

## **ASIA TECHNO FARM**

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### **Abstract**

Prior to ASEAN Economic Community establishment in December 2015, the author proposed one project entitled "Asia Rice Project" at JSAMFE held at Okinawa, Japan in May, 2014. The project concept consists mainly of the followings: 1) Asian agriculture overview, 2) How AEC should be promoted, 3) Collaboration between Resource oriented (ASEAN member) and Technology oriented (ASEAN plus 3 countries), 4) Making Asia a world food pantry, 5) High technology innovation & application and transfer 6) Human resources development based on university consortium and student mobility, 7) Create & develop new Asia brand of food products, 6) Mutual benefit & prosperity for collaboration, 7) Final goal is to achieve the final goal of economic promotion and regional peace keeping. In this paper the concrete practical ways how the program should be managed and operated to materialize and promote the program of Asia Food Project.

**Keywords:** ASEAN economic community, Asia Food Project, Smart agriculture, Food security, FFA human resources growing program.

### **BACKGROUND**

Asia is one of the higher potential agriculture based regions in the world. We are facing two immersing global issues of Energy and Environment as already known to us. It is generally said that the main problem of Environment is caused by the drastic consumption of fossil energy and its burning which is typically called or popularly known as a global warming or climate change. Many ways for solving these issues are therefore being attempted for finding the optimum solution, however nothing could be found yet even though some approaches looked good, but some of the obstacles are still left for negotiating and deriving the perfect or appropriate answer.

Agriculture has been closed up from this point of view especially carbon neutral that it deals mainly with bio-resources production available for food and energy resources in addition to the new material production. Carbon neutral means that no accounting of produced carbon dioxide can be done because the absorbed CO<sub>2</sub> by bio-resources is always more than the discharged one, Then as the result of this process, the produced CO<sub>2</sub> can't be accounted to be no increase of CO<sub>2</sub>. It can be easily found that as far as we use bio-resources, no more increase of CO<sub>2</sub> can be accounted, which contributes a lot in reducing CO<sub>2</sub> production in the viewpoint of not jeopardizing environment. Agriculture can play an important role in both sectors of energy and environment.

World human population is rapidly increasing on the other hand at the rate of 80 million per year, in which totally 140 million are newly born, but 60 million are dying per year. It can be easily guessed from this current situation that food issue will be coming soon

next. Preparation of food production should be started to cover the increasing human population immediately. As already mentioned above, Asia has a higher potentiality of producing a huge amount of food enough to feed the increasing human population, however as far as we concerned with the food production, it must be completely safe and well managed even for the quality. In addition the product liability of food should be guaranteed as well. From this point of view, it looks that Asia is ranked highly enough to produce and supply timely on demand for feeding them, however the quality and safety control are still not in the satisfactory level.

1A was established in December 2015. Asia Food Project is one of the proposals for AEC how it should be conducted and managed for promoting regional economy and keeping regional peace stably. Most of the ASEAN member countries are still relying on the economy from agricultural production more or less because they are still living as agricultural countries. Agriculture can make member countries tighten the unity of ASEAN Community. Rice is one of the commonly cultivating crops, therefore if rice is focused on and picked up as the axis of main framework of ASEAN Economic Community it makes them easier to be united each other to compete and collaborate among the community. The best way to promote the ASEAN Economic Community is collaborate together between ASEAN member countries, which can be named after Resource oriented countries and ASEAN plus 3 countries which can be named after Technology oriented countries such as Japan, China & South Korea. The former provides resources and the latter provides technology necessary for promoting economy and achieving the final goal of making 1) Asia the world food pantry and 2) a new Asia brand of food for stable promotion of economy and regional peace keeping. [4][6][10].

### **ASIA TECHNO FARM**

Asia Techno Farm is another program to promote and materialize the Asia Food Project on actual farming site. Asian agriculture can be characterized as a small scale farming mainly based on family farming. The average scale of farming per one farmer (family) in Asia is between almost 1.5 ha (South Korea) to 3.7 ha (Thailand), however the other countries like EU, England, France, Canada, Australia, US are 6.2, 36.2, 23.2, 135.8, 1303.8, 73.3 times bigger than Japan respectively when Japan is set as 1.0.

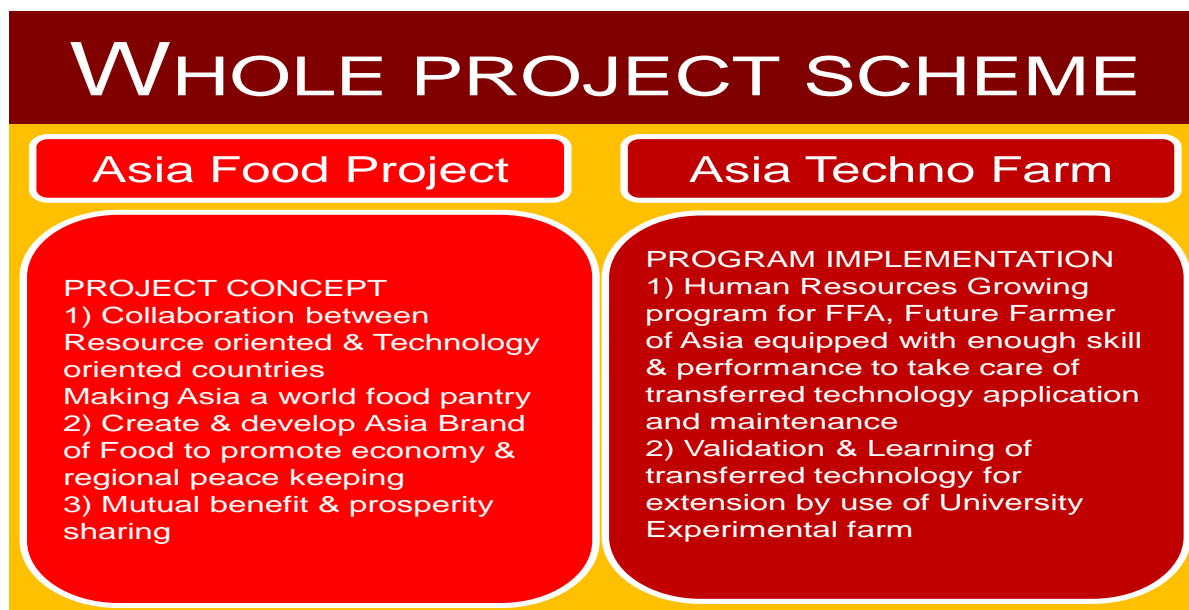


Fig. 1 Comparison between Asia Rice Project and Asia Techno Farm

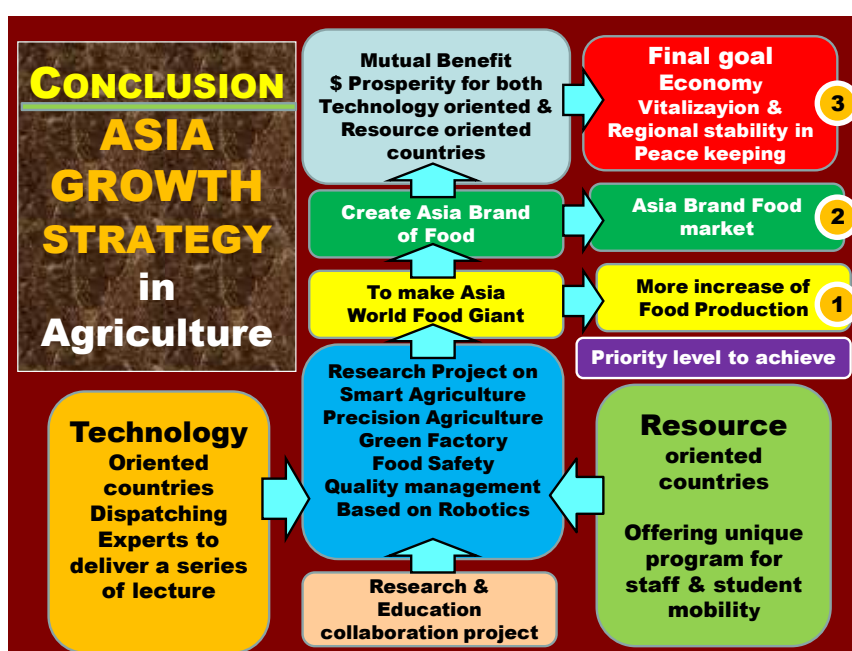


Fig. 2 Asia Rice project how to follow the process

It can be obviously found that Asian agriculture is extremely based on smaller scale one than the others US, Australia, Canada, England, France, EU.

One of the most important conditions to satisfy the requirements for food production is that the food product should be more competitive in the market, therefore the product should be 1) safe and high quality and 2) price should be set cheaper or reasonable for most of the conventional people normally to buy. As far as we think how agriculture should be changed for further improvement looking at a small scale family farming, it looks almost hopeless to

make it possibly better due to the upper limitation of scale merit. The reason why we have so many small scale farmers is also due to huge number of farming population. Sooner or later the farming population should be reduced toward the future under the strong leadership of central government and the overflowed extra farming population should be accepted by the different sector of industry. Then the farm land released by the farmers accepted by the other industrial sector can be collected together for scale up of farming. Promotion of farm mechanization means to actively do "promote" it with strong will, not naturally letting it be going relying totally on the individual farmer. The meaning of strengthening agriculture is to make it more competitive, therefore the above mentioned two conditions of 1) and 2) should be kept in mind. In small scale farming more losses can be produced, however big scale of farming reduces those losses and improve the productivity. This is the reason why the farming scale should be expanded for scale up. When it comes to talk about the agriculture in Asia, most of the people say and ask questions generally that highly advanced technology looks too far to apply to the current agriculture in Asia. The level of agricultural mechanization in Asia is still at walk-behind type power tiller and four wheel riding type tractor introduction. Stripper type combine harvester is just under the progress of practical acceptance for extension. Looking at this level of mechanization, some of the people say it looks too early to consider high tech machine introduction now. Against the opinion by those people, the author thinks how many years more we must force the small scale farmers to follow and engage with low income business of agriculture which is not so attractive especially for younger generation. For what purpose was ASEAN Economic Community established? Needless to say that's the purpose really for promoting economy as one community, not individual farmer based agriculture. On one hand the farming population should be reduced for farming scale up, however on the other hand the program should be prepared and offered for growing FFA, Future Farmers of Asia, otherwise the technology can't be transferred smoothly, therefore the higher level of training / education program should be prepared and offered. Growing FFA is not only focusing on future Thai farmers, but also growing the other Asian country farmers who can be surely contributable and needed to ASEAN Community agriculture. Rice producing country like Thailand, Indonesia, Vietnam, Cambodia and Laos should be the group leader of AEC based on high tech mechanization of agriculture.

### **SMART AGRICULTURE**

Considering this background situation of Asian agriculture and its level of mechanization, it can be easily found how important and necessary the program should be followed by high tech control and management system equipped with advanced technology to satisfy the necessary condition and requirements in food production already mentioned above, such as more competitive in safety and high quality in addition to inexpensive reasonable price. Normally this type of farming is consisting of the followings. They are 1) Precision Agriculture, 2) Robotics and 3) Green Factory. They are explained one by one as shown below. Fig. 3 shows three technologies of precision agriculture, robotics & green factory. Fig. 4 shows mobile agricultural machines of rice transplanter, combine harvester and green factory.

A. Precision Agriculture - Precision agriculture is one of the high productivity promising farming systems reducing losses and saving time, energy, resources and material. It is similar to TOYOTA car production and manufacturing system called JIT (Just In Time) or KANBAN, something like to 1) apply what you need, 2) by as much as you need, and 3) when needed. This can be done by use of variable rate control function. GPS (Global Positioning System) is needed for precise positioning of mobile machines and GIS (geographical

Information System) is also used for providing the various information related to the position of mobile machine referring to the mapping data such as soil fertility, moisture content distribution etc. Moving mobile machine can apply the necessary amount of material such as fertilizer and moisture content depending on the growing level of objective crop by use of variable rate of control. In case of crop already well grown up, fertilizer can be applied less, however in case of insufficient crop growing, it must be applied more for promoting the growing rate. [3][7][9]

B. Agricultural robot Agricultural Robot can be applied and used in various farming systems. One of the most different points of agricultural robot from industrial one is as shown below.

1) Agricultural robot always deals with non standardized product whilst the industrial robot does standardized one.

2) Working condition is always changing from time to time with moving motion. Sometimes it comes to the wet ground condition and some other time it comes to loose and soft & muddy ground with full of bushes, therefore the machine should recognize the condition quickly and make an appropriate motion control to be fitted with the condition encountered, however

3) Industrial robot doesn't need to do such a control, because normally it stays at the same fixed position and motion can be followed by program basically. Products under supply by belt conveyor are already recognized and suitable parts are prepared automatically to be in time for assembly, therefore industrial robot doesn't need to know and recognize and identify which model is coming next. Those information are provided automatically in advance. This is the artificially designed product manufacturing system in car production for example, different very much from agricultural products. The merit of robotization is mainly for the energy & labor saving, however more can be found in the followings such as timely operation, higher productivity, avoidance of dangerous & dirty farm operation, uniform & high quality products production, however the problems are still left for negotiation as follows. They are safety & product liability assurance for extension, therefore the intellectual copy right submission & registration should be done for patenting until the commercial robotic machines come to market. It is announced that autonomously guided unmanned car would be developed by the year 2020, therefore even the agricultural robotic machines may be followed for commercialization. The speed of development may be accelerated faster. Even now some of them are already achieved technologically in the laboratory and experimental station level. Problem is how to negotiate and overcome the product liability when extended practically to site.

C. Green factory - Green factory is another type of farming or agriculture systems operated under ICT and IoT application circumstances. Green Factory can be classified mainly into two types: 1) Completely closed system and 2) Open system. Objective crops are grown up under completely closed condition, however various color diodes are used for controlling the growing rate in both of vertically and horizontally by the suitable combination of lighting time & frequency and color of light. Basically soil is not used and crops are cultivated based on hydroponic ways. Fertilizer can be applied as the liquid fertilizer and re-circulated going through the whole plant factory system. Completely closed environment similar to clean room for processing a very large scale integrated circuit controls and protects the crops from infectious disease perfectly. Green Factory farmers are forced to wear the special clothing and mask not to bring in the virus from outside, therefore they are forced to sterilize for coming in and out of plant. More energy is needed for operation, however the productivity can be increased up drastically by the increase of cultivation number. Normally in case of conventional crops they are cultivated once or twice a year, however in case of growing in green factory more than 10 to 20 times cultivations are available for special kinds of crops. Always green and fresh vegetables can be harvested through whole year. In addition yield is almost constantly stable and promising if they are grown up automatically following the ideal

model of cultivation. Soilless is one of the characteristic points of hydroponic way of cultivation. Even under severe condition like desert consisting of only sands, green factory makes it possible to grow fresh vegetable as far as the minimum amount of water is provided. Electric power can be obtained easily from solar cell mounted at the top of green factory. Highly value added crop may be more recommendable to grow like a pharmaceutical plant for higher income. Open system green factory is still using natural air for ventilation and temperature control to keep the stable condition for vegetable crop growing. .

D. Food security - Food security consists of the following four items: 1) Enough production to feed, 2) Quality control and management, 3) Safety standard assurance by traceability, 4) Product liability between producer and consumer. Most of them listed above here look comparatively to negotiate and overcome because no human factors are involved, however one of the most difficult ones is the fourth one due to the involvement of various human intervention activity such as intentional information manipulation of fake label mounting, This issue is still serious and no perfect solution is not found yet. Similar news are broadcasted and televised through mass media almost every day. This means how difficult this issue is to tackle and solve completely. [2]



Fig. 3 Three smart agriculture technologies



Fig. 4 Mobile machines & green factory

### WHOLE PROGRAM SCHEME

Fig. 1 shows the whole program scheme comparison of Asia Food Project and Asia Techno Farm in which the former shows the concept and process how the project should be promoted following the stages. The latter shows the contents of the program what and how they should be promoted. The schematic detailed contents of Asia Food Project is shown in

Fig. 2. Asia Techno Farm is the demonstration program of various technologies developed and innovated for practical application for extension as shown below.

A. Asia Techno Farm - Asia Techno Farm (initiative) consists basically of three organizations of 1) Central national government, 2) University (program organizer) and 3) Industry. These three organizations are requested to share a corresponding burden more or less. Fig. 5 shows the schematic view of mutual relationships of three organizations and their main role to play respectively. A big amount of budget may be prepared and provided by the central government as one of the national projects. Specified university(ies) should be responsible for program organizer and provides the facilities, especially university experimental farm in this case. Some of them must be prepared for demonstration to verify the validity of transferred / innovated technology how it can be successfully functioned on to the actual site. demonstration is one of the most easiest ways for the participatory people to know what the program they are involved is focused and to which way it is going in addition to know the technology level and its possibility. The rest of the farmland should be prepared and provided for FFA participants to practically experience the cultivation more than one season at least in addition to join the training program offered such as regular progress report meeting for presentation and gathered raw data & document submission.

B. Budget proposal - Budget proposal and implementation is one of the most important and necessary things for the program organizer to start and promote any kind of program. Not only university, but also the central national government should be active to grant a big amount of budget to a big project for promoting agricultural mechanization as one of the national or bi-national, or international collaborative projects including the main countries or some neighbor related countries focusing on some of the specified programs. Government should encourage universities to submit the proposals more actively. University should think and show unique attractive and original ideas how the facility can be usefully used based on the collaborative joint education and research projects. Especially for the autonomous university, it is not allowed strictly to leave the land property like farm and spacious building without using for a long time. All the facilities should be always actively managed under efficient and effective usage for promoting research and education, therefore the farmland should be opened for university to use collaborative project / program with industry jointly. This makes the opportunity for the people outside in the society to see directly the university activity what and how much she is doing. It can be a big contribution and impact not only to the related or involved organizations in the project even to the outside society and budget can be pulled in by this project start up. In agriculture it may be sometimes mis-understood that the main cause of the low income problem is due to technology development and mechanization, however the most essential problem is how to increase the farmer's income. Even if the technology and mechanization are already at the level of application for extension, farmers are too much poor to purchase the expensive machines, because the total income to be obtained from farming only has the upper limit caused by the farming scale. This is the reason why the author emphasized the decrease of farming population and increase the average farmland ownership by one farmer which is equal to the scale up of farming. The other way to increase the income up is to provide the part-time job for farmers in Japan. More than 85 % of the farming population accounts for part time farmers whilst the rest of 15 % does for full time farmers. One of the merits of this way application is not necessary for farmers to release their small farmlands. They can still continue farming by use of the purchased machine covered by increased income from part time job. In addition mechanization could be promoted and technology can be developed and innovated faster under this condition. However most of the farmers are not so much active to make their products competitive or may not be necessary to do so, because they are well satisfied with the improved situation of income increase. In addition under this condition, agriculture may be kept staying as small scale. Then the competitiveness may not be improved. Some of the

factors such as productivity, energy, time & labor saving may be improved, however the others like quality, uniformity & safety may depend on totally the mechanized technology level.

C. Simple machine - Simple machine development was proposed one time in the past as one of the possible proposal by the national government of Japan to the industry for the purpose of lowering the price of machine to make farmers buy easier, therefore most of the additional devices & equipments for automated operation are removed, however those simple machines were not accepted by the majority of concurrent (part time) farmers, because they are not full time farmers who are not professional farmers, therefore they needed and wanted fully automated machines than simple ones even though they are expensive. This is one of the worst examples to show and know how important to find what the consumers needs are and where the problem is hidden behind. Even for the industry it is no use anymore to manufacture the unacceptable machines by the majority farmers in spite of the national government guidance. This farmers needs pushed industry to promote the development of high tech equipped automated machines and brought in the complete rice mechanization even applicable to autonomously guided unmanned control of operation.

D. FFA growing programs - FFA growing program is a part of the program of Asia Techno Farm. Huge area of university experimental farm should be prepared and provided for implementing the program operation. University can accept the applicants for FFA, (Future Farmers of Asia) based on the application and official announcement. Anybody can apply if they have a strong intention to learn and study for becoming FFA. It is necessary to reduce the farming population for scale up of farming and collecting the farmland to get it stick together, however it is also necessary for growing FFA qualified enough to be fitted with the performance and skill of using high tech agricultural machines and their maintenance & repair. In addition the higher skills and performance are needed to monitor, process, analyze the gathered data by remote sensing devices such as field server and satellite. At least one or two demonstration sites should be prepared and demonstrated at any time if necessary on demand to let the people understand easily and simply the precision agriculture visually by direct observation. A certain divided farming area should be prepared for rent to FFA and their use for growing crops at least more than one season of growing. University (program organizer) should prepare the budget to cover all expenses necessary related to program operation. Participants for FAA should be paid for purchasing necessary materials and their labor fee depending on the working day how many days they worked and engaged with farming operation. The following shows the six divisions in Fig. 6. It mainly consists of the four research areas plus education and social service They are mutually related for the Zero Emission Sustainable Society building, in which those six divisions are 1) Global solution S&T, R/D division based on Agro-Techno Fusion concept, 2) Precision Agriculture Division, 3) Agricultural Robotics Division, 4) Green Factory Division, 5) Special Education Division, 6) Social Service Division.



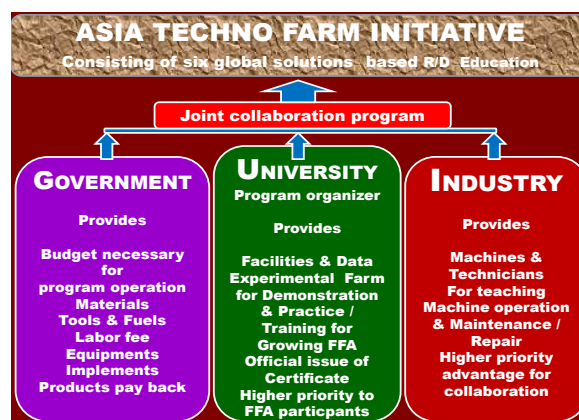


Fig. 5 Asia techno farm initiative scheme

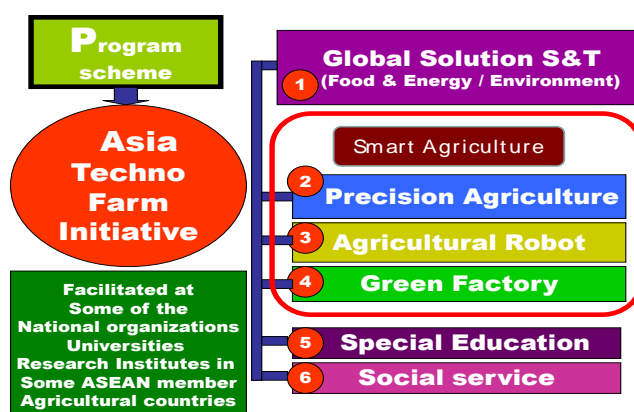


Fig. 6 Division &amp; program content

Progress report presentation should be organized regularly once a month getting together spending one day including the observatory visit on site. Handout(s) or progress report should be prepared and submitted to the program organizer prior to progress report presentation for distribution. All participants are strictly requested to follow the above mentioned way. How to write the final report and to make a PPT presentation material are also the techniques to learn.

E. University - Industry Linkage Machines and equipments are needed for the participants to use for cultivating the objective crops experimentally. University requests agricultural industry to provide those machines. those machines and equipments shouldn't be new model. Secndhand ones are also welcome, however one of the basic conditions is to function without any problem. The reason why program organizer needs to request industry to provide those machine and equipments is due to the difficulty to find the parts if damaged or broken, however industry can find them easily for replacement. In addition university should ask industry to send one technician for taking care of the machines & equipments and implements with free of charge. In special case, some payment can be considered. The philosophy of this idea is to ask collaboration to promote agricultural mechanization. University can provide the farmland with free of charge, therefore the program organizer would like industry to join and support playing a partial role of program promotion. What kind of merits can be found for industry? Answer for this question is as follows. Demerits for industry are machine providing and one technician sending with free of charge, however in future some of the potential FAA would like to be a big scale farmer the university (program organizer) actively considers highly for him / her to purchase machines from the industry who has joined the program to support with strong recommendation and certain amount of

discount price possibly. All the people involved in the program operation should be equally happy to share the role and corresponding assignment. This is the spirit of this program [5][11].

F. Inter / Multi - disciplinary Education Inter / Multi - disciplinary Education for R/D (Research & Development) is extremely needed for next young generation to be equipped. Terminologies such as Mechatronics and Bio-informatics are artificially made for showing the newly combined important and necessary academic area. Mechatronics is one of the Japanese made English terminologies to show the combined technology area between mechanical engineering and electric & electronic engineering, which is not an original English. As already well known from the above mentioned description, no machines equipped without electronic control systems functioned by software are found. Even for the conventional car engine, assembling and disassembling are easy for anybody to do, however engine can't be started without electronic control systems. It means that all the machines and equipments completely controlled the motion under the software while operated. Agricultural machineries are mostly at the same level as car industry. Tractor engines are already changed into hybridization. Even for the excavator, one of the typical construction machines hybrid engine is already mounted popularly. It should be strongly notified from this point of view that inter / multi disciplinary education is extremely requested to learn for FFA growing program, [1][8][12].

G. Social service - Social service is another important division to issue the official documents such as certificate and approval, diploma to certify the successful completion of the program offered, recommendation to specified industry with first priority for FFA to choose and buy machines with some advantages in startup of farming newly. Demonstration and regular meeting organizing are also the contribution and social service to the society in letting the people outside of campus know the level and progress of national project / program. Gathered raw data can be stored and shared for any related or involved people to access and take out for further processing in use in research and education.

### **EXPECTED EFFECTS**

The expected effects to be obtained from this program implementation are shown below.

- 1) Toward the future Asia can be one of the big food producing region called as world "Food Pantry" region in enough production and supply for feeding the rapidly increasing world human population timely on demand.
- 2) By the development of creating new Asia food brand can promote and stabilize the regional economy and peace keeping.
- 3) Not only Thai farmers but also Future Farmers of Asia should be grown up even though the farming population should be reduced for farming scale up to make agriculture more competitive in the world.
- 4) Resources countries of ASEAN member countries and Technology oriented countries of ASEAN plus three should collaborate and compete each other for vitalizing Asia agriculture for sustainable development of regional economy.
- 5) University should open the facility like agricultural experimental station for Future Farmers of Asia to experience the crop cultivation practically at least more than one season by use of those facility and study high tech farming system.
- 6) University provides the facility, Industry provides agricultural machines, then national government provides the budget for encouraging farmers to shift to a big scale farming farmer managed by use of high tech autonomously guided / controlled machines under the navigation system with GPS / GIS.

- 7) One of the most important requirements to make the products more competitive in the world market, they must be high quality, safe and reasonable inexpensive price.
- 8) Asia is already well known as one of the famous agricultural regions enough to produce and supply timely on demand, however as far as concerned with food production, the quality and safety must be guaranteed together with the sufficient amount of production. High technology applied equipment should be introduced sooner to achieve the next target goal up to the final goal.
- 9) Not only the technology transfer but also the human resources development such as FFA (Future Farmers of Asia) can be promoted and grown up for future economy and regional peace keeping respectively.
- 10) Young generation should be exchanged based on mobility program for getting higher education opportunity to become a center of excellence of FFA.
- 11) Asia Techno Farm program can contribute a lot globally in showing the good example of training program model for human resources development.
- 12) Program surely promotes to encourage younger generation wishing to be FAA.
- 13) Asia can be united strongly and tightly based on agriculture mainly focusing on rice mechanization
- 14) Thailand can be qualified as the leader in Asia and it becomes a big contribution to the regional community especially for AEC if this program is implemented and operated.
- 15) If this program can be managed and operated successfully, agriculture is no longer an unattractive low-income occupation. This is very much important to make agricultural industry attractive.

## CONCLUSION

Here shows the conclusion derived from the discussion in this paper.

- 1) Scale up of farming is one of the keys to make it certain the technology and the products produced and processed by the application of its technology. Normally the way to make agricultural products competitive in the world market, the farming scale-up should be followed sooner or later.
- 2) One of the ways to accelerate the speed of farming scale-up is the decrease of farming population by the preparation of the other job opportunity for them to shift. Then released farmland should be collected in one place to make the farming more effective and efficient reducing the losses totally. By this policy and strategy, the mechanization can be promoted faster in addition to the technology development and innovation to be fitted with large scale farming. If this goes well, more precise operation control and the technology to control the food quality uniform and safe may become necessary.
- 3) Not only this program, but also some kind of similar program to Asia Techno Farm initiative should be prepared and implemented to promote Asia Food (Rice) Project in which the author proposed for ASEAN Economic Community as one of the main frameworks to get together and collaborate each other.
- 4) There could be seen so many effects to be hopefully expected as already listed in the previous section.
- 5) For the program operation, human resources development is also important issue even though the farming population should be reduced for farming scale-up. Highly qualified FFA (Future Farmer of Asia) growing is one of the targets of this program, One of the most important thing is to set the regional level target for growing FFA enough to take care and cover the Asian agriculture.
- 6) This program involves many various program contents consisting of six divisions such as global solution, smart agriculture, special education, social service etc. In addition the

demonstration site should be prepared for outside people to know and understand what is going on at university.

7) The proposal is now under preparation and submission to the related Ministry for the official budget approval and implementation.

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