

## How much FEE we can pay for Sustainable Society Building

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**Abstract**— We have mainly four global issues, in which they are Population, Food, Energy and Environment named Global Tetralemma by the author almost 20 years ago. It should be notified that those four issues are mutually related each other along the ecological order starting from the dominant presence of human beings. Two issues of energy and environment we are facing now are the results mainly caused by human economic activity. It can easily guessed that the food issue will be coming soon next considering the real fact of rapidly growing human population at the rate of 80 million per year. Human beings should be responsible for making action to find and cover the issues we facing and the one to be encountered. The following shows the contents of the paper. 1) Maximum human population capacity of Earth; 2) Total required amount of food production to feed the increasing world population; 3) Overview of world human population change in recent years; 4) Food production including security, safety and product liability; 5) What and how we can do for ASEAN Economic Community establishment. The answers are: a) Asian Food / Rice Project can be introduced and proposed under mutual collaboration & competition among the nations between resource oriented and technology oriented ones. b) In the proposed project what crop should be focused is discussed for what purpose or reason why. c) The process to the final goal is shown as follows. d) First is to make Asia as Food Giant. e) Final goal is to create a new Asian brand of food for Asian economic promotion and stability. f) Low cost and high quality production by smart agriculture technology application. g) Higher possibility of pre-harvest technology than post harvest one for loss reduction

**Keywords**— ASEAN Economic Community; Asia Rice Project; World food giant; Resource and technology oriented countries; Asian brand food

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### I. INTRODUCTION

We have to invest or prepare a certain amount of money to start the project and business payable for successful completion and achievement. Fee is almost the same meaning as fare to be responsible for payment to get or purchase on monetary base. The terminology "FEE" used in the title of this paper is a playing word for alternative expression of Food, Energy and Environment. It means therefore that the title of this paper means how much we can do pay attention to the above mentioned global issues for Asia sustainability. The year 2015 will be the begging of new era for Asia due to the establishment of ASEAN Economic Community consisting of 10 countries for the purpose of vitalizing and promoting the continuous stable economy development in Asia. Simultaneously it should be noted that it contributes a lot in many ways not only the economy, but also the peace keeping and regional stability. As mentioned above the main purpose of ASEAN Economic Community establishment is to promote Asian economy needless to say, however we already learned that the sustainability is more importantly considered from the

immerging issues of energy and environment we are facing now popularly closed up as climate change and global warming. Sustainability means almost the same meaning as sustainable development to promote economy without jeopardizing environment, in which both of them should be sustainably developed under the condition of maintaining the good balance between them. The definition or meaning of sustainability, therefore can be understood that the economy must be promoted, however done without jeopardizing the environment. According to the recent statistics, the world population is increasing at the rate of 80 million per year, in which totally 140 millions are newly born, however almost 60 millions are dying, therefore the difference between the newly born and dying ones becomes 80 million as surviving ones as shown above. Assuming that the world population is increased at the same rate even toward the future, it can be guessed easily what comes next after the issues of energy and environment. Yes, the food issue will be coming soon and we must be ready for making action to cover and feed the increasing population. In addition it should be good to know first the maximum population capacity of our planet of earth how many they can be survived at maximum. This document is a template. An electronic copy can be

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## II. POPULATION AND FOOD

The following shows the procedure to calculate and estimate it. Based on the assumption that it is continuously increasing at the same rate as today. The potential rated capacity of human population acceptable for the planet earth can be estimated simply as follow, considering the total energy available from the sun. The result of the calculation may become different depending on the assumption of what and which factors should be involved to take into consideration. According to the result of the calculation anyway, it can be estimated to reach a maximum of 24 billion, as shown below.

- 1) Solar energy coming to earth =  $170\text{J/m}^2 \cdot \text{sec}$   
 $\rightarrow 1.5 \times 10^{17}\text{J/m}^2 \cdot \text{day}$
- (1cal=4.2J)
- 2) Cultivated area =  $[5.1 \times 10^{14}\text{m}^2] \times 3.0\% = 1.5 \times 10^{13}\text{m}^2$
- 3) Photo synthesis efficiency = 0.1 %
- 4) Required energy per capita per day =  $9.2 \times 10^6\text{J/capita/day}$   
 $= 2200\text{kcal/capita/day}$ , where 1cal=4.2J
- Available maximum capacity of earth =  $(1 \times 2 \times 3) / 4 = 2.4 \times 10^{10}$  capita  
 $= 24$  billion capita

Assuming that the world population would increase at the same rate as of today, it would be almost over the estimated maximum capacity of the earth in year 2130.

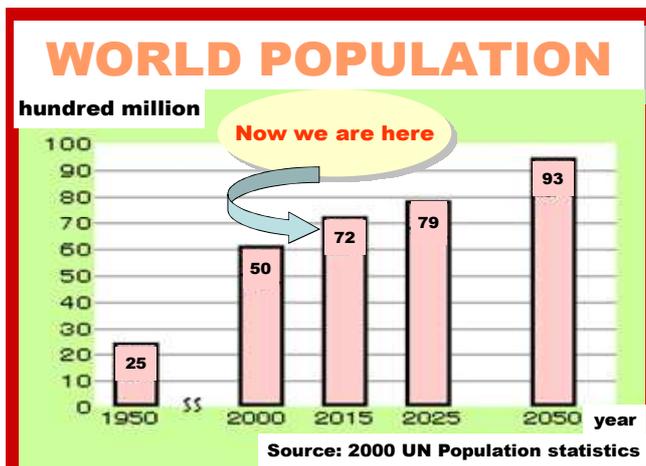


Fig. 1 World population change

Fig. 1 shows the world population change for one century from 1950 to 2050 including the future estimation. As shown in this figure, the current population is over 7 billion and it will be increased up to 9.3 billion in 2050, however this figure is not coincided with the estimated one calculated based on the current data of increasing rate per year. Based on the increasing rate of population 80 million as shown

above, the estimated population in 2015 will be calculated as follows. By use of the population increasing rate per year, the number of years up to 2050 and 72 billion we have now, it becomes  $((2050 - 2015) \times 80 \text{ million} + 7.2)$  billion = 10 billion, which is a little bit overestimated number, however it looks almost coincided with the one shown in Fig. 1.

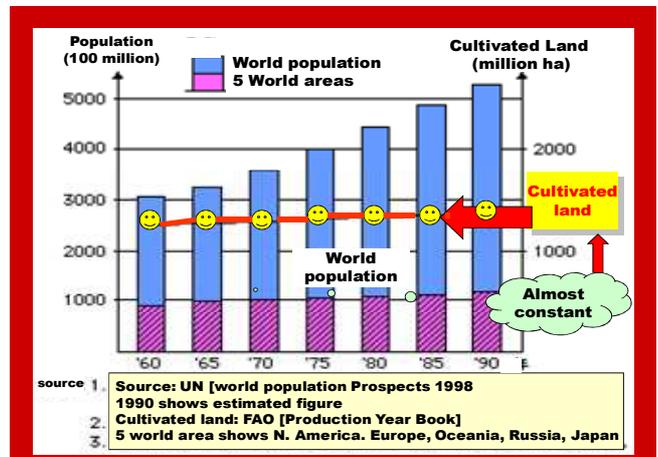


Fig. 2 World population and cultivated land

The reason why the population issue is picked up here is that most of the issues are due to human activity mainly economic production one. The typical ones are two issues of energy and environment as mentioned above. These are mainly caused by the result of human economic activity. As mentioned above the food issue may be surely coming next due to the rapidly increase of population, therefore the possibility should be necessarily reviewed how we can produce and supply food to cover the increasing population. Fig. 2 shows the world population and the cultivated land change in the past three decades from 1960 to 1990. It can be found two things from Fig. 2 that the total population is increased drastically as shown in blue colored bar graph, however the population in 5 areas is not increased and maintained almost constant as shown in purple colored bar graph, where the five areas mean the followings such as North America, Europe, Oceania, Russia and Japan. It can be easily found from this graph that the population increase might be caused by mostly developing countries.

Food production is extremely needed considering the rapidly increase of population. How much food is needed? It is generally said that the food/capita/year is almost 400kg which can be calculated from the total food production divided by the population. Assuming that this figure of 400kg should be needed toward the future, total required amount of food production will be the product of this number times total number of population. The cultivated land is therefore needed to develop to satisfy the condition mentioned above, however the total cultivated land has not been changed, but kept almost constant. This may be due to the reason that the farmland has been reduced by soil erosion and desertification in the new arable land development. How the food production could be maintained enough to feed the increased population could be totally depending on the new technology development and its innovation and extension. It can be guessed easily from this fact that the development of

cultivated land may not be done effectively and successfully. More highly advanced technology innovation and its extension must be promoted. In addition as far as concerned with food production, food security should be guaranteed, which may consist of the following three factors of 1) safety & quality management and 2) enough quantity of production in addition to 3) product liability between producer and consumer. How we can do for humans survival is totally depending on our knowledge and wisdom especially focusing on Asia sustainability based on ASEAN Economic Community.

Almost ten years ago the author showed his own aspects of direction, in his paper entitled "Low Carbon Society" which way we should go to challenge and solve the global issues especially food, energy and environment. Needless to say the main direction is to shift from HCS, High Carbon Society to LCS, Low Carbon Society. The following is the main content he showed. There can be seen so many kinds of energy, however what type of energy could be chosen and survived as the ultimate type one. It might be the electricity due to many beneficial points of view such as easy handling, no CO<sub>2</sub> production under operation etc. In addition many kinds of energy resources can be found except oil such as renewable energy like solar, wind, biomass and so on. The problem is however the method how those energy resources can be converted to electricity under strict constraints. Considering those conditions, the energy resources might be bio-based, renewable and, rechargeable to be used many times in its longer life in addition to make recycle, reuse and maintenance possible easily. The conditions to satisfy CO<sub>2</sub> production might be in order as follows: No CO<sub>2</sub>, Less CO<sub>2</sub> and active use of CO<sub>2</sub> if not easy to control the production. Even for the discharged CO<sub>2</sub> it shouldn't be fixed, but used for new energy resource. For food production, the land & space should be used not in: 2 dimensional, but 3 dimensionally.. No more huge dam or power plant in the center but small ones should be diversified in local. It can be shown that one of the predictions could come to real as high story green factory with completely closed system showing the good example of space use from 2D to 3D. [8]

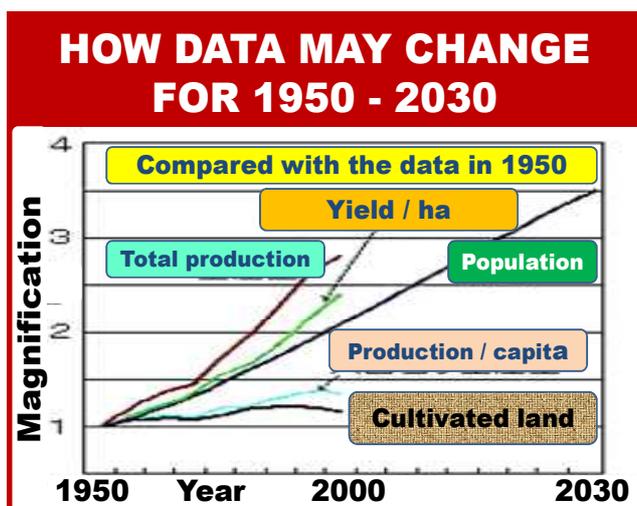


Fig. 3 Food production change

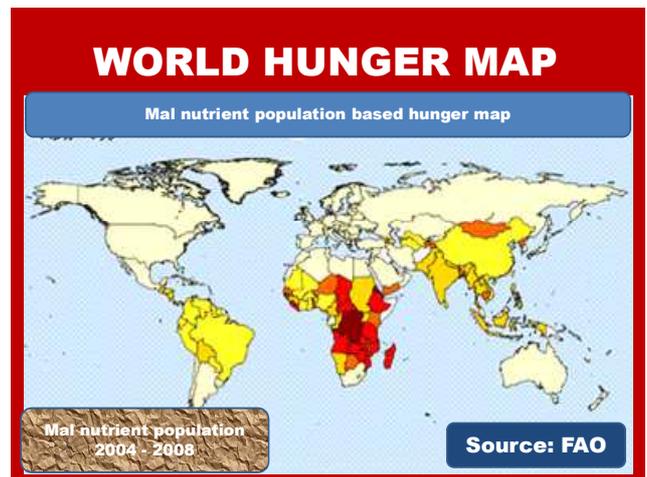


Fig. 4 World hunger map

Fig. 3 shows the change of four kinds of data related to food production such as total production, population, production per capita and cultivated land how they changed or may be changed during the year 1950 to 2030, Each curve shows the change of each data how it was varied depending on the year passage. Four each data were shown by use of magnification number compared with the ones in 1950 = 1.0 basis. It can be found clearly all the data were not negatively changed, however the cultivated land has been neither increased nor decreased, but left almost constant as the other two of total food production and yield per unit area as already mentioned above. It can be also obviously found from this that the technology development played an important role in food production in spite of the no increase of cultivated land.

The important contribution of technology development must be kept in mind. The following shows the current status of food production simply: for Cereals it is roughly 2.2 billion tons in which they are rice, wheat, corn, soybean etc. and fruits, vegetables, meats etc are almost 600 million tons, therefore the total food production may be around 7~8 billion tons, then the food available per capita per year will be around 400kg/capita/year. This figure looks almost enough for one person (capita) to live one year in case of the story when the food could be equally provided and shared. Fig. 4 shows the world hunger map how huge number of the people are facing to hunger and mal-nutrition due to poverty. Even in case of possible to eat, they can't eat the nutrient food. It is said that the people facing to that condition may be almost 0.9~1.0 billion. Logistics and supply chain of the produced food are the obstacle to negotiate not only for the production, but also for the distribution needless to say. How we can make it is the common task for us in worldwide, however it can be started even from the regional community. ASEAN Economic Community is proposed for that purpose and its achievement.

### III. ASEAN ECONOMIC COMMUNITY

The main purpose of this economic community establishment is clearly understood and described as mentioned above already, however which industry sector should be considered to pick up and how it should be

managed are not clarified yet. Here shows the author's idea of project framework including how it should be managed and followed. First of all we have to think two things; 1) to find the industry sector to be hopefully promoted based on technology transfer and 2) to develop human resources qualified enough to take care of technology transfer education which can be achieved by young staff and student mobility program based on ASEAN university consortium. Asia is known as one of the huge agricultural regions. Most of the ASEAN community member countries are still relying on agricultural economy.

Agriculture should be set as the main pillar of framework for economic promotion. Because it will be easier for all the member countries to be united and commonly shared the issues among them. Which type of crop should be picked up? it must be needless to say rice, which is produced almost more than 90 % of the world production (6.8 hundred million ton) as one of the main staple food crops in Asia. Additionally higher potentiality of production can be hopefully expected including the possibility of multi-purpose use of rice too. The reason why the technology transfer is needed can be explained as follows. Considering the background story it looks almost impossible to develop the new farmland from the discussion shown above. The importance of new technology development is already emphasized too. In addition it takes more time to develop a new technology from the beginning. Furthermore in case of dealing with the objective food production like rice especially, the safety including quality control and management must be secured with first priority. Both quantity and quality must be managed and controlled, however it is necessary to find the obstacle to negotiate and consider how much ASEAN can perform and achieve it from many points of view not only academic and social, but also economic and environmental. For smooth and healthy promotion of community activity mutual collaboration and competition are needed depending on case by case to strengthen the unity as one community.

Most of the ASEAN countries food self sufficiency are more than 100 % as we know already, therefore they are exporting rice for food, however rice for food resource especially is normally cheap. Cheaper price setting is good and needed negotiate the competition and expand the marketing share, however another way can be done by the value adding technology development especially . How we can make it vale added should be discussed from two points of view, 1) scale up of farming and 2) the quality control / management of the final product.

Fig. 5 shows the project proposal entitled Asia Rice Project. Here shows the summarized content of the project. Industry sector to be picked up is agriculture mainly focusing rice. Rice can make ASEAN countries to unite due to main staple food. Collaboration can be made easily even for competition may be promoted due to the same crop production of rice. Main purpose of the project is firstly to make Asia one of the world food giants enough to access to the upcoming food issue. Then it must be focused to create the new Asia brand food product, which can promote not only Asia economy, but also regional stability and peace keeping.

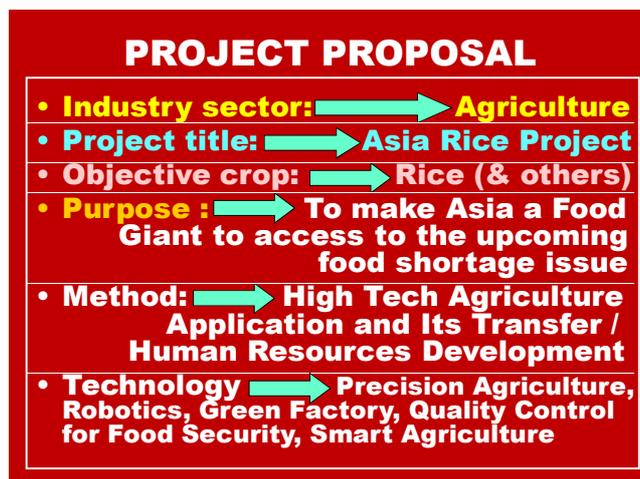


Fig. 5 Asia Rice Project

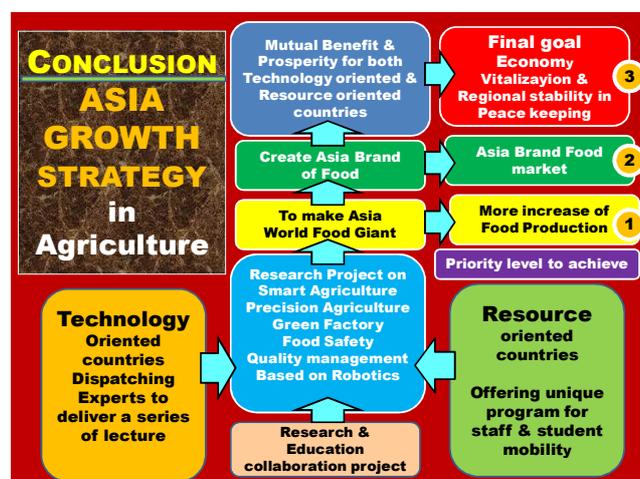


Fig. 6 Asia Growth Strategy in Agriculture

Fig. 6 shows the schematic view of the concept of Asia growth strategy in agriculture including rice production. Asia is already known as one of the world big giants in resource production, however the quality is not controlled yet. Additionally those products are produced by numerous small scale farmers, therefore it makes difficult to control the quality and its management.

The scale up of farming based on mechanization reduces the number of quality control, however it can't be promoted so quickly due to many conditions and obstacles to negotiate such as land ownership transfer and its official registration etc. Even though the promotion of scale up of farming is effective and valid for production / productivity increase ad quality control, it can't be promoted so easily due to many conditions, therefore the quality control and management should be easily started for food safety in parallel with making efforts for farming scale up. In Asia there are two kinds of countries, 1) resource oriented countries and 2) technology oriented ones. Former ones need the technologies for quality control and safety and the latter ones need the resources. One of the best options is to collaborate and compete each other based on technology transfer and human resources development. First target is to make Asia a world food giant (pantry) and second one is to create the new Asia

brand food product to stabilize Asian economy in addition to regional peace keeping. Fig. 6 shows the schematic concept of Asia growth strategy in agriculture how to follow the process and achieve the final purpose of target and how to promote and vitalize economy for getting benefit for both resource oriented and technology oriented countries. Most important key point is to make action continuously and actively to move forward based on the team work not only collaboration, but also competition when necessary.

#### IV. SMART AGRICULTURE

In general a hot topical terminology called smart agriculture means the information and communication technology assisted agriculture normally consisting of the following three:

1) Precision agriculture in which the mobile agricultural robotic machines are guided autonomously and complete the objective operation such as fertilizer / herbicide application under the precise control of navigation system of GPS and GIS. Rice can be cultivated and grown up by use of autonomously guided mobile machines such as tractor for tillage, transplanter for planting, and combine for harvesting. Variable control application can be done while the machine is under operation. The amount of water spraying and chemical application can be varied depending on the growing condition of crops. Many kinds of information can be provided to the machine while moving by GIS from time to time, therefore the machine completes the appropriate precise operation to meet with the condition when it comes to the location based on the information provided timely. The optimum harvesting time can be found and decided timely. The quality of rice can be checked while growing by NDVI (Normalized Difference Vegetation Index) to check the intensity of green color of leaves while growing, dark or light. It can be known even for the taste.

2) Robotics in which many kinds of agricultural robots are already developed and applied for extension. Most typical one is harvesting robot to harvest the objective fruits and vegetables autonomously one by one. The objective fruit can be identified by machine vision before harvesting, therefore only the selected fruits can be harvested in which only the specified fruits to meet the required condition of pre-standardized code. This kind of technology can control the quality add the value on the fruits before harvest and reduce the loss after harvest. This leads to the total loss reduction of final fruit product due to no more additional selection processes in post-harvest production.

3) Those robots are mostly operated in Green factory (Plant factory) for fresh vegetable growing under stable condition of environment. The danger leading to the fatal accident can be drastically reduced as far as the robot is operated inside the green factory. The objective plant is grown up following the ideal growing model under timely temperature control and the growing rate of the vegetable is also controlled while growing by the combination of color and lighting length of LED. The yield can be promisingly secured. Continuous fresh vegetable production can be possible even through the whole year. The green factory is operated mostly based on hydroponic way without using any soil and space can be used three dimensionally, therefore more space can be available. The infectious plant disease

problem can be avoided and protected especially for the completely closed green factory. There are two types of green factory mainly such as 1) open system which is natural sunshine light and natural air can be used under control of temperature and air ventilation for humidity and 2) closed system in which everything is completely under closed system isolated from natural environment. Lighting and temperature control can be done electric - electronically. Air conditioning for temperature control and water recirculation for irrigation can be done by the powered motor. LED can be timely and suitably used to control the growing rate to meet along with the targeted ideal model of vegetable growing. Higher story building can be used and objective vegetables are grown up in the multi layer shelf, therefore no windows are mounted on this building and completely closed and isolated from outside atmosphere with concrete.

On the other hand the open system is still depending on the natural environment such as ventilation and temperature control by opening and closing the curtain to be used even for the shade to shut down the strong sunlight temporarily depending on the condition. Table 1 shows the comparison between two types of green factory, open and closed ones for three items of yield / unit area, growing speed of vegetable and water consumption. The data for closed system is shown as the specific value compared to the open system, therefore it can be found from this table how much the closed system is superior to the open system for three items mentioned above. It is interesting to know which type of electric lamp is superior to the other even for the same closed system green factory. Table 2 shows the comparison between them. It is obviously found that LED lamp is more excellent both in yield per unit area and the electric energy consumption.

TABLE I  
SPECIFIC COMPARISON BETWEEN OPEN SYSTEM AND CLOSED SYSTEM IN GREEN FACTORY

	Open system	Closed system
Yield / unit area	1	100
Growing speed	1	2.5
Water consumption	1	1/100

(Source: Mirai Corporation & General Food)

TABLE II  
ELECTRICITY CONSUMPTION COMPARISON BETWEEN TWO TYPES OF LAMP

	Fluorescent lamp	LED
Yield per unit area	1	+ 50%
Electric consumption	1	- 40%

(Source: Mirai Corporation & General Food)

Fig. 7 shows the various types of green factory: big & small scale, portable type for personal use etc. Fig. 8 shows the satellite launching rocket for many purpose use, however one of them is for agricultural use. The continuous information gathering and monitoring is getting popularly extended in use such as weather forecast, environment agriculture etc. Satellite is getting one of the important infrastructures. Needless to say it looks impossible for one country sometimes to launch, however it will become possible as the community. Technology oriented country should propose actively to promote this business and

contribute to Asian agriculture development for economic promotion, which can be the mutual prosperity for both sides of resources oriented and technology oriented countries.



Fig.7 Various type of green factory



Fig. 8 Possibility of launching Asia agri-sat

## V. CONCLUSIONS

Here shows the summarized conclusion of this paper. Prior to the ASEAN Economic Community establishment the author introduced one of the proposal what and how it should be focused to achieve the final target of economic promotion and its regional stabilization based on the main primary industry sector of agriculture in which the mutual collaboration and competition can be easily and commonly shared. It is obviously known and understood that we still have a big difference and gap between the current status of agriculture and the future one we are going to reach, however the main pillar must be put and settled to show the direction to go and achieve the final target as the community. It takes time to make preparation until we arrive at the required stage of making action fully.

Both of technology transfer and human resources development must be promoted together in parallel and sooner is better to show the project scheme to lock on the target clearly. Outline of project scheme is shown and explained referring to Figs 5 and 6 for further details. One of the most important things is to collaborate and compete each other to promote the project toward the common final target to achieve for mutual benefit and prosperity. Pride and dignity are requested for all the community members to equip not to bear the selfish way of thinking seemed to be a serious obstacle of project promotion.

Hopeful possibility of smart agriculture high technologies are introduced. There are two ways of promoting agriculture: 1) Scale up of farming based on mechanization and automation mainly production and productivity even for the quality up and 2) Post harvest technology application to add the value on the harvested product. It takes time to achieve the first trial because there are so many small farmers in Asia, which is one of the characteristic features of Asian agriculture. In addition the total amount of agricultural production is a lot in Asia enough to export, however the safety and quality management are not done and still behind. Even for the economic promotion the value adding technology is extremely required especially safety issue as far as concerned with human food. It can be concluded that especially in Asia, the item 2) should be implemented first to make action for moving forward, however the possibility of item 1) also should be continuously being searched in parallel.

The way of thinking about the basic infrastructure should be changed. It is notified that the irrigation and drainage system settlement is still important and necessary and kept in mind, however the future vision to look forward shouldn't be forgotten either. Considering the background situation why the idea of ASEAN Economic Community establishment came to propose, the purpose and final target can be automatically found and understood. Active further assistance of technology oriented countries to ASEAN community is strongly required and requested for mutual benefit prosperity in addition to the contribution to regional stability and peace keeping based on the economic promotion.

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