the capability development of the farmers in the area of IPM using the capability development process according to the GMM model. The approach of systems thinking and learning-in-action is used in the learning process. In this case 10 growers are selected to be as sample.

4.5.2 Research Process

- Select ten of farmers with the qualifications mentioned above.
- Evaluate the farmers using GMM in the area of IPM according to Table 4.10 GMM Evaluation on Integrated Pest Management (IPM) to know the capability level of the farmers.
- Introduce the learning process according to the GMM model in order to enhance the capability level of the farmers according to Table 4.11 Improving Learning process on IPM By GMM and Table 4.12 Utilization Learning Process on IPM.
- Reevaluate the farmers again using the GMM Evaluation on Integrated Pest Management 60 days after that for the purpose of comparing the capability improvement of the farmer under the capability development process using GMM.

Table 4.10 GMM Evaluation on IPM

10 INTEGRATED PEST MANAGEMENT (CB7)		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Using chemicals from advise of chemical store or other sources	√
Level 3 (Defined)	The technical worker on farm has been trained about IPM, The grower have knowledge about reduce intensity of pets attacks and able to identify the situation of enemies pets coming in to the farms and able to manage. All plant protections that applied to the farm have been record	
Level 4 (Managed)	The grower has considered on using non chemical when pest attack When applied the chemical, the growers have consider on resistance and applied chemical follow the recommendation as indicated at label	
Level 5 (Optimization)	The grower have use other technic to control enemy pest like close system, baits, or biological technic	

Table 4.11 Improving Learning process on IPM By GMM

INTEGRATED PEST MANAGEMENT				
Maturity Level	**Grower Generic Practices**	**Tasks Knowledge**	**Measurement**	
			Cost	**Risk**
Level 1 (Initial)	Doing pest management as past experience not recognize type of pests.	N/A	Ineffective usage of chemical	Crop failure, contamination, and over MRL
Level 2 (Repeated)	Using chemicals from advise of chemical store or other sources	Basic knowledge on type of chemicals and pests	High cost of chemical applied	Misunderstanding, contamination, and over MRL
Level 3 (Defined)	The technical worker on farm has been trained about IPM, The grower have knowledge about reduce intensity of pest attacks and able to identify the situation of enemies pest coming in to the farms and able to manage. All plant protections that applied to the farm have been record	Integrated Pest Management	Reduce cost of chemical usage	Reduce risk of using wrong type of chemical, over usage, and over MRL
Level 4 (Managed)	The grower has considered on using non chemical when pest attack When applied the chemical, the growers have consider on resistance and applied chemical follow the recommendation as indicated at label	Symptom and pests attack situation. Alternative pest control	Reduce cost of chemical usage	Reduce risk of contamination over MRL and pests resistance

Table 4.11 Improving Learning process on IPM By GMM (Continued)

INTEGRATED PEST MANAGEMENT				
Maturity Level	**Grower Generic Practices**	**Tasks Knowledge**	**Measurement**	
			Cost	**Risk**
Level 5 (Optimization)	The grower have use other technic to control enemy pest like close system, baits, or biological technic	Alternative pest control, biological for pest management	Reduce cost of chemical usage	Prevent risk of contamination, over MRL. Environmental friendly

Table 4.12 Utilization Learning Process on IPM

Maturity Level	**Tasks**		**Inferences**	**Domains**	**Knowledge Base**	**Utilization**
	Knowledge	**Skill**				
L 1 → L2	-Pests -Chemicals	Classifying Pests, Spraying Chemical	How to find pest, How to use Chemical	Habitat of pests, destruction of pests, food sources. Type of Chemical, Chemicals Mixture, active Ingredient, Period before the harvest, Prohibition Caution	D.O.A (Entomology Dept.), University, Book, Internet, Entomology Association	Manual, Cartoon, Animation, Games (Pestworldforkids. org), Social Network (FB)

Table 4.12 Utilization Learning Process on IPM (Continued)

Maturity Level	Tasks		Inferences	Domains	Knowledge Base	Utilization
	Knowledge	**Skill**				
L 2 → L3	-IPM	Making Insects traps	Assessment outbreak situation	Rate and level of outbreak	D.O.A (insects Group and Zoology) D.O.A.E, University, Book, Internet,	Record Forms, Manual, Cartoon, Animation, Games, Social Network (FB)
			How to make insects traps	Bites an traps		
		Planning for intervention	How to reduce density of enemy pests	Predator and Enemy Pests, Parasite, Pathogen, Pheromone		
				Intervention Program and record		
L 3 → L4	-Pests Resistance to Chemical	Planning for Chemical intervention Program	How to use Chemical by anti-resistance	Allocated use of chemicals to avoid resistance.	D.O.A (Research development of crop protection) D.O.A.E, University, Book, Internet.	Experimental workshop, Manual, Cartoon, Animation, Games, Social Network (FB)
			How to control pests and disease outbreak, How to reduce chemical usage	integrated pest management program		

Table 4.12 Utilization Learning Process on IPM (Continued)

Maturity Level	Tasks		Inferences	Domains	Knowledge Base	Utilization
	Knowledge	Skill				
L 4 → L5	- Technology	Computer and Technology skill,	How to search information. How to apply naturally biological control	Agricultural Technology, Marketing trend, Naturally Biological control	Book, Internet, TV, Customers, Agriculture, and Horticultural trade fare (Fruitlogisica, Horti Fair)	Agricultural Tour, Agricultural Seminar

4.5.3 Results and Discussion

This case study is carried out with a growers of OKRA in Thailand. This growers have experiences of vegetable growing more than 10 years. They own a piece of land and are under the contract farming of an export of agricultural goods. The company needs to develop the potential and maturity of growers to be ready for the assessment by the examining company of Global GAP for exporting goods to UK. The growers are thus selected as case study by assessing the growers based on GMM for the requirement of Integrated Pest Management (IPM). Since the framework of GMM consists of 13 criteria and each criterion consumes a lot of time, the crucial issue in farm management, i.e. IPM is thus considered in this study.

The assessment in the first time is to know the capability and maturity level of grower under the IPM criteria based on GMM in Table 4.13. It is found that the growers are at the second level, i.e. Repeated. The growers use chemicals based on the recommendation by the chemical vendor and neighbour who have no idea about the regulations from the importing countries. There are sometimes mistakes from false identification of plant pests so that the chemicals are inefficiently used. The mistakes are a cause of the contamination of banned chemicals. Also, the contamination is higher than the allowable threshold. These result in higher costs of using ineffective chemicals and lead to the deficit in growing agricultural goods. The problems can repeatedly occur if the grower is not developed to higher maturity levels.

The learning framework according to GMM (Table 4.14) is introduced to the grower. It is found that the grower is lack of the basis knowledge of IPM. The grower has some idea about the insects and chemicals. However, to develop the growers to the third level (Defined), the growers need to know IMP in order to reduce the use of chemicals, thus reducing the chances of contamination higher than allowable standards of chemical use.

After assessing the growers using GMM Evaluation on IMP (see Table 4.13) and studying the learning framework (Table 4.14), the knowledge of IMP from various sources including Department of Agricultural, (Office of Insect Group and Zoology), Department of Agricultural Extension, Kasetsart University, IPM Book, and Internet, as well as the distributed document and media in terms of animation has been transferred according to learning theory “Learning in Action” (Garvin D., 2000). The knowledge transfer is based on the belief that when a child learns, he/she can transfer the knowledge to adult. However, it

still has limitations on agricultural field and cannot be fully used because there is no production in other core requirements for good agricultural practices. The learning form via games also motivates the memorization and then application. In view of recording, there is a presentation of complete form so that the growers are easily understand and systematically and completely record. There is a preparation of IPM handbook for the growers so that the growers can comparatively study what they encounter when farming in a convenient and rapid manner. However, the transfer of knowledge takes only 1 day and the grower studies by himself from the introduce media.

From the side of buyers or exporters, if the products from the growers are bought and lack of examining chemical residues, the goods from the companies may be sent back or banned by the importing countries, especially when the problems continually occur.

In view of the country level, the goods may be banned. Yet the reputation of the country is degraded and the trust in other agricultural products may be lost. Consequently, there is difficulty in trade. The importing is more serious. The buyers are lack of confidence and reduce the import such that agricultural goods cannot be exported as planned. These affect the whole supply chain of Thai agricultural business.

Sixty days after that there is another reassessment based on the GMM assessment as shown in Table 4.13. It is found that the growers understand more. The growers reduce the use of chemicals and follows IPM to some extent. The frequency of chemical use is reduced because the growers study the types of pest and rates of pest spreading. There is the use of pest capture tape in the farm to trap the pests. The density of pests is also identified. The grower records the performed activities into the given form.

It is seen that the growers start to learn and recognize the benefits and drawback of the existing maturity level. The growers are motivated by the cost situation and the different risks of each level. If the cost reduction is desired and there is risk, the growers recognize that they must learn and eventually change the behaviour in farming. The preparation of learning to suit growers in all aspects of GMM remains challenging for researchers. Internet should be a source that largely helps growers, no matter from web or social network like Facebook. However, there are still problems and obstacles. For examples, the internet infrastructure in Thailand has not covered in the areas of most farming. It is thus difficult for growers to access the internet. Moreover, the knowledge in computer using of growers is another factor that takes time and requires their children to teach them. Language is also

another obstacle in using computer and internet because the growers and children have not enough English basis to take advantage of the knowledge that is applicable internationally. The trend is getting positive because companies, servers, search engines try to develop translating programs to local languages.

It can be seen from the case study that there is a systematic leaning, confer Table 4.15. There is a guideline in developing continuous learning, as seen in Figure 4.1. Knowledge base is transferred to the each maturity level and is transferred according to the framework of GMM-based learning process, which leads to higher maturity levels. The knowledge has been continuously developed for a systematic and suitable transfer to growers.

Table 4.13 Result GMM Evaluation on IPM

10 INTEGRATED PEST MANAGEMENT (CB7)		
Maturity Level	**Grower Generic Practices**	**Results**
Level 1 (Initial)	N/A	
Level 2 (Repeated)	Using chemicals from advise of chemical store or other sources	
Level 3 (Defined)	The technical worker on farm has been trained about IPM, The grower have knowledge about reduce intensity of pets attacks and able to identify the situation of enemies pets coming in to the farms and able to manage. All plant protections that applied to the farm have been record	√
Level 4 (Managed)	The grower has considered on using non chemical when pest attack When applied the chemical, the growers have consider on resistance and applied chemical follow the recommendation as indicated at label	
Level 5 (Optimization)	The grower have use other technic to control enemy pest like close system, baits, or biological technic	

Table 4.14 Improving Leaning Process by GMM

Plants protection from insects

Level	Inference Knowledge			Know How	Know Why
	Resources	Process	Output		
1	N/A	N/A	N/A		
2		IP1 The way to protect plants from insects		H1 Using Chemical (PPP) H2 Using Pests management program (IPM)	
3		IP2 The way to write records IP3 How to use protection equipment and tools	IO1 Plants could be protected from insects IO2 Insecticide might be found and might be over residual limited IO3 Traceability is possible IO4 Avoid risk of worker injury or hazard	H1 Record no. of insects found per sqm. (outbreak rate) H2 Record on chemical used, rate applied, date of applied. H3 Record plan and process of IPM program H4 Protection equipment and tools are ready to be used	

Table 4.14 Improving Leaning Process by GMM (Continued)

Plants protection from insects

Level	Inference Knowledge			Know How	Know Why
	Resources	Process	Output		
4	II1 Insecticide II2 Protection Equipment and Tools II3 Record Form II4 Workers			H1 Apply as label indicates H2 Use only already registered chemicals H3 Wear chemical protection suite while working H4 Have Emergency plans H5 Hygiene equipment in place and available to be used H6 Have record on schedule and chemical applied, Maintenance H7 Workers have been trained on Insecticides, IPM, Safety, Hygiene, and emergency plan	W1 Help to remind and avoid mistake W2 Chemical Applied give fast result W3 IPM is slow result but low cost and more sustainable W4 Avoid over residual W5 Avoid outlaw W Help to protect from contact with pesticide W6 Reduce heavy injury W7 Record for traceability purpose and evaluation W8 Increase worker efficiency and safety

Table 4.14 Improving Leaning Process by GMM (Continued)

Plants protection from insects

Level	Inference Knowledge			Know How	Know Why
	Resources	Process	Output		
5	II5 Information on alternative solutions and safety from Internet, Book, and experts			H1 Learning about Insect's life cycle H2 Acquire alternative solutions to control or prevent insects	W1 Cut lifecycle of insects is more sustain to control the insects outbreak then using insecticides W2 Cut the cost down and more safety

Table 4.15 Systems Thinking

TASK	HOW TO THINK	DOMAIN
Task 1 Field Revival	Principle of Field Revival	- Fertilizer Use - Soil Reversion - Plant nutrients in the soil - Killing pathogens and insects in the soil
	Process	- Consideration on suitable of space and treatment - Worthiness
	Practices from Experience	- Floating is worthiness for soil hygiene and nutrient
	Caution	- The flood water should be left for at least 30 days. - After the flood water should be dried for at least 15 days.
	Principle of Data Recording	- Should be checked and recorded soil nutrient. - Should have Soil Mapping - Have Soil History

In plantations, systems thinking as a maturity improving as the criteria of GMM may 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 farmers. As in the example of the field revival, require knowledge of the criteria of site history and site management and fertilizer use was involved. Record also the criteria of involvement in several task view record because it is the foundation of data and statistics to be utilized in the further development.

Figure 4.2 Learning Cartoon for Capability Improvement

(Source: Chakpitak, (2010) Cartoon Inherit Work of Royal Thought: Source of Water, Collage of Art, Media and Technology, Chang Mai University)