Final Report on Regional Cooperation on Edible Mushroom Technology

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After Committee of Experts for the Perez-Guerrero Trust Fund approved the project of “Regional Cooperation on Edible Mushroom Technology (Reference number INT/09/K10)”, the project started in June, 2011, delayed by disputation of South China Sea afterwards and completed in January 2014. China, Philippine and Vietnam are the participative countries of the project. The implementers are three respectively in the three countries: Asia Pacific Edible Mushroom Training Center in China, Rizal Technological University in Philippine and Center for Plant Biotechnology under Institute of Agricultural Genetics in Vietnam. Guided by China Center for International Economic Exchanges, Asian Pacific Edible Mushroom Training Center, as the leading party of the project, initiated the project.

I. Background

The issues of Resource, Environment and Development have been being hot spots in developing countries. Edible mushroom industry is one of a good and operable solution to the interrelated hot spots.

-- In cultivation of edible mushroom, agricultural wastes are used, which recycles agricultural resources and protects environment. The recycle of agricultural resources diminishes the use of woods and makes output from agricultural wastes.

-- Edible mushroom industry is suitable for rural area. It offers a way to improve employment, increase income of family and food, and alleviate poverty in rural area, which boost rural development. China has much experience in it and succeeds in the way.

-- Edible mushroom contains proteins far more than vegetables, more than 8 sorts of amino acids and many kinds of trace elements. So it is a good nutrient food for human.

Developing edible mushroom industry is an effective approach to solve the problems of resources, environment, employment, nourishment &

health. The industry has bright prospects.

Edible mushroom industry has become an important industry in the three countries in past decades. Development of edible mushroom industry however has been not yet in equilibrium in the three countries for a long period of time, resulting from technology, economy and awareness of mushroom. The Vietnam and Philippine still lag behind on research, cultivation technique, production processing and marketing. Developing edible mushroom industry may change the situation and make mushroom become popular in market.

Being short of production also hinders the local consumption of edible mushroom in the two countries. Their edible mushroom market is under development, so they have expansive space to develop.

Asia Pacific Edible Mushroom Training Center boasts strong technical forces and comprehensive ability to implement large-scale international project. Since its establishment in 1995, the center has all along been focusing on carrying out South-South Cooperation projects as its main functions.

The center, in the project, aimed at mushroom industry in the participative countries. By training course, the center offered the trainees of the participative countries the technology of cultivation and primary process. Besides they learnt about wide rank of mushroom knowledge on nutrition and medical function, and share information of the industry and play the roles of propeller in the field of mushroom. By the project the farmers in the participative countries learnt cultivation technology from the trainings, developing an awareness of mushroom. Thus the mushroom technologies were spread in the country and the farmers were improved in the cultivation of mushroom.

II. Training course on mushroom technology in Vietnam and Philippine

Training courses on mushroom technology is the main part of the project. The training courses were accomplished in Philippine and Vietnam with joint effort of Asian Pacific Edible Mushroom Training Center and the other two implementers.

For better training result, before visiting, Asian Pacific Edible Mushroom Training Center made a plan for the training courses, aiming at improving the trainees' cultivation, increasing cultivation method and heightening awareness of development of edible mushroom industry. The training courses covered theories and practical inspection and field guide.

1. Training course in Vietnam

Asia Pacific Edible Mushroom Training Center initiated the training course in Vietnam and Center for Plant Biotechnology, the cooperative party, took part in implementation of the training course.

Following the proposal of the project and grounding the training course on the production of mushroom in Vietnam and request of local technicians, the two centers discussed and decided the subjects of training: Development of Mushroom Production in China, Control of Pest and Disease, Cultivation of *Volvariella volcacea*, cultivation of *Agricus blazei*, Field Guiding to Production of *Lentius edodes*, *Pleurotus eryngii*, *Auricularia aricula and Agaricus bisporus* .

The two centers discussed in detail about the implementation of the project, grounded themselves on cooperation and improvement. They reached the consensus on work by each other in the implementation.

Center for Plant Biotechnology did the work:

-- Enrolled the technician and farmer.

According the proposal of project, the center enrolled 100 technicians from the center and other relative institutes, agricultural company and provincial agricultural extension department. And 300 farmers were taught afterwards. The technicians and the farmers were enrolled from

Hanoi city, Quang Ninh province, Ninh Binh province and Hung Yen Province

-- Offered the locale and facilities for training.

The locale was the meeting room of Institute of Agricultural Genetics in Vietnam, equipped with multimedia for teaching.

-- Offered the translator and interpreter for training.

Two translators were offered to translate the PPT of teaching material from Chinese language to Vietnam language. Two interpreters were offered to interpret the teacher's lecture in classroom.

-- Guided Chinese experts to inspect the field of mushroom.

In the light of mushroom production in Vietnam, the center guided Chinese experts to inspect the field of mushroom that were located in Hung Yen Province.

Asia Pacific Edible Mushroom Training Center did the works:

-- Selected the mushroom experts and go formality of going abroad for them.

According to the subjects of the training, the center selected the experts on the subjects. The experts prepared carefully for the training – writing teaching material and making PPT file. The relative formality of going abroad was gone for them to be ready for visiting Vietnam, including approval of government, insurance in Vietnam and passport.

-- Arranged schedule of the training

Through Center for Plant Biotechnology, Asia Pacific Edible Mushroom Training Center made training plan: arranged the schedule, personnel association, accommodation, route and transportation for the training in Vietnam. The first stop was Hanoi, second Hung Yen Province, third Ha Tinh province.

-- Prepared the mushroom spawn.

According the proposal of the project, spawn of a variety was cultivated and prepared and it was transferred to the cooperator in

Vietnam.

-- Coordinated with Center for Plant Biotechnology.

Asia Pacific Edible Mushroom Training Center appointed a special coordinator of the project to coordinate with Center for Plant Biotechnology to facilitate the implementation of project.

The training course included lecture, inspection and guidance of production for local farmer.

In the lecture of Cultivation of *Volvariella volcacea*, bag cultivation method, as a new method, was introduced to Vietnam mushroom growers. This method is easy in operation, less in pest and diseases, high in yield, short in growth times. It is welcomed by the trainees.

In the lecture of Cultivation of *Agaricus Blazei*, high yield cultivation is introduced. As this species was new in Vietnam and had good medical function, the trainee accepted and wished to cultivate it.

In the lecture of control of pest and diseases, various pests and diseases were introduced, and their controls were the key points to be taught. The pests and diseases that the trainees confronted in their cultivations were brought out for discuss and solution. By the lecture, they mastered control ways.

In lecture of Development of Mushroom Production in China, how to develop the industry was the main to introduce. This lecture gave the trainees the idea of development in their own cities or provinces.

Besides theories in the lectures, the mushroom experts of Asia Pacific Edible Mushroom Training Center gave field guidance and inspection at Van Giang county, Hung Yen Province in Vietnam. Firstly, the experts inspected the mushroom production base where Center for Plant Biotechnology demonstrated the cultivation of mushrooms and did commercial cultivation. The base grew *Pleurotus ostreatus*，*Agaricus bisporus*, *Pleurotus Eryngii*, *Hypsizygus marmoreus* and *Ganoderma Lucidum* among which problems were confronted in cultivation. After

inspections, the experts gave the solutions on casing soil of *Agaricus bisporus*, high yield of *Pleurotus Eryngii*, temperature control of *Hypsizygus marmoreus*, and environmental improvement for *Ganoderma Lucidum*. Secondly, the experts visited mushroom grower—Mr. Le Chinmin's farm. Mr. Le grew *Auricularia auricular* and confronted mould diseases in cultivation. The experts gave the solution on mould control.

Agreement for further cooperation executed by the two centers

To further Cooperation between Center for Plant Biotechnology and Asia Pacific Edible Mushroom Training Center, the both centers had meeting to exchange information of mushroom science in China and Vietnam and to discuss the way to cooperation. The two centers reached an agreement to further cooperation on research, cultivation, spawn making and training.

2. Training Course in Philippine

Asia Pacific Edible Mushroom Training Center initiated the training course in Philippine and Rizal Technological University, the cooperative party, took part in implementation of the training course.

Following the proposal of the project and grounding the training course on the production of mushroom in Philippine and request of local technicians, the centers and the coordinator of the university discussed the subjects of training and decided them: Control of Pest and Disease, Cultivation of Volvariella volcacea, Cultivation of Agaricus blazei, Industrial Production, Field Guidance to Production, Fundamentals of Mushroom Laboratory Operations and Fundamentals of Mushroom Entrepreneurship.

The center and the coordinator discussed detail of implementation of the project in Philippine, grounded themselves on cooperation and improvement. They reached consensus for work division in the

implementation.

Rizal Technological University did the work:

-- Enrolled the technician and farmer.

According the proposal of project, the university enrolled 100 technicians from mushroom grower association and agricultural company and 300 farmers were trained afterwards. The technicians and the farmers were enrolled from Manila city, Lipa City, and Calamba City

-- Offered the locale and facilities for training.

The locale was the multimedia classroom of Rizal Technological University, equipped with multimedia for teaching.

-- Guided Chinese experts to inspect the field of mushroom.

In the light of mushroom production in Philippine, the center guided Chinese experts to inspect the field of mushroom that were located in Cavite Province.

-- Arranged the routine of field inspection and guide.

The university arranged the schedule of the training and visiting according to the implementation plan made by the center: arranged the schedule, personnel association, accommodation, route and transportation for the training in Philippine.

Asia Pacific Edible Mushroom Training Center did the work:

-- Selected the mushroom experts and go formality for them.

According to the subjects of the training, the center selected the experts on the subjects. The experts prepared carefully for the training – writing teaching material and making PPT file. The relative formality was gone for them to be ready for visiting Philippine, including approval of government, visa to Philippine, insurance in Philippine and passport.

-- Made the plan of the training

Asia Pacific Edible Mushroom Training Center made the plan of training: the implementation schedule, the expert selection, accommodation arrangement and travel schedule in Philippine.

-- Prepared the mushroom spawn.

According to the proposal of the project, spawn of a variety was cultivated and prepared and it was transferred to the cooperator in Philippine.

-- Coordinated with Rizal Technological University.

Asia Pacific Edible Mushroom Training Center appointed a special coordinator of the project to coordinate with the university to facilitate the implementation of project.

-- Offered the translator and interpreter for training.

Two translators were offered to translate the PPT of teaching material from Chinese language to English language. Two interpreters were offered to interpret the lectures.

The training course comprised the lectures as same as those in Vietnam and inspection and guidance of production for local farmer.

The lectures were welcomed by the technicians and farmers. The trainees mastered control of pest and disease, bag cultivation of *Volvariella volcacea*, Cultivation of *Agaricus blazei*, Industrial Production and learned about the development of Chinese mushroom industry. The training boasted good results.

Experts from Asia Pacific Edible Mushroom Training Center visited Metolius Valley Mushroom Farming in Alfonso, Cavite Province for inspection and field guidance. The Farming grew *Pleurotus* and *Lentinus edodes* and had problems of low yield, diseases and substrate remainders. The experts gave the suggestion on solutions to the problems.

III. Database and Consultant Network

Asian Pacific Edible Mushroom Training Center, in the project, aimed at informationization of mushroom industry and carried out this part of the project.

1. Collection of the data of species in the China, Philippine and Vietnam

Asia Pacific Edible Mushroom Training Center did field work to collect the data of species. The center sent investigators to farmer's field, industrialized cultivation field and research institutes. The investigated cities were the ones where mushroom cultivation prevailed, where the value of mushroom production was high and where the cultivation scale was large, with skillful technology. The cities were followings: Fuzhou City, Gutian County, Pinnan Couty, Shunchang County and Zhangzhou City. In Zhangzhou City, Gutian County and Pinan County, investigators went to farmers' mushroom-cultivation house in rural area and observed the cultivated species. And they collected 19 species that were cultivated commercially: *Lentinus edodes, Volvariella volvacea, Agricus bisporus, Auricularia, Flammulina velutiper, Agaricus blazei, Stropharia rugoso, Hericium erinaceus, Pholiota nameko Griflola frondosa, Tricholoma lobynsis, Agrocybe aegerita, Hypsizygus marmoreus, Pleurotus eryngii, Pleurotus nebrodensis, Pleuratus ferulae, Pleurotus citrinipileatus, Pleurotus sajor-caju, and Ganoderma Lucidum.* The investigators visited the institutes that are engaged in research of mushroom – Gutian Kexing Edible Fungi Institute, Fujian Edible Fungi Research Institute, Soil and Fertilizer Institute and Fujian Edible Fungi Association. In Fujian Edible Fungi Research Institute, they gained the data of cultivars of *Agaricus bisporus* – A2796; in Soil and Fertilizer Institute, they gained the data of cultivars of *Agaricus blazei.*

Besides the data from the investigation, Asia Pacific Edible Mushroom Training Center collected the data from *Colored Album of Chinese Macro-fungi* and *Chinese Micro-fungi Album*. The center collected information of 1201 species.

Rizal Technological University in Philippine and Center for Plant Biotechnology under Institute of Agricultural Genetics in Vietnam, as participants of the project, actively collected the data of species by field

work and visiting institute. The two participants collected edible fungi species respectively in their own countries, covering most tropical and subtropical species in their cultivation. They offered the data to Asia Pacific Edible Mushroom Training Center.

2. Process of the data

By the joint effort of three participants in one year, the data of the species of macro-fungi accumulated to 1701 species covering micro-fungi of basidiomycetes and ascomycetes from 298 genera belonging to 72 families in 21 orders. Asia Pacific Edible Mushroom Training Center analyzed and sorted out the data, according to the fungi science rules and commercial views. The data contained colored photographs that showed gross morphology and details, the most diagnostic features, inhabitation and the known geographical distribution in each species data. Additional information was given to each species --- edible, medicinal, poisonous, wood-rotting and mycorrhizal fungi. In the light of taxonomy, morphological characters were illustrated by line drawing.

3. Completion of the database of macro-fungi (mushroom science)

According to the characteristics of the data of macro-fungi, aiming at users in the three countries, Asia Pacific Edible Mushroom Training Center analyzes the user of the database: they are researchers, technicians and farmer in macro-fungi field for research or for production. They needed a retrievable and easily-usable database when they inquired the information of each species of the database. In the light of propose of this project –sharing knowledge and information of macro-fungi, the information should give them profile of each strain. Considering users' requirements, the center designed the database structure and user interface. To use easily, the center made database installation-free in personal computer. The database contained the elements: a). Taxonomy

information, b). Name search of mushroom, c). Description of each species, d). Habit of species, e). Usage. User could find the species according to the taxonomy system and can search the species by scientific name. The data of each species offer photo, Latin name, Chinese name, description of each species, distribution and edible or poisonous information.

In regard to quantity of the data of species, the center adopted Microsoft Access as database language, because Access was agile and assessable.

4. Establishment of open consultant network of edible mushroom

To share the experience and knowledge of experts of macro-fungi, Asia Pacific Edible Mushroom Training Center initiated an open consultant network of edible mushroom.

The network covered scientific research, commercial production and trade in China, Philippine and Vietnam. The experts of the three countries in this field and industry are gathered to offer the consultant service. Thus the exchange of three countries is strengthened. They were engaged in scientific research, production, cultivation and in trade. The experts work together to offer advice and experience to farmer and technician and trader, for purpose of improving commercial production and trade among the three countries.

The carrier of the network was newsletter via email initiated by Asia Pacific Edible Mushroom Training Center. The center set columns of newsletter. The columns covered news, research achievements, production and cultivation, process, facility and trade and Q&A. The research achievements column had 3 parts – taxonomy, domestication, bio-physiology; the production and cultivation column had 2 parts--commercial productions, control of pest and disease; process column had 2 parts – primary process and refined process; trade column

had 2 parts – production material and mushroom. Q&A column aimed for answer from experts.

5. Benefits of database and consultant network

The database with graphical user interface was shared with the other two implementers, echnicians and farmers in Philippine and Vietnam. The data increases user's knowledge of macro-fungi taxonomy and of mushroom identification in production and research.

The consultant network offered a platform where the technicians and experts exchange in China, Vietnam and Philippine on information and technology and where farmers in the three countries gained answer and solution to problems in cultivation of mushroom.