

*EX-POST EVALUATION REPORT*

*ON*

***THE  
RESEARCH PROJECT  
FOR  
HIGHER UTILIZATION OF FOREST  
AND AGRICULTURAL  
PLANT MATERIALS  
IN THAILAND***



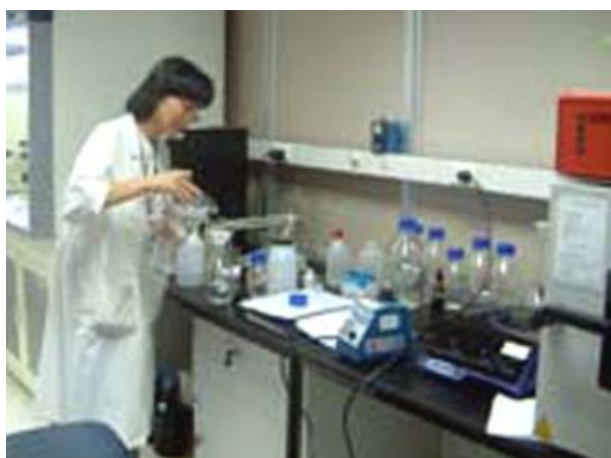
**FINAL REPORT**

MARCH 2005

**JICA Thailand Office**

**KOKUSAI KOGYO (THAILAND) CO., LTD.**

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| 5 | 6 |
| 7 |   |

- 1 Main office building of KAPI in Kasetsart University
- 2 Paper mulberry planted in front of KAPI's office
- 3 Provided equipment in KAPI
- 4 Researcher is using equipment provided by JICA
- 5 Doing research work
- 6 Nursery center of KAPI that now conducting research for asparagus
- 7 Paper mulberry

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## **ABBREVIATIONS**

BAAC	Bank for Agriculture and Agricultural Co-operatives
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
C/P	Counterpart
DF/R	Draft Final Report
DOAE	Department of Agricultural Extension
FIO	Forest Industry Organization
F/R	Final Report
HUFA	Research Project for Higher Utilization of Forest and Agricultural Plant Materials in Thailand
JICA	Japan International Cooperation Agency
KAPI	Kasetsart Agricultural and Agro-Industrial Product Improvement Institute
KU	Kasetsart University
KURDI	Kasetsart University Research and Development Institute
MOAC	Ministry of Agriculture and Cooperatives
MTEC	National Metal and Materials Technology Center
NRCT	National Research Council of Thailand
OTOP	One Tambon One Product
PCM	Project Cycle Management
PDM	Project Design Matrix
PPTC	Public-Private Technology Development and Transfer Center
RFD	Royal Forest Department
SMEs	Small and Medium Enterprises

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# 1 Outline of the Ex-post Evaluation Study

## 1.1 Background and Purpose of the Study

Japan International Cooperation Agency (JICA) Thailand Office has decided to conduct an ex-post evaluation on “The Research Project for Higher Utilization of Forest and Agricultural Plant Materials in Thailand”, which was completed 3 years ago. The result of this study will contribute to better-informed decision-making and will be shared by Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI) and Kasetsart University (KU). The main objectives of the evaluation study are as follows:

1. To extract lessons-learned and recommendations to improve future JICA planning and the implementation capacity of the implementation agencies by evaluating mainly the impact and sustainability of the project.
2. To ensure accountability to the Japanese tax payers by producing reports in both electronic and printed forms.

Other objectives of the ex-post evaluation study in relation with the project are:

1. To study the extension situation of the new model of an agroforestry system to rural communities.
2. To study the current situation and management condition of the Implementing Agency, including the financial condition, activities for extension of the transferred technology and strengthened research studies, and condition of inputs provided to the project.
3. To clarify the cooperation from other institutes in extending technology and research transferred by the project.

## 1.2 Evaluation Team and the Study Period

The members of the Ex-post Evaluation Study Team are as follows:

Assignment	Name	Nationality
Team Leader	Mr.Precha Chuntakorn	Thai
Researcher	Ms.Nuengnam Navaboonniyom	Thai

The Study started on January 31, 2005 and ended on March 4, 2005. The work schedule is summarized in the table below.

Table 1-1: Work Schedule of the Ex-post Evaluation Study

Year Item	2005										
	January			February				March			
Study				A	B	C					
Reports						▲ DF/R		▲ F/R			

Note: DF/R – Draft Final Report  
F/R – Final Report

Below is the outline of the work procedure.

**A. Preparation Work (January 31-February 6, 2005)**

- A1 Develop Evaluation Grid
- A2 Consult with JICA Thailand Office to finalize the Evaluation Grid
- A3 Prepare questionnaire based on the Evaluation Questions in the Evaluation Grid

**B. Field Study (February 7-February 17, 2005)**

- B1 Conduct evaluation according to the Grid
- B2 Prepare Draft Final Evaluation Report and Draft Summary Sheet

**C. Final Study (February 18-March 4, 2005)**

- C1 Submit Draft Final Evaluation Report and Draft Summary Sheet
- C2 Receive comments from JICA Thailand Office
- C3 Conduct supplemental study (if necessary)
- C4 Prepare Final Report and Summary Sheet
- C5 Submit Final Report and Summary Sheet

## 2 Study Methods

### 2.1 Outline of the Project

Project Title: The Research Project for Higher Utilization of Forest and Agricultural Plant Materials in Thailand  
Project site: Bangkok  
Period of Cooperation: August 1, 1996-July 31, 2001  
Counterpart Agency: Kasetsart University (Faculty of Forestry/Kasetsart Agricultural and Agro-Industrial Product Improvement Institute [KAPI])

#### 2.1.1 Background of the Project Request

In 1980s-1990s, Thailand's forest were diminishing rapidly due to increasing demand for timber fuelled by rapid economic development and an increase in population, as well as an increase in the cultivation of forests and slash-and-burn agriculture carried out by poor farmers. Thailand's Royal Forest Department prioritized the maintenance of 40% of all land as forest in its national social and economic development plan and promotes afforestation. The Thai government recognized the need for technology that enables the efficient use of timber and development of timber alternatives, and requested Japan's assistance in a Project-type technical cooperation to develop a manufacturing technique for pulp and paper, which was expected to meet the increasing demand and extension of the method. In response, the Thai and Japanese governments agreed to establish a project aiming at creating a new model for an agroforestry system that would enable sustainable development of the regional agricultural societies through the production of pulp and paper.

#### 2.1.2 Framework of the Project

##### **Overall Goal:**

The effectiveness of the new model of an agroforestry system is verified through a verification study on a model community, and the model is introduced into the rural communities in Thailand

##### **Project Purpose:**

A new model of an agroforestry system with higher utilization of forestry and agricultural plant materials is developed for sustainable rural development

##### **Outputs:**

- 1) The technologies on the biological process of the agroforestry system are improved and developed.
- 2) A sustainable agroforestry system is formulated and recommended.



- 3) Practical and clean pulping technology for small-scale pulp mills is developed for higher utilization of forestry and agricultural plant materials.
- 4) Utilization and environmental management technology for pulping wastes and plant material residues are developed.

## **2.2 Stakeholders and Study Methods**




Based on the joint evaluation report produced by the Thai and Japanese sides at the completion of the project in March 2001, the Team produced an evaluation plan and then prepared evaluation questions to respective stakeholders as shown below.

Stakeholders	Study Method
Implementing Agency 1. Kasetsart University	Interview Survey
Direct Target 2. KU's Counterparts	Questionnaire Survey
Indirect Target 4. Trainees who participated in training course provided by KAPI	Questionnaire Survey
Other Related Groups Bank for Agriculture and Agricultural Cooperatives Kasetsart University Research and Development Institute	Interview Survey Interview Survey

## 3 Study Results

### 3.1 Sustainability

The sustainability of the Project results from completion to present is expressed by the arrow as indicated in the table below.

Very high	Maintained, sustained	Lower than at Completion
		

#### 3.1.1 Technical Aspects:

The technical cooperation between the Japan International Cooperation Agency (JICA) and Kasetsart University (KU) on the “Research Project for Higher Utilization of Forestry and Agricultural Plant Materials in Thailand (hereinafter referred to as “the Project”) during 1996-2001 has contributed to strengthening the research capability of the counterparts through the research of two (2) sub-projects namely, “Development of Agroforestry System Model” and “Development of Pulping and Related Technology”. The research capabilities of the project counterparts are considered to be highly sustained considering that the techniques, skills, and knowledge they obtained are being used in their research works and expanded to other research fields. It could be noted that those research activities could be continued with significant results owing to existence of the sophisticated equipment provided by the Project.

The equipment provided to KAPI and the Faculty of Forestry during the Project is summarized in the following table.

Table 3-1: Summary of the Equipment Provided by JICA  
During the Project

Year	1996	1997	1998	1999	2000	Total
Group						
Agroforestry Group	11	3	3	43	23	83
Pulping Group	18	14	17	62	42	153
Central Equipment	2	3	-	2	22	29
Total	31	20	20	107	87	265

KAPI’s capability for maintaining equipment and machines used on a daily basis is considered to be moderately high, partly owing to the skills obtained from the experts during implementation of the Project. As a result, most of the equipment is in good condition and well-maintained. (A list of the equipment and maintenance conditions appears in Annex 1.) The institute also got cooperation from the Faculty of Engineering in repairing

more sophisticated equipment and machines but still has to rely on outsourcing agents for highly sophisticated machines or in case of severe damage. Though repair costs of the equipment are highly expensive, KAPI, by some means, managed to get the equipment repaired through budgets of other projects which need to utilize KAPI's equipment.

On the other hand, for some machines directly imported from Japan, there have been problems concerning the limited capacity and inadequate maintenance capability of Thai resources. Presently, two machines, the BOD analyzer and COD analyzer, are out of order which has affected the continuance of some research activities conducted by KAPI.

### 3.1.2 Organizational Aspects:

It could be observed that sustainability in terms of human resources is relatively high, as 98 out of 99 staff, who were assigned as project counterparts, are still working in KU. The reasons for the high retention rate are as follows:

- a) KU is a government agency with secure jobs and fringe benefits provided by the government to its staff.
- b) KU has a policy to give great support to its staff in fields of continued study and academic research in both domestic and overseas programs.

Moreover, KAPI is also inclined to secure more staff for further research, as it has retrieved two staff members who have just graduated from Japan to be permanent staffs of KAPI. As a result, more notable research activities, especially in the field of agroforestry and non-destructive evaluation can be expected. The securing of staff would also resolve problems with personnel shortage caused by the resigning of temporary staff employed during the Project.

In terms of continuing its research activities and expanding the results, KAPI attained high sustainability as the institute prolongs its policy on conducting research, transferring results to the community, supporting academic activities, and conserving the tradition and culture of university.

### 3.1.3 Financial Aspects:

It could be considered that KAPI was able to maintain its financial sustainability by continuously getting supports for transferring technologies related to the Project from Kasetsart University Research and Development Institute (KURDI), which provides equal opportunities to any organizations in KU to get research budgets on proposal basis.<sup>1</sup>

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<sup>1</sup> The proposal submitted to KURDI would be examined by the research committee of such particular fields and approved by the National Research Council of Thailand (NRCT). In 2004, KURDI supported approximately three hundred (300) research activities with total budget of 187 million Baht, ranges from fifty thousand (50,000) to millions Baht per project.

Besides the full financial supports, KAPI also got half-supports from KURDI through undertaking projects supported by other organizations.<sup>2</sup> Supports to activities related to the Projects until present have been carried out by the Japan International Cooperation Agency (JICA), the Public-Private Technology Development and Transfer Center (PPTC), and the Bank for Agriculture and Agricultural Cooperatives (BAAC). Among these, the financial support from BAAC is considered to be so far sustained, subsequent to its policy to follow the government policy to strengthen the people at the grass-roots level through transfer of technology, and its 5-year program (2003-2007) to support the technology transfer of the KAPI.

The budget of KAPI for the transfer of technology and its financial source are tabulated in the table below.

Table 3-2: The Budget of KAPI for Transfer of Technology during 2002-2005=

Year	Financial Support	Budget (Baht)
2002-2003	KURDI for Research Transfer	1,700,000
2003	KURDI for Technology Transfer	400,000
	PPTC and BAAC for Technology Transfer	300,000
2004	JICA for Technology Transfer	800,000
	KURDI for Technology Transfer	300,000
2005	PPTC and BAAC for Technology Transfer	350,000
Total		3,850,000

Though budgets for research activities and technology transfers could be secured, budgets related to equipment seem to be relatively unstable as it depends on the implementation of other projects. The tendency to get budget solely for equipment repairs or for capability building on equipment repairs seems to be very low.

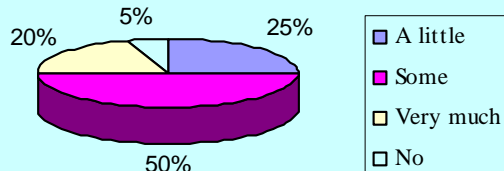
<sup>2</sup> Project to be conducted by any institutes in KU are required to get consent from the University and KURDI would consequently finance half of the project.

### Summary of the Questionnaire Survey Results

In this study, a questionnaire about views of counterparts regarding the technical aspects of the project was given to 25 counterparts in KU. Among them, five counterparts received overseas training in Japan during project implementation. Their replies are summarized as follows:

#### View of 20 Counterparts:

Have you used your knowledge from the project in your daily work?

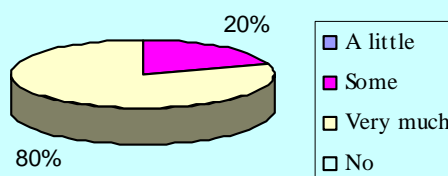


In the questionnaire, 5 (25%) responded that they use knowledge from the project in their daily work a little, 10 (50%) replied that they use some and four (20%) said they use it very much, while 1 (5%) said that he has not used it.

Comparing the results of the questionnaire survey given to the counterparts who participated in the project and the Japan-trained counterparts, it was found that the overseas trainees tend to utilize the knowledge they have gained in their daily work more than the other counterparts do.

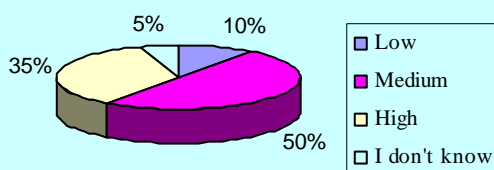
#### View of 5 Counterparts who received Overseas Training:

Have you used your knowledge from the project in your daily work?



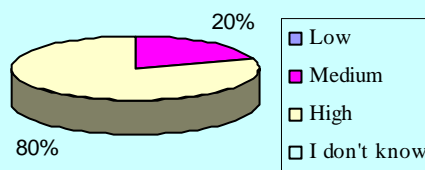
In the questionnaire, 1 (20%) responded that he uses some knowledge from the project, while 4 (80%) replied that they use it very much.

#### What level does your knowledge still valid?



Regarding the level of knowledge still valid, 2 (10%) and 10 (50%) responded that the level of knowledge still valid is low and medium respectively. Seven (35%) replied that the level is high while 1 (5%) said he doesn't know.

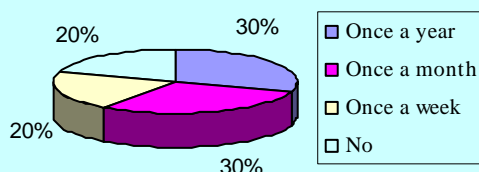
#### What level does your knowledge still valid?



Regarding the level of knowledge still valid, 1 (20%) and 4 (80%) responded that the level of knowledge still valid is medium and high respectively.

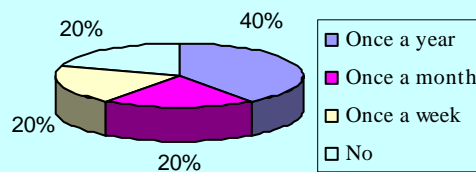
According to the survey, the knowledge of overseas trainees is still valid at a high level, while that of the other counterparts is at a medium level. This is in accordance with the fact that the utilization of knowledge in daily work of the overseas trainees is also higher than that of the other counterparts.

#### Have you updated your knowledge?



In the questionnaire, 6 (30%) replied that they updated their knowledge once a year, another 6 (30%) and 4 (20%) responded that they updated their knowledge once a month and once a week respectively. Four (20%) said they have not updated.

#### Have you updated your knowledge?



In the questionnaire, 2 (50%) replied that they updated their knowledge once a year, 1 (25%) responded that he updated once a month and another 1 (20%) updated knowledge once a week. The remaining 1 (20%) said he has not updated.

In question number 1, 30 % of the counterparts indicate that the knowledge has been utilized very little in their daily works. Moreover, in question number 2, the valid knowledge is only at 10 %, while 5 % is unknown. This reflects the fact that 20 % of the counterparts do not update their knowledge.

Meanwhile, approximately 80 %, of the overseas trainees have immediately updated their knowledge of technology, which is relevant to the 2 mentioned questions that this 80 % of them have utilized the knowledge in their daily work, thus it is still valid in the high level, together with updating their knowledge of technology, instantly.

### 3.1.4 Sustainability of Project Effects

#### **Research for Development of Agroforestry System Model:**



##### (1) Technological Improvement on Biological Process of the Agroforestry System

After termination of the Project in July 2001, KAPI did not terminate its research activities and has been trying to adapt the technology for cultivating other kinds of plants, such as, pineapples, bananas and kenaf. For research on biological technology, KAPI conducted several projects for developing raw materials by selecting and developing paper mulberry strains, and for developing tissue culture techniques for other plants. The nursery utilized for agroforestry during the project is still being used as a plant nursery, which includes paper mulberry and pineapple principally for research on tissue culture for the development of pulp/paper. It is also being used for research activities for other kinds of plants such as asparagus, piper betel, minispermaceae, etc. The knowledge and data obtained during implementation of the project were utilized as a component for integrating the biological technology of paper mulberry to that of other plants which are practical for pulp/paper production.

##### (2) A Sustainable Agroforestry System

Being concerned with the real meaning of the “new” agroforestry system model, which infers the scope of rural development planning (including modification of the traditional agroforestry system, pulp and paper production throughout value-added product, marketing, waste management, and environmental protection), KAPI was aware of not only technologies for better plantation but also the full cycle of processes after gaining the raw materials, specifically pulp and paper production, marketing, waste management, and environmental protection.

For technology on product development, the institute has improved the paper mulberry paper/pulp processing process and further utilized skills and technologies in clarifying the characteristics of banana, pineapples, and other plants’ fibers. Research results were also utilized in handicraft development with the perspective of transferring those techniques to local communities.

For marketing techniques, which is the component that was not included in the activities during implementation, KAPI itself was highly concerned of its importance considering that rural or community development could be accomplished by not only producing raw materials or end-products, but also by being able to sell those products. The institute got cooperation from the College of Human Ecology, The University of Tennessee in 2001 for training on

the marketing and socio-economic aspects of paper mulberry, which later become one of the important components, while transferring pulp/paper technology to rural communities.

**Research for Development of Pulping and Related Technology:** 

(3) Clean Pulping technology for Small-scale Pulp Mill

After termination of the Project, the counterparts have conducted several research activities on pulping technologies based on environmental friendly methodology and also extended those technologies to other plants besides paper mulberry. Some examples are described below.

For development of harvesting method, a mechanical engineering researcher from Kampaengsaen Campus has developed a paper mulberry production machine.

For cleaner technology with respect to the chemical and mechanical pulping method for handmade and/or small scale mills, further research on technology of the alkali-oxygen pulping process, sulfite pulping process, and other pulping processes is conducted, targeting the utilization of other plants such as Eucalyptus. This technology is efficiently applied in the Small and Medium Enterprises (SMEs) dealing with not only paper mulberry but also other kinds of pulp/paper.

For enzyme technology, an application for utilizing enzyme technology for adding value to agricultural residues has been developed. An application with other plants such as Eucalyptus bark and Kenaf targeting high-quality fiber is also being developed. Furthermore, KAPI's enzymologist has extracted various enzymes and other valuable substances from a number of micro organisms and plants.

For bio-pulp technology, bio bleaching utilizing hydrogen peroxide is continuously conducted and the technique of utilizing hydrogen peroxide instead of chlorine is being transferred to several paper mulberry producing groups and industries. Besides, several projects on an environment-friendly process for producing paper mulberry pulp/paper were introduced to both handmade and industrial sectors. The institute also developed the technique of mixing long fibers from paper mulberry with short fibers obtained from other agricultural product residues and recycled material.

(4) Utilization and Environmental Management Technology for Pulping Wastes and Plant Material residues

For waste management, KAPI has continued several projects concerning the waste management system in paper mulberry pulp/paper production, and the utilization of micro organism enzymes and photo catalyst/UV for color removal of water waste management in the paper mulberry pulp/paper industry.

For techniques on the utilization and management of pulping wastes and the utilization of related residues for other purposes, research in many fields on the utilization of natural products and residues mainly from plants, i.e. other fibers from biomass (cassava, pineapple, banana, eucalyptus, bamboo) besides paper mulberry, rubber, palm oil, and herbal extracts, are being conducted by counterparts of the project. KAPI's woody researcher has focused on various types of fiber plant waste applications by using the steam explosion machine. Besides, technology on developing higher digestible animal feeds from plant material wastes was developed with research cooperation from animal husbandry experts. The technique was transferred to local communities and the wastes are being used as poultry feeds. A joint research between KAPI and a forestry researcher has been highly successful in the development of a particle board using palm leaf residues with a production scale of 200 tons of fresh palm leaf weight.

It could be observed from the above activities that the research of KAPI, both for development of the agroforestry system model and for development of pulping and related technologies, have been greatly sustained, while expanding the technology application to several research activities in other fields. It should also be noted that the main reasons why those research activities were possible are because of the existence of equipment provided by the Project and partly due to the skills and techniques obtained through activities during the Project.

The number of KAPI research projects related to the Agroforestry System Model and Pulping Technology since project termination until 2004 is summarized in the following table.



Table 3-3: Number of Research Projects Related to HUFA by KAPI

Section	Year 2002*		Year 2003		Year 2004	
	No. of Projects	Educational Support**	No. of Projects	Educational Support	No. of Projects	Educational Support
Business Products Improvement Technology Section	15	7	16	10	12	13
Natural Fabric Technology Section	8	-	7	-	9	-
Biotechnology for Industrial Section	6	3	9	2	13	2
Enzyme and Waste Management Technology Section	7	5	7	3	5	3
<b>Total</b>	<b>36</b>	<b>15</b>	<b>39</b>	<b>15</b>	<b>39</b>	<b>18</b>

\* Year: Educational Year from 1 June – 31 May

\*\*Educational Support: To be advisor committee for master course and doctorate students.

## 3.2 Impact of the Project

### 3.2.1 Impact Attained by Overall Goal

At the end of the Project in July 2001, the Project Purpose, “to develop a new model agroforestry system with higher utilization of forestry and agricultural plant materials for sustainable rural development”, was completely achieved, considering that the model has been accomplished by compiling the outputs from the project into a systematic and useful report and by getting Thai researchers to understand the technologies of the developed model.

KAPI attempted to extend the model by conducting training courses and workshops to transfer technologies and research results to personnel in the paper mulberry pulp/paper industry, business owners and companies dealing with pulp/papers, personnel in the Department of Agricultural Extension (DOAE), community leaders, and farmers in rural communities. This is partly the result of the recommendation from the terminal evaluation report that human resource development is necessary for securing rural community leaders who have initiative in promoting the new models in rural communities. The contents of the courses and workshops include general information on the situation of paper mulberry paper production, mass-propagation including tissue culture techniques, the forest situation in Thailand and the advantages of paper mulberry cultivation, information on raw materials for the paper mulberry paper industry, chemical substances and waste management, hand-made paper mulberry pulp/paper production, value-added of paper mulberry paper products, and marketing. The training courses and workshops have been

periodically conducted since 2002, the year after termination of the Project, until present.

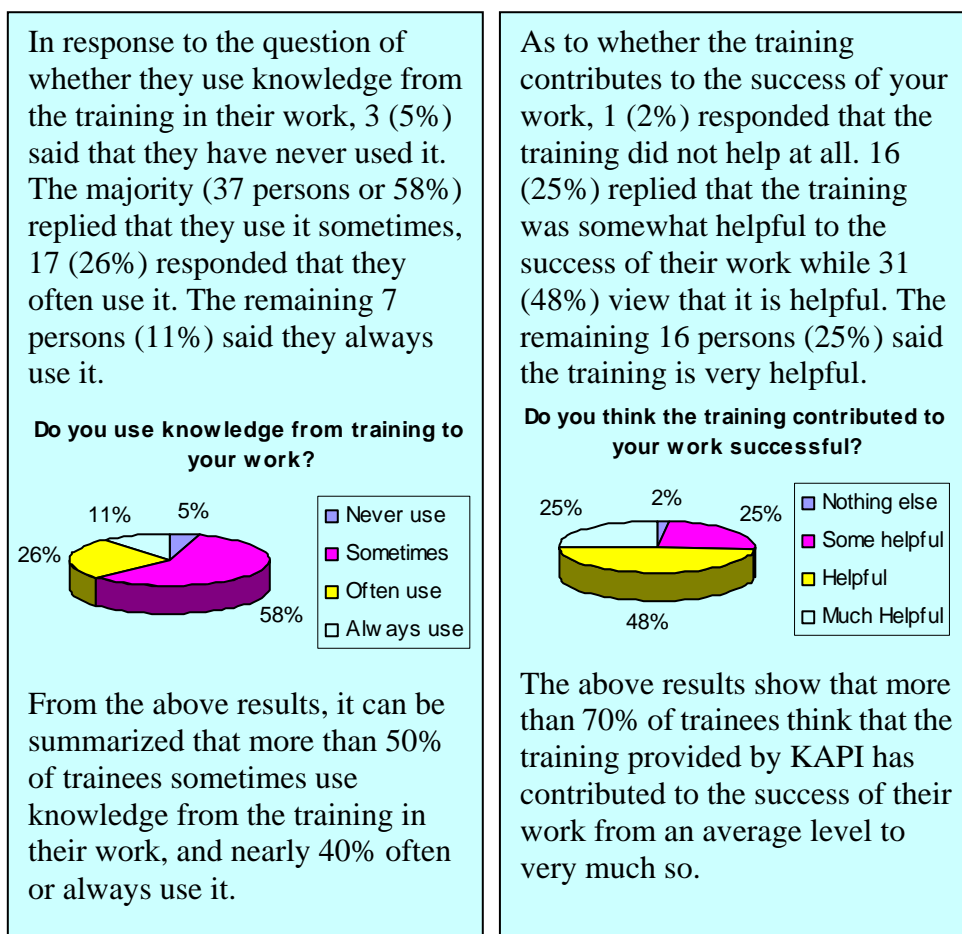
It was found that, in the programs for the transfer of technology, KAPI got cooperation from DOAE not only on information and data on the needs on paper production of farmers in rural areas and specific groups who require training, but also on personnel as trainers on adding value to the products, such as designing and packaging.

The following are training courses conducted during 2002-2005.

Table 3-3 Training Programs for Transfer of Technology in Paper Mulberry Pulp and Paper Industry by KAPI from Year 2002-2005

Year	Month	No	Topic	Venue of Training	Financed	No. of Trainees
2002	Aug	1	1 <sup>st</sup> Research Transfer on Paper Mulberry Pulp/Paper to Personnel in Mulberry Industry	KU, Bangkok	KURDI	50
	Aug	2	2 <sup>nd</sup> Research Transfer on Paper Mulberry Pulp/Paper for Personnel in Mulberry Industry to Farmers from Phare, Nan, Lampang, Chiangmai, Chiangrai	Chiangmai	KURDI	60
2003	Mar	1	1 <sup>st</sup> Technology Transfer on Paper Mulberry Production and Value-added Products to General People	KU, Bangkok	KURDI	25
	Mar	2	2 <sup>nd</sup> Technology Transfer on Paper mulberry Production and Value-added Products to General People	KU, Bangkok	KURDI	32
	Mar	3	1 <sup>st</sup> Research Transfer on Paper Mulberry Pulp/Paper to DOAE personnel and farmers	Chiangrai	KURDI	65
	Mar	4	2 <sup>nd</sup> Research Transfer on Paper Mulberry Pulp/Paper to DOAE personnel and farmers	Lampang	KURDI	50
	Apr	5	3 <sup>rd</sup> Technology Transfer on Paper Mulberry Production and Value-added Products to General People	KU, Bangkok	KURDI	30
	May	6	4 <sup>th</sup> Technology Transfer on Paper mulberry Production and Value-added Products to General People	KU, Bangkok	KURDI	26
	May	7	5 <sup>th</sup> Technology Transfer on Paper Mulberry Production and Value-added Products to General People	KU, Bangkok	KURDI	34
	Dec	8	1 <sup>st</sup> Technology Transfer on Hand-made Paper Mulberry and Pineapple and Value-Added Products to Paper mulberry Group	Nan	KURDI	25
	Dec	9	2 <sup>nd</sup> Technology Transfer on Hand-made Paper Mulberry and Pineapple and Value-Added Products to Mulberry/Pineapple Paper Group	Uthai Thani	KURDI	50
2004	Feb	1	1 <sup>st</sup> The Country Training Program in Transfer of Technology for Paper Mulberry Pulp and Paper Industry to Personnel in Mulberry Pulp/Paper Industry	Chiangmai	JICA, KURDI	69
	Mar	2	2 <sup>nd</sup> The Country Training Program in Transfer of Technology for Paper Mulberry Pulp and Paper Industry to Personnel in Mulberry Pulp/Paper Industry	KU, Bangkok	JICA, KURDI	72
	June-July	3	Technology Transfer on Saa Thai Hand Paper Making and Value Added Products to Farmers	KU, Bangkok	KURDI	19
2005	Feb	1	Technology Transfer on Pulp and Paper Mulberry by Clean Technology to Farmers in Phufah Project	Nan	PPTC-BAAC	30
	Mar	2	Technology Transfer on Pulp and Paper Mulberry by Clean Technology to Farmer Group	KU, Bangkok	PPTC-BAAC	10
Total						647

In this evaluation study, a questionnaire to obtain the views of trainees regarding the training and utilization of acquired technology during the training was given to 117 trainees, with 64 replies. The trainee's opinions are shown below.



Though the attempts of KAPI to extend the model are remarkable, it could be observed that the rural communities tend to chiefly accept just some parts of the model, which are mainly on product development and marketing techniques, while neglecting the parts on paper mulberry plantation and the production of raw materials from paper mulberry. On the other hand, it could be noted that KAPI has been greatly successful in conveying techniques on waste management to several paper making groups and companies dealing with the paper industry by introducing chemical substances that have less effect on the environment for paper bleaching. It was found that most paper that is exported at present is being bleached by the technique introduced by the Project, which uses hydrogen peroxide instead of chlorine.

The following are reasons why there has been little achievement in paper mulberry plantation or production of raw materials from paper mulberry.

- (1) The economic situation has changed from the period of project implementation when the economic crisis occurred. During that

period, an extensive interest in producing paper mulberry raw material was found in people who were jobless, while the need for raw materials for paper mulberry paper industry was noticed to be very high.

However, since the economic recovery, the interest in paper mulberry has declined since farmers tend to produce more economic crops such as pineapple or eucalyptus, and tend to use fibers of those economic crops for paper productions. Besides, more opportunity for other well-paid jobs such as day-paid labor jobs is another factor which reduces interest in paper mulberry plantation, to which very complicated process and time consumption are needed after harvesting.<sup>3</sup> People previously conducted paper mulberry plantation has altered their jobs to the more profitable one which could be easily found during this economic upturn.

- (2) Though paper mulberry plantations were promoted, it was found that very few communities tried to obtain the idea of planting as people could find paper mulberry in the forest. However, the tendency of European countries to accept only paper products using materials produced from planted trees might become a main factor in urging more plantations in the future. KAPI's continuous effort to extend knowledge on paper mulberry plantations until present is expected to be fruitful when policy on exported paper products gets stronger in the future.

Seeing the decreasing tendency of producing raw materials for paper mulberry, KAPI has adapted the techniques to utilize the remains of economic crops such as pineapples as raw material for pulp/paper production, and has succeeded in leading some communities to produce paper utilizing mixed fibers of paper mulberry and pineapple and produce products utilizing that paper.

Seeing from the above activities and their results, the Overall Goal 'to verify the effectiveness of the new model agroforestry system through a verification study on a model community, and to introduce the model into the rural communities in Thailand' is considered to be partly achieved, as some components of the model, namely pulp and paper production, marketing, waste management, and environmental protection, have been adopted and carried out by communities and companies related to the paper industry. However, plantation activities, which are critical to mitigate the problem of diminishing forest, are hardly observed at present.

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<sup>3</sup> *The harvesting of paper mulberry, whether cutting or peeling, has many process and consumes a lot of time. After peeling, it must be thoroughly dried in the Sun in order to avoid fungus.*

On the other hand, achievement could somehow be expected through communities in the Phufah Development Center Project (hereinafter referred to as the Phufah Project),<sup>4</sup> to which KAPI has involved for an agroforestry system model, by planting paper mulberry with red beans in the allocated 10 rai of land since 2002, and by transferring technology on paper mulberry paper/pulp production since 2005. Though tendency to adopt the full cycle of the agroforestry system model starting from plantation until selling products could be expected from communities in the Phufah Project, consideration and discussion on a further approach to support forest plantation of other areas are needed by KAPI and related organizations.

### 3.2.2 Impact not Anticipated at Project Completion

Impact	Reasons/support information
Setting Standard for Paper Mulberry Paper Price	Before starting the project, farmers sold both thick and thin paper mulberry paper at the same price. After the pilot project was introduced, it was suggested that the price of thick paper should be higher than the thin kind due to the amount of raw materials used in the production. One kilogram of paper mulberry pulp costing 35 Baht can produce 50 sheets of thin paper, while it can produce only 10-15 sheets of thick paper. The project helped farmers to understand the mechanism of raw material costs and price and to increase the price of thick paper mulberry paper to be higher than that of thin paper mulberry paper.

<sup>4</sup> The Phufah Project, under the Patronage of Her Royal Highness Princess Mahachakri Sirindhorn, was established in Borkuar District, Nan Province in 1999. One of the main objectives of the project is to study, research and transfer technology for development and sustainable natural resources management together with the coordinating center for rural development and improvement of the living conditions of local people. The Phufah Development Center has a total area of 2,000 rai (320 hectare). In the project, 1,400 rai (224 hectare) of land is used for people's farmland and the remaining 600 rai (96 hectare) is used by the center for study and research purposes. The Phufah project has been supported by various organizations in both the public and private sectors. KU has taken responsibility for 100 rai of land in the project, of which 10 rai has been allocated to KAPI.

Impact	Reasons/support information
Using Paper Mulberry Leaves for Animal Feed	One of the consequences of this project was concerned with waste utilization, as waste from the production process was expected to be utilized as much as possible, with the main focus on the otiose paper mulberry leaves. According to studies, paper mulberry leaves contain quite a lot of protein (20%), which is similar to horse tamarind leaves used for poultry diet. However, due to some toxic substance in the horse tamarind leaves, it can supplement an animal's diet to merely 5%. In the case of paper mulberry, it can be dried and mixed with animal feed up to 20%, which saves 8 Baht per kilogram. Therefore, the Thai Chicken Raisers Cooperative in Lamphoon placed orders with farmers in Phrae and Nan via the project for 5 tons/week of dried paper mulberry leaves at a price of 5 Baht/kg, or 5,000 Baht/ton. However, as there are no middle persons to collect the dried leaves for the cooperative, the purchasing orders were not efficiently supplied. In addition, the farmers who raise chickens were advised to mix the dried leaves of paper mulberry with the chicken feed in order to save money as well.

### 3.3 Analysis of Factors of Impact and Sustainability

#### 3.3.1 Promoting Factors

##### Policy Factor:

- KAPI could attain high sustainability in continuing its research activities and expanding the results since the institute maintain its policy focusing on conducting research and transferring results to the community.
- Financial support for the technology transfer could be highly sustained owing to the Thai government's main focus on grassroots people and its support to the One Tambon One Product (OTOP) policy. This leads to the cooperation from government agencies, such as BAAC, to support the activities of KAPI in transferring technology for the production of paper mulberry to the poor.

##### Organizational Factor:

- Financial sustainability in terms of research activities and technology transfers could be continuously expected owing to KAPI's high motivation and enthusiasm in conducting research activities and transferring technology to farmers, which is consequently related to attempts in finding financial sources to support such activities.

- High education level and high research capability of the counterparts of the Project are factors promoting efficiency and continuation of the research activities after the termination of the Project.
- Equipment of daily usage and high sophisticated equipment provided during the Project allow, not only counterparts of the Project but also other university experts, to continue research activities both for development of agroforestry system model and for development of pulping and related technologies, and to expand research activities in other fields.

### 3.3.2 Inhibiting Factors:

#### Policy Factor:

- The absence of export control on paper products made from natural materials constrains the extension of paper mulberry plantation promoted by the Project because farmers tend to cut down indigenous paper mulberry.

#### Economic Factor:

- Improvement of economic condition after termination of the Project has affected the interest of farmers in planting paper mulberry which is a complicated and time-consuming task. Tendency to focus on paper mulberry industry has been changed to more profitable and easier jobs which could be easily found during the period of economic upturns.
- Due to high maintenance cost of some equipment provided by the Project, continuation of some activities needing to use such equipment, such as activities on enzyme technology and waste management, are restrained.
- There is concern that product development at the handicraft-level may have limitations due to the price down of paper making from paper mulberry because handmade paper products are freely available on the market, while no problems with continuation of KAPI's activities for product development using paper mulberry paper and its technology transferring to farmers have occurred up to this time.

## 3.4 Conclusions

After the project's termination, the sustainability of the project in field of technical aspects and organizational aspects are highly sustained. For technical aspects, it can be noticed from research capabilities of the project counterparts that expanded to other research fields. For organizational aspects, it could be observed from sustainability of the human resources of the counterpart is relatively high. In view of financial aspects, KAPI was able to maintain its financial sustainability by continuously getting supports for technology transfer related to the Project from KU and other organizations. Sustainability of the



project effects is highly achieved. KAPI has been conducting many kinds of researches in field of biological process of the agroforestry system, sustainable agroforestry system, clean pulping technology for small-scale pulp mill and utilization and environmental management technology for pulping wastes and plant material residues.

For impact, it can be concluded that the project has partly achieved the overall goal. Because some components of the model such as pulp and paper production, marketing, waste management and environmental protection have been adopted and carried out by communities and companies related to the paper industry. While plantation of paper mulberry has been little achieved due mainly to the economic situation in Thailand has drastically changed from crisis during project implementation to recovery at present. Since the economic recovery, the farmers' interest in paper mulberry has declined.

## **4 Recommendations and Lessons Learned**

### **4.1 Recommendations**

For JICA:

- With regards to necessity of utilizing some high sophisticated equipment directly imported from Japan such as BOD and COD analyzers and the limited maintenance capacity by the Thai resources after breaking down, it is recommended that an engineer who could conduct maintenance of such high sophisticated equipment should be sent to KAPI for the technical transfer principally of the maintenance of the equipment. In this regards, KAPI has planned to provide two additional staff graduated from abroad to accept skills transferred from the expert. Sustainability after gaining the techniques is expected to be high provided that this two staff would become in charge of the research activities utilizing these two machines and also be in charge of the long-run maintenance.

For KAPI:

- Product development of paper made from paper mulberry at the industrial level is one of the main factors for further continuation of KAPI's activities. Therefore, it is necessary to consider the promotion of the research and development of paper mulberry to be applied to industrial products, similar to the utilization of kenaf for building boards and draining material for pre-load in Japan. As an initial phase to start the research and development described above, KAPI should conduct an analysis of industries which can utilize paper mulberry as a product ingredient, and also consider the concrete fields to be developed, market needs, the practicable scope of technical activities by KAPI, and the necessity of technical cooperation from Japan.

### **4.2 Lessons Learned**

- During the Project, some of the equipment, such as BOD and COD auto-analyzer, was directly procured from Japan. When this kind of equipment breaks down, it is highly difficult to find an agent to repair it or the techniques of local resources are sometimes not adequate. Considering sustainability of equipment utilization and prospect of having the maintenance done by local resources, it is essential to carefully investigate the possibility of procuring such equipment in Thailand.
- Timely monitoring and proper review of the activities to achieve the overall goal and/or to utilize the outputs borne from the project activities, in accordance with the rapid change in the economic and social situation, is highly important.

In case of KAPI, though economic upturns has occurred after the termination of the Project, which highly affected the interest of local people in planting

non economic crops such as paper mulberry, KAPI has been trying to promote the plantation by including the content on value-added paper production to the training courses to induce the interest of farmers together with promoting the plantation during the training. Besides, the institute also utilizes the research techniques obtained during the Project to other plants, especially on economic crops, which response to the needs of farmers in the current economic situation.

Though it might take time to achieve the overall goal, it is necessary to consider the activities which could be adapted or conducted for the better achievement.

### **4.3 Follow-up Situation**

- Three individual short-term experts were dispatched in fiscal year 2001, to assist in the activities at the agroforestry testing sites.
- In addition, the in-country training programs on the “Transfer of Technology for Paper Mulberry Pulp and the paper Industry” were conducted on February 25-27 and March 1-2, 2004 in Chiangmai and at Kasetsart University, respectively.

# Annex 1



## *Equipment List and Its Condition*

## List of Equipment Provided by JICA for HUFA Project in Year 1996-2000

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
<i>IN YEAR 1996</i>						
1.	HPLC	1	SHIMADZU LC-10AD		KAPI	Fine
2.	Vehicle	1	TOYOTA Land Cruiser	Engine No. 5V2-0351502 Chassis No: JT 111VJ950018468	KAPI	Fine
3.	Biohazard Safety Cabinet	1	MICROFLOW MDH Class II	S/N. 97/05/2/059	KAPI	Fine
4.	Autoclave (with dryer)	1	TOMY SD-320	S/N 32108015	KAPI	Fine
5.	Portable Photosynthesis System	1	ADC LCA-4	S/N. 24704	Faculty of Forestry	Repairing
6.	N-C Analyzer	1	YANACO MT-700	S/N 72802	Faculty of Forestry	Fine
7.	Stereoscopic Microscope	1	NIKON SMZ-U	S/N. 580425	KAPI	Fine
8.	Illuminate Incubator with CO <sub>2</sub> Control	1	EYELA FLI-301 NHC	S/N 77241112	KAPI	Fine
9.	Soxlet-Fat Extractor	1	BUCHI B-811	S/N. 1440063	KAPI	Fine
10.	Pulping Unit	1	HAATO L & WF 1229	S/N. 6879	Pulping house	Fine
11.	Rotary Autoclave	1	KUMAGAI KRK 2616/42	S/N. 9707086	Pulping house	Fine
12.	Pulp Disintegrater	1	KUMAGAI KRK 2530	S/N. 9707087	Pulping house	Fine
13.	Refrigerated Centrifuge	1	TOMY GRX - 220	S/N. 32037030	KAPI	Fine
14.	Refrigerated Stocker	1	HITACHI RC-M 100C	S/N. 285693	KAPI	Fine
15.	Water Bath Shaker	1	EYELA NTS - 1300	S/N. 7307234	KAPI	Fine
16.	Fraction Collector	1	EYELA DC - 1200	S/N. 70500770	KAPI	Fine
17.	Accessories of HPLC (Electrochemical Detector)	1	SHIMADZU L-ECD-6A	C20643500140 LP	KAPI	Fine
18.	Accessories of Refrigerated Centrifuge (Fixed Angle Rotor)	2	TA - 6 TA - 24BH		KAPI	Fine
19.	Accessories of CO <sub>2</sub> Growth Chamber	3	Thai made		KAPI	Fine
20.	Cooling Incubator	2	TERMAKS KBP 6087 KBP 6151	S/N. 980354 S/N. 98344	Faculty of Forestry KAPI	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
21.	Computer	1	COMPAQ	SN734BN53H891	KAPI Faculty of Forestry	Fine
	Computer	1	COMPAQ	SN715CD02FT231		
	Printer	1	EPSON P9304	SN3J0016624		
	Printer	1	HEWLETT PACKARD	SNSCGB17786		
22.	Autoclave (High Pressure Steam)	2	HIRAYAMA HVE – 50	S/N. 980387327 S/N. 980387328	KAPI	Fine
23.	Water Bath with Cover	1	MEMERT WB 22		KAPI	Fine
<b><i>IN YEAR 1997</i></b>						
1.	GC-Mass Spectrometer	1	SHIMASU GCMS-QP-5050A	S/N C70113600598SA	KAPI	Fine
2.	Pick up Car	1	TOYOTA Hilux	Engine No. 2L-9460460 Chassis No. LN85-7113503	KAPI	Fine
3.	Root Length Measurement System	1	DELTA-T T-SCAN	SG 81714055	Faculty of Forestry	Repaired
4.	Automatic Weather Station	1	DELTA-T WS01		Wangchin, Phare	Fine
5.	Explosion System	1	NITTO KOUATSU (CHINO)	PA7YA058	Pulping house	Fine
6.	Ozone Generator	1	OZONAIR RXO-15	S/N. AS-12-04717E	KAPI	Fine
7.	Water Quality Checker (Water Checker and Sampler)	1	HORIBA U-10	S/N. 712054	KAPI	Fine
8.	High Consistency Pulp Disc Refiner	1	KUMAGAI KRK	S/N. 9804069	Pulping house	Fine
9.	Experimental Flat Screen	1	KUMAGAI KRK	S/N. 9804070	Pulping house	Fine
10.	Gel Chromatography Column for HPLC	2	WATER 5GPC-100 WATER 5GPC-300	S/N A41025 S/NF41017	KAPI	Fine
11.	Biological Microscope	1	NIKON E600	S/N. 771597	KAPI	Fine
12.	Tensile Strength Measurement	1	KUMAGAI KRK No. 2001	S/N. 9804071	KAPI	Fine
13.	Bursting Strength Measurement	1	KUMAGAI KRK No. 2023	S/N. 9804072	KAPI	Fine
14.	Folding Endurance Measurement	1	KUMAGAI KRK No. 2015-M	S/N. 9804076	KAPI	Fine
15.	Square Sheet Machine with Press & Air Dyer	1	KUMAGAI KRK No. 2555 KRK No. 2530 KRK No. 2572	S/N. 9804073 S/N. 9804074 S/N. 9804075	Pulping house	Fine
16.	Brightness Tester Machine	1	KUMAGAI KRK No. 2066	S/N. 9804077	KAPI	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
17.	Automatic COD Analyzer	1	YANACO COD-308	S/N. 9821005	KAPI	Out of Order
18.	Ultra Filtration	1	AMICON 8400		KAPI	Fine
19.	PCR	1	STRATAGENE Robocycle 40	S/N9651522	Faculty of Science	Fine
<b>IN YEAR 1998</b>						
1.	Pulp Naginata Beater	1	UMEHARA		Pulping House	Fine
2.	PFI mill	1	KUMAGAI KRK No. 2510	9812165	Pulping House	Fine
3.	Canadian Standard Freeness Tester	1	KUMAGAI KRK No. 2580-A	9812167	Pulping House	Fine
4.	Fermentor	1	BIO STATC 8844925	S/N 03012/98	Pulping House	Fine
5.	Plant Efficiency Analyzer	1	HANSATECH PEA 2.40	9901	Faculty of Forestry	Fine
6.	Digital Micrometer for Sheet Thickness	1	KUMAGAI KRK No. 2137-I	9812169	KAPI	Fine
7.	Tearing Strength Tester	1	KUMAGAI KRK No. 2033	9812168	KAPI	Fine
8.	Standard Sieve & Shaker	1	ITOH MS-200	2340	KAPI	Fine
9.	Monitor/basis Weight	1	KUMAGAI KRK No. 2141	MJ 300	KAPI	Fine
10.	Soil Moisture Extraction	1	Daiki Dik-9212	S/N. 3452	Faculty of Forestry	Fine
11.	UV-VIS Spectrophotometer	1	JASCO V-530	B 105560512	KAPI	Fine
12.	Refrigerated Circulating bath	1	EYELA CA-1110 Nissin eletece	S/N 84614129	KAPI	Fine
13.	BOD Analyzer & Low Temperature Incubator	1	BOD-2100 EYELA LTI-1000SD	S/N .MFG-A 1947-8 S/N6625511	KAPI KAPI	Out of Order
14.	Centrifugal Dehydrator	1	KUMAGAI No. 2536-I	9812170	Pulping House	Fine
15.	Pulp Classifier	1	KUMAGAI No. 2590-I	9812166	Pulping House	Fine
16.	Lab Floatator	1	KUMAGAI KRK No.2583	9903022	Pulping House	Fine
17.	Lab Size Press (size gum Tester)	1	KUMAGAI KRK No.2202-B	9903023	Pulping house	Fine
18.	Lab Calendar	1	KUMAGAI KRK No.2232	9903024	Pulping house	Fine
19.	Rotary Dryer	1	KUMAGAI KRK No.2575-I	9903021	Pulping house	Fine
20.	Smoothness Tester	1	KUMAGAI KRK No.2044	9903020	KAPI	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
<i>IN YEAR 1999</i>						
1.	Stomacher	1	LAB SYSTEM Stomacher 400 BA 7021	36502	KAPI	Fine
2.	Atomic Absorption Spectrometer	1	Perkin Elmer ANALYST 300	04150030115	Faculty of Forestry	Fine
3.	Deep Freezer	1	SANYO MDF-492AT	S/N 9090730	KAPI	Fine
1.	Atomic Absorption Spectrometer	1	Perkin Elmer Analyst 300	S/N 04150070108	KAPI	Fine
2.	Distillation and Digestion Apparatus	1	Gerhardt - Vapodest 30 - Kjeldatherm KB20 - TURBOSOG TUR - KJELDAHL	VAP 002345 40013333 4000781 4000978	Faculty of Forestry	Fine
3.	Sap Velocity System	1	DELTA-T	SV1-10DL-2 AR-150587/E103582	Faculty of Forestry	Fine
4.	Time Domain Reflectometer	1	MODEL 6050 XI	S/N 1683	Faculty of Forestry	Repairing
5.	Water Purification System	1	HANILTON BRANSTEAD  AquaMatic : AWC/85  Easy Puse UV : D7402-33  Easy Pure RO : D4722-33	7417  1163000857765 742000860669	Faculty of Forestry	Fine
6.	Vehicle	2	TOYOTA Commuter	Chassis No. LH 184- 10023475L4940250  Chassis No. LH 184- 1002359 5L4941568	Faculty of Forestry KAPI	Fine
7.	Spectrophotometer	1	SHIMADZU UVmini-1240	A 10933700650	Faculty of Forestry	Fine
8.	Hot air Oven	3	MEMMERT  UM 500	6500-0429  6500-0435 6500-0432	KAPI  KAPI KAPI	Fine
9.	Jar Test Apparatus	1	Phips & Bird 7790/920B	S/N. 20004716	KAPI	Fine
10.	Computer Server & Upgrade set	2	COMPAQ PROLIANT 800  COMPAQ PROLIANT 800  SP SUPER POWER Upgrade set	S/N 7010CNL 30053  S/N7010 CNL30056	KAPI 203  KAPI Japanese Side KAPI	Fine



Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
11.	Laboratory Furnace	1	CABOLITE CWF 11/23/201	6/00/1491	KAPI	Fine
12.	Water Purification System	1	Millipore Rios16 Milli-Q Gradient	FØDN 68 Ø 35I	KAPI	Fine
13.	Visualizer	1	CANNON RE-350	S/N02502482	KAPI	Fine
14.	Irrigation System	1	THAI MADE Model.NF 30-CS	-	Faculty of Forestry	Fine
15.	Freeze Dry System	1	LABCONCO Free Zone 77535-01	000710196K	KAPI	Fine
16.	Concentration Centrifuge System	1	UNIVAPO 150 H	S/N15082	KAPI	Fine
17.	Steam Boiler	1	LK Boiler Industry Type D 60E	614	Pulping house	Fine
18.	Stainless Steel Digesting Vessel for Cooking in the boiling water	1	THAI MADE		Pulping house	Fine
19.	Stainless Steel Digesting Vessel for Cooking in hot Stream water	1	THAI MADE		Pulping house	Fine
20.	Stainless Steel Tank for pulp washing	1	THAI MADE		Pulping house	Fine
21.	Stainless Steel Tank for bleaching	2	THAI MADE		Pulping house	Fine
22.	Stainless Steel Beater	1	THAI MADE		Pulping house	Fine
23.	Centrifugal Pulp water Extractor Machine	1	THAI MADE		Pulping house	Fine
24.	Stainless Steel Lifting Vat for Thai Style	1	THAI MADE		Pulping house	Fine
25.	Stainless Steel Lifting Vat for Japanese Style	1	THAI MADE		Pulping house	Fine
26.	Stainless Steel Paper Sheet Dryer	1	THAI MADE		Pulping house	Fine
27.	Energy Saving Furnace	1	THAI MADE		Pulping house	Fine
28.	Hydraulic Press	1	THAI MADE		Pulping house	Fine
29.	Wiley Lab Mill	1	WILEY Rotary Pulverizer System		KAPI	Fine
30.	Soil Stirrer Apparatus	4	HAMILTON 1G936	A 3999 A 0789 A 3999 A 4689	Faculty of Forestry	Fine
31.	Oriented Sheet Former	1	KUMAGAI KRK No. 2543	2005057	Pulping house	Fine
32.	Wet Strength Tester	1	KUMAGAI KRK No. 2567	2005056	Pulping house	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
33.	Standard Sample Cutter	1	KUMAGAI KRK No. 2130	2005054	KAPI	Fine
34.	Automatic Film Applicator	1	KUMAGAI KRK No. 2228	2005058	Pulping house	Fine
35.	Compression Strength Tester and Accessories (Crush Tester)	1	KUMAGAI KRK No. 2094-II	S/N2005053	KAPI	Fine
36.	Curly Stiffness Tester	1	KUMAGAI KRK No. 2049-D	2005051	KAPI 611	Fine
37.	Cobb Size Tester	1	KUMAGAI KRK No. 2075	-	KAPI 611	Fine
38.	Temperature and Humidity Recorder	1	Cole Permer 80010-25	S/N29716	KAPI	Fine
39.	Thermistor Thermometer	2	Cole-Per 08402-20 91100-20	S/N .JC10281	KAPI	Fine
40.	Light Meter	1	Cole-Permer 01588-34	S/N.249798	KAPI	Fine
41.	Air flow Measurement (Heavy Duty Thermometer)	1	Cole-Permer 10200-00		KAPI	Fine
42.	Time Controller	2	Cole-Permer 170 170	S/N.000085 S/N.000087	KAPI	Fine
43.	Programmable Plug-in Controller	2	Cole-Permer		KAPI	Fine
44.	UV Germicidal Lamp	2	Cole-Permer 97505-25	S/N994287 S/N.M003881	KAPI	Fine
45.	Screen Plate	1			Pulping house	Fine
46.	Screen Plate	1			Pulping house	Fine
47.	Wire Cloth	1			Pulping house	Fine
48.	Wire Cloth	1			Pulping house	Fine
49.	Portable Ec Meter	1	TOA CM-14P	78cp017W	Faculty of Forestry	Fine
50.	Incubator	1	EYELA LIT-100ISD	10018686	KAPI	Fine
51.	Soil Penetration Tester	3	DAITOU GREEN H-60		Faculty of Forestry	Fine
52.	Desktop Shaker	1	NISSHIN RIKA NX – 33D	00204001MD	Faculty of Forestry	Fine
53.	Three Phase Meter	1	DAIKI DIK-1121	1827	Faculty of Forestry	Fine
54.	Digital pH Meter	1	TOA HM – 12P		Faculty of Forestry	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
55.	Water Bath	2	MEMMERT WB 22	S/N.L50.0275 S/N.L50.0270	KAPI	Fine
56.	Stirring Motor	1	KIKA Works (IKA) RW 20 DZM-n	8016653	KAPI	Fine
57.	Digital Balance	1	Precisa 303A	S/N0037-43	KAPI	Fine
58.	Hot Plate Stirrer	2	SCHOTT GLAS SLK3	S/N.950337 S/N. 95033	KAPI	Fine
59.	Fume Hood	1	Major Scientific Product Super Flow 150		KAPI	Fine
60.	Near Infrared Spectrophotometer	1	Bran & Luebbe InfraAlyzer 500	9628785	KAPI	Fine
61.	Gas chromatography	1	Shimadzu GC – 14B		KAPI	Fine
62.	Biohazard Laminar Air Flow Cabinet	2	Super Clean 150 BS		Faculty of Forestry KAPI	Fine
63.	Rotary Evaporator	1	EYELA Rotary evaporator Digital Water Bath SB 651 Aspirator : A-35 Colling Ace : CA- 1110 Rotary Vacuum Evaporator NN-series N-INN	S/N. 10022643  S/N. 10024409  S/N.10023727  S/N. 1002367	KAPI	Fine
64.	Tube + Block Digester	1	Gerhardt Kieldatherm digestion fortube : Type KB 20S+TR For flask : Type KI 11/26 Turbosong scubber : Type TUR/K Distillation : Type VAP30		KAPI	Fine
65.	Colony Counter	1	FUNCE GERBER	S/N. 8502-1147	KAPI	Fine
66.	Sheet Machine with water recycle and suction	1	KUMAGAI KRK No. 2558-I	2005055	Pulping house	Fine
67.	Automatic weather station	1	DELTA-T	DLAE 93/9	Faculty of Forestry	Fine
68.	pH Meter	3	TOA  HM – 20J EUTECH CYBER Scan 500	S/N. A5CF802W  S/N. 71595 S/N. 71586	Faculty of Forestry KAPI	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
69.	Stereoscopic Microscope	1	NIKON SMZ800		KAPI	Fine
70.	Homogenizer	1	Pro Scientific Pro 400 Benchtop	04-01086	KAPI	Fine
71.	Extraction Set	1	ISOPAD RE 6250 ml.	S/N. 60211	KAPI	Fine
72.	Viscometer	1	Brookfield RVDV-II +	RT 60136	KAPI	Fine
73.	Constant Temperature and Humidity Oven	1	WTC binder	990190	KAPI	Fine
74.	Gel Document	1	UVP - 26	S/N.062500-002	Faculty of Science	Fine
75.	Electrophoresis with Power Supply	1	BIO-RAD Power/PAC 1000	S/N. BR 02607	KAPI	Fine
76.	Refrigerated Micro Centrifuge	1	JOUAN MR 23i	S/N. 3004196	KAPI	Fine
77.	Shaking water Bath	1	Stuart Scientific SBS 30/1	R0001 00175	KAPI	Fine
78.	Top Berch Centrifuge	1	Hettich Zentrifugen MIKRO 22R	S/N. 0001326-04-00	KAPI	Fine
79.	Shaking Incubator	1	Forma Scientific FOR-1420	S/N. 29315-397	KAPI	Fine
80.	Inverted Microscope with Fluorescence Attachment	1	NIKON ECLTPSETE 300 HB-10104AF	414971	KURDI	Fine
81.	Biolistic Gene Gun System	1	BIO-RAD PDS-1000/He	901 BR 00909	KURDI	Fine
82.	Computer Set for Presentation and Extension	2	COMPAQ COMPAQ	S/N.5703DG24H280 S/N.5703DG24H303	KAPI Faculty of Forestry	Fine
83.	Deep Freezer	1	Forma Scientific FORMA 8585 Series Non-CEC	29040-6	KAPI	Fine
84.	Colorimeter	1	Nippon Den Shoku NR-3000	S/N.060731	KAPI	Fine
<b>IN YEAR 2000</b>						
1.	Ups CL 5000 (for GC - MS)	1	LEONIC CL 5000	S/N. 30010-2-0001-001	KAPI	Fine
2.	Ultra 2 Capillary Column (for whiskey application of GC-MS)	1	HEWLET PACKARD 19091B-115	S/N. 60178814	KAPI	Fine
3	DB-5J & W Capillary Column (for GC - MS)	1	DB - J&W		KAPI	Fine
4	Vessel Ferrule	10 PCs			KAPI	Fine
5	Washer	5 PCs			KAPI	Fine
6	Female Nut	5 PCs	1.6 FN		KAPI	Fine
7	Injection Part Septum	5 PCs			KAPI	Fine
8	Filter Assay	2 PCs			KAPI	Fine
9	Molecular Sieve Filter	1 pk			KAPI	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
10.	Graphit Ferrule	1 pk			KAPI	Fine
11.	Glass Insert	2 pk			KAPI	Fine
12.	Micro Syringe	2 PCs			KAPI	Fine
13.	O - ring for gas leak	5 PCs			KAPI	Fine
14.	O – ring for joint leak	5 PCs			KAPI	Fine
15.	Gasket injector	1 PCs			KAPI	Fine
16.	Filament	2 PCs			KAPI	Fine
17.	Capillary Assay	1 PC			KAPI	Fine
18.	O - ring for joint leaks	4 PCs			KAPI	Fine
19.	Graphite Ferrule for Glass Insert	1 PC			KAPI	Fine
20.	UPS CL 3000 (for HPLC)	1	SOCOMECEGYS – D 3000	S/N. 001163304	KAPI	Fine
21.	Glass Vacuum Holder (for HPLC)	1	SARTORIOUS Cat No.16309		KAPI	Fine
22.	Camera	1	NIKON F90X		KAPI	Fine
23.	Camera	1	NIKON F90X		KAPI	Fine
24.	Dry bath incubator	1	BOCKEL ANALOG 112002	S/N. 01005	KAPI	Fine
25.	Liquid nitrogen tank	1	CRYOGENIC GT 35		KAPI	Fine
26.	Stabilizer for BOD	1	Socomesicon EGYS-D3000	S/N. 01157663	KAPI	Fine
27.	UPS 3KVA for Atomic Absorption	1	LEONICS 0A1	S/N. 30129-1-0036-082	KAPI	Fine
28.	Vortex Mixer (Minishaker)	2	Kika works (Asia) Sdr.Bhd MS1	S/N. 0801621	KAPI KAPI	Fine
29.	Magnetic Stirrer with hot plate	3	FISHER MSH 300		KAPI KAPI KAPI	Fine
30.	Bench - top shaker	2	New Brunswick Scientific Innova 2100	S/N. 001290124 S/N. 1289960	KAPI KAPI	Fine
31.	Conductivity pH meter	1	Denver Instrument 220		KAPI	Fine
32.	Walk in fume hood for Atomic Absorption	1	MAJOR Super Flow 2000		KAPI	Fine
33.	Japanese Frame and Screen	2			Pulping house	Fine
34.	Hygrothermograph	1	SEKONIC ST-100V		KAPI	Fine
35.	Digital Balance	1	PRECISA Series XT 220A		KAPI	Fine
36.	Hot Air Oven	1	MEMMERT UM 500	B 500.0497 S/N. 6500.0497	KAPI	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
37.	Water bath	1	MEMMERT WB 7		Faculty of Science	Fine
38.	Orbital Shaker	1	VRN 360	S/N. 290085	Faculty of Science	Fine
39.	Solar Energy Sensor	2	Delta-T ES-UM-10	ES 2-258 ES 2-259	Faculty of Forestry	Fine
40.	Solar Energy Recorder	1	Delta-T DL 2C	DL2C 9717	Faculty of Forestry	Fine
41.	Microwave Oven	2	Turbora TRX-249i TRX – 249i	991100366 S/N. 90300556	KURDI KAPI	Fine
42.	Automatic gas burner	1	WLD-TEC Gasprofi 2	004342	KURDI	Fine
43.	Furnace	1	Fisher Scientific Cat No. 10-550 14A	S/N. 011N0118	Faculty of Forestry	Fine
44.	Infrared Moisture Meter	1	KUMAGAI YMC	2011126	KAPI	Fine
45.	Vacuum Constant Oven	1	YAMATO DP - 33	39100030R	KAPI	Fine
46.	Thermocouple Thermometer	2	NANNA HI9053 K-type		KAPI	Fine
47.	Electrode Beckman	2	FUTURA Gel-Filad Combination 511053		KAPI	Fine
48.	Automatic Bunsen Lamp	1	SMART FLAME	S/N. SM 420115	KAPI	Fine
49.	Multi – Purpose Machine	1	HQ-400	S/N. 070192	Pulping house	Fine
50.	Magnifiers	1			KAPI	Fine
51.	Hack Saw Machine	1	Hero		Pulping house	Fine
52.	Drilling Machine	1	King Type No.420		Pulping house	Fine
53.	Pipe Threading Machine	1	EMERSON Type RT - 3		Pulping house	Fine
54.	Welding Machine (Crown welding machine)	1	Crown type No. 300A		Pulping house	Fine
55.	Gas Welding Set	1	HARRIS		Pulping house	Fine
56.	Hydraulic Stacker	1	SK 1000 - 1900	S/N. 0460	Pulping house	Fine
57.	Aminex HPX-87P (for HPLC)	1	Aminex HPX 87P		KAPI	Fine
58.	Horizontal Laminar flow Cabinet	1	120 - H		KAPI	Fine
59.	Shaker	1			KAPI	Fine
60.	Temporary Immersion Culture System	3	300-4050		KAPI	Fine
61.	Air Compressors	1	PUMA PP-2		Pulping house	Fine

Item No.	Equipment	Qty.	Brand/Model	Serial number	Place to Keep	Condition
62.	TMC Hand Pallet Trucks	1	TMC 20-601	S/N. 3695	Pulping house	Fine
63.	High Speed Cut off Machine	1	WINNER	S/N. A00	Pulping house	Fine
64.	Stabilizer For. AA-9	1	QURSAR	S/N. 010815300	KAPI	Fine
65.	Digital Handheld Dispenser	1	2IDG-10		KAPI	Fine
66.	Micropipette	1	GILSON P100		KAPI	Fine
67.	Copying Stand	1	6220		KAPI	Fine
68.	Bench Grinder wheel	1	CIFES 200F	S/N. 1850	Pulping house	Fine
69.	Electric Fan	1			Pulping house	Fine
70.	Auto Sampler Syringe	1	SHIMADZU		KAPI	Fine
71.	Auto CD ROM	3			KAPI	Fine
72.	Table Truck	3	ST3-50075		KAPI	Fine

## Annex 2



### *Evaluation Grid*



**Project Title: Ex-post Evaluation on the Research Project for Higher Utilization of Forest and Agricultural Plant Materials in Thailand**

**Evaluation Grid**

<b>IMPACT</b>					
<b>Evaluation Questions</b>		<b>Achievement Criteria/Measures</b>	<b>Data Needed</b>	<b>Data Source</b>	<b>Data Collection Methods</b>
<b>Main Questions</b>	<b>Sub Questions</b>				
1. Has the new model of agroforestry system (agroforestry system/or and pulping technology) been expanded?	<ul style="list-style-type: none"> <li>• Has the new model of agroforestry system carried out in a model community?</li> <li>• How much has the project contributed to the improvement of the new model of agroforestry system to rural communities?</li> </ul>	Compare the newly model with the previous reports	<ul style="list-style-type: none"> <li>• Project Report</li> <li>• Experimental data</li> </ul>	<ul style="list-style-type: none"> <li>• KAPI</li> <li>• Faculty of Forestry</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Interviews</li> </ul>
2. Has the new model of agroforestry system introduced into the rural communities in Thailand?	<ul style="list-style-type: none"> <li>• To what extent the new model of agroforestry system has been introduced?</li> <li>• Has the KAPI expanded the new model to other fields?</li> </ul>	Describe the results of discussion with all concerned agencies	<ul style="list-style-type: none"> <li>• Project Report</li> <li>• Seminar/ training report</li> <li>• Annual plan</li> <li>• Future plan</li> </ul>	<ul style="list-style-type: none"> <li>• KAPI</li> <li>• Faculty of Forestry</li> <li>• Trainees who participated in seminar/training courses provided by KAPI</li> <li>• Bank for Agriculture and Agricultural Cooperatives</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Questionnaire survey</li> <li>• Interviews</li> </ul>

<b>IMPACT</b>					
<b>Evaluation Questions</b>		<b>Achievement Criteria/Measures</b>	<b>Data Needed</b>	<b>Data Source</b>	<b>Data Collection Methods</b>
<b>Main Questions</b>	<b>Sub Questions</b>				
3. Has the project contributed to improve institutional capacity of the implementing agency?	<ul style="list-style-type: none"> <li>• Are the trained staff sufficient for the knowledge on the new model of agroforestry system?</li> <li>• How much has the project improved knowledge and technology of KAPI's staffs regarding new model of agroforestry system?</li> </ul>	Describe the result of discussion with all concerned agencies and counterparts	<ul style="list-style-type: none"> <li>• Training delivery to counterparts</li> <li>• Change in agroforestry system</li> </ul>	<ul style="list-style-type: none"> <li>• KAPI</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Questionnaire survey</li> <li>• Interviews</li> </ul>
4. Are there any positive or the negative changes resulted from the project in besides what were originally intended?	<ul style="list-style-type: none"> <li>• What are positive and negative effects of the project?</li> <li>• What are the gains from the project?</li> </ul>	Describe the result of discussion with all concerned agencies and counterparts		<ul style="list-style-type: none"> <li>• KAPI</li> <li>• Faculty of Forestry</li> <li>• KURDI</li> <li>• IFRD</li> <li>• Trainees who participated in training courses provided by KAPI</li> <li>• BAAC</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Questionnaire survey</li> <li>• Interviews</li> </ul>
5. Are there any external factors affected the achievement of the Project Overall Goal?	<ul style="list-style-type: none"> <li>• Are there any changes in the government policy?</li> <li>• What events after the project termination did influence the project's goals?</li> </ul>	Describe the result of discussion with KAPI, Faculty of Forestry	<ul style="list-style-type: none"> <li>• Government's policy</li> </ul>	<ul style="list-style-type: none"> <li>• KAPI</li> <li>• Faculty of Forestry</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Interviews</li> </ul>

<b>SUSTAINABILITY</b>					
<b>Evaluation Questions</b>		<b>Achievement Criteria/Measures</b>	<b>Data Needed</b>	<b>Data Source</b>	<b>Data Collection Methods</b>
<b>Main Questions</b>	<b>Sub Questions</b>				
1. Has the KAPI been maintaining the new model of agroforestry system and/or pulping technology?	<ul style="list-style-type: none"> <li>• Has the technologies on biological processes of the agroforestry system been continued to develop?</li> <li>• Has the clean pulping technology for small scale pulp mill been continued to develop?</li> <li>• Has the enzyme technology been continued to develop?</li> <li>• Has the utilization and environmental management technology for pulping wastes and plant material residues been continued to develop?</li> <li>• Has the bio-pulp technology been continued to develop?</li> </ul>	Describe the result of discussion with all concern agencies	<ul style="list-style-type: none"> <li>• Research paper</li> </ul>	<ul style="list-style-type: none"> <li>• KAPI</li> <li>• Faculty of Forestry</li> <li>• Faculty of Agriculture</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Questionnaire survey</li> <li>• Interviews</li> </ul>

<b>SUSTAINABILITY</b>					
<b>Evaluation Questions</b>		<b>Achievement Criteria/Measures</b>	<b>Data Needed</b>	<b>Data Source</b>	<b>Data Collection Methods</b>
<b>Main Questions</b>	<b>Sub Questions</b>				
2. Has the financial status of KAPI been sustained?	<ul style="list-style-type: none"> <li>• Is the research activities of KAPI supported by the Kasetsart University?</li> <li>• Does KAPI secured necessary financial and human resources for continuing the research activities?</li> <li>• How many counterparts have been still working related to the project?</li> <li>• Has Kasetsart University allocated a sufficient budget for repairing and replacing the laboratory equipments?</li> <li>• Is there additional recruitment of the staff?</li> <li>• Can KU do some maintenance the provided equipment?</li> <li>• Is it possible to make equipment repairing at local agents?</li> </ul>	Describe the result of discussion with all concern agencies	<ul style="list-style-type: none"> <li>• Budget Allocation of KU</li> <li>• Budget of KAPI</li> <li>• Budget of KURDI</li> <li>• Personnel recruitment plan</li> </ul>	<ul style="list-style-type: none"> <li>• KU</li> <li>• KAPI</li> <li>• KURDI</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Questionnaire survey</li> <li>• Interviews</li> </ul>
3. What are the factors contributing to or inhibiting the projects outcomes?	<ul style="list-style-type: none"> <li>• What are the obstacles of your work?</li> </ul>	Describe the significant changes and enquire its reasons	<ul style="list-style-type: none"> <li>• Policy &amp; structural change</li> </ul>	<ul style="list-style-type: none"> <li>• KAPI</li> <li>• Faculty of Forestry</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Questionnaire survey</li> <li>• Interviews</li> </ul>

<b>SUSTAINABILITY</b>					
<b>Evaluation Questions</b>		<b>Achievement Criteria/Measures</b>	<b>Data Needed</b>	<b>Data Source</b>	<b>Data Collection Methods</b>
<b>Main Questions</b>	<b>Sub Questions</b>				
4. Are there any other financial support in this project after the project termination?	<ul style="list-style-type: none"> <li>• What are those financial supporters?</li> <li>• How much budget is available?</li> </ul>	Describe the result of discussion with KAPI and all concerned agencies	<ul style="list-style-type: none"> <li>• Budget allocation</li> </ul>	<ul style="list-style-type: none"> <li>• KAPI</li> <li>• Bank for Agriculture and Agricultural Cooperatives</li> </ul>	<ul style="list-style-type: none"> <li>• Literature/ document search</li> <li>• Interviews</li> </ul>

## Annex 3

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### *Evaluation Questions and Its Results*

**Project Title: Ex-post Evaluation on the Research Project for Higher Utilization of Forest and Agricultural Plant Materials in Thailand**

<b>IMPACT</b>		
<b>Evaluation Questions</b>		<b>Results</b>
<b>Main Questions</b>	<b>Sub Questions</b>	
1. Has the new model of agroforestry system (agroforestry system/or and pulping technology) been expanded?	<ul style="list-style-type: none"> <li>Has the new model of agroforestry system (agroforestry system/or and pulping technology) carried out in a model community?</li> </ul>	KAPI attempted to extend the model by conducting training courses and workshops to transfer technologies and research results. The training courses and workshops have been periodically conducted since 2002 until present. However, it could be observed that the rural communities tend to chiefly accept just some parts of the model while neglecting the parts on paper mulberry plantation and the production of raw materials from paper mulberry. The reasons are; (1) The economic situation has drastically changed from economic crisis when project implementation to recovery at present. The interest in paper mulberry has decreased among farmers and (2) People could find paper mulberry in the forest.
	<ul style="list-style-type: none"> <li>How much has the project contributed to the improvement of the new model agroforestry system to rural communities?</li> </ul>	KAPI has conducted totally 16 training courses and workshops to transfer technologies and research results to personnel in the paper mulberry pulp/paper industry since Aug. 2002 until present. 647 trainees have acquired knowledge and technology from these training courses and workshops. The contents of the courses and workshops include general information on the situation of paper mulberry paper production, mass-propagation, the forest situation in Thailand and the advantages of paper mulberry cultivation, information on raw materials for the paper mulberry paper industry, chemical substances and waste management, etc.
2. Has the new model of agroforestry system introduced into the rural communities	<ul style="list-style-type: none"> <li>To what extent the new model of agroforestry system has been introduced?</li> </ul>	Some components of the model, namely pulp and paper production, marketing, waste management, and environmental protection, have been adopted and carried out by

<p>in Thailand?</p>		<p>communities and companies related to the paper industry. However, plantation activities are hardly observed at present. Now, a new model community is being established in the Phufah Development Center Project in Borkuar District, Nan Province, which is under the patronage of Her Royal Highness Princess Sirindhorn. KU has taken responsibility for 100 rai of land in the project, of which 10 rai has been allocated to KAPI for an agroforestry system model by planting paper mulberry with red beans since 2002. The tendency to adopt the full cycle of the agroforestry system model starting from plantation until selling products could be expected from communities in Phufah Project.</p>
	<ul style="list-style-type: none"> <li>• Has the KAPI expanded the new model to other fields?</li> </ul>	<p>KAPI has also conducted researches of other agricultural raw materials besides paper mulberry, such as pineapples, bananas, eucalyptus, bamboo, etc.</p>
<p>3. Has the project contributed to improve institutional capacity of the implementing agency?</p>	<ul style="list-style-type: none"> <li>• Are the trained staff sufficient for the knowledge on the new model of agroforestry system?</li> </ul>	<p>There has been sufficient knowledge of new agroforestry system model of the staff.</p>
	<ul style="list-style-type: none"> <li>• How much has the project improved knowledge and technology of KAPI's staffs regarding new model of agroforestry system?</li> </ul>	<p>The knowledge that counterpart gained from the project fairly enhanced the knowledge and technology in new agroforestry system model.</p>



Evaluation Questions		Results
Main Questions	Sub Questions	
4. Are there any positive or the negative changes resulted from the project in besides what were originally intended?	<ul style="list-style-type: none"> <li>What are positive and negative effects of the project?</li> </ul>	One of the advantages was that before starting the project, farmers sold thick and thin paper mulberry paper at the same price. After the pilot project was introduced, it was suggested that the price of thick paper should be higher than the thin kind due to the amount of raw materials used in the production. The project helped farmers to understand the mechanism of raw material costs and price and to increase the price of thick paper mulberry paper to be higher than that of thin paper mulberry paper.
	<ul style="list-style-type: none"> <li>What are the gains from the project?</li> </ul>	According to studies in the project, paper mulberry leaves contain quite a lot of protein (20%), which is similar to horse tamarind leaves used for poultry diet. However, due to some toxic substance in the horse tamarind leaves, it can supplement an animal's diet to merely 5%. In the case of paper mulberry, it can be dried and mixed with animal feed up to 20%. Therefore, the Thai Chicken Raisers Cooperative in Lamphoon placed orders with farmers in Phrae and Nan via the project for 5 tons/week of dried paper mulberry leaves at a price of 5,000 Baht/ton.
5. Are there any external factors affected the achievement of the Project Overall Goal?	<ul style="list-style-type: none"> <li>Are there any changes in the government policy?</li> </ul>	The government has set their main focus on grass-rooted people and supporting the OTOP policy, therefore the transfer of technology for paper mulberry paper to the rural communities has been supported by the government agencies.
	<ul style="list-style-type: none"> <li>What events after the project termination did influence the project's goals?</li> </ul>	The economic situation has drastically changed from the period of project implementation when the economic crisis occurred to the economic recovery at present. The interest in paper mulberry has declined since farmers tend to produce more economic crops and opportunities for other well-paid jobs are provided.

<b>SUSTAINABILITY</b>		
<b>Evaluation Questions</b>		<b>Results</b>
<b>Main Questions</b>	<b>Sub Questions</b>	
1. Has the KAPI been maintaining a new model of agroforestry system and/or the pulping technology?	<ul style="list-style-type: none"> <li>Has the technologies on biological processes of the agroforestry system been continued to develop?</li> </ul>	<p>KAPI conducted several projects for developing raw materials by selecting and developing paper mulberry strains, and for developing tissue culture techniques for other plants. The nursery utilized for agroforestry during the project is still being used as a plant nursery, which includes paper mulberry and pineapple principally for research on tissue culture for the development of pulp/paper.</p>
	<ul style="list-style-type: none"> <li>Has the clean pulping technology for small scale pulp mill been continued to develop?</li> </ul>	<p>For cleaner technology with respect to the chemical and mechanical pulping method for handmade and/or small scale mills, further research on technology of the alkali-oxygen pulping process, sulfite pulping process and other pulping processes is conducted, targeting the utilization of other plants such as Eucalyptus. This technology is efficiently applied in the SMEs dealing with not only paper mulberry but also other kinds of pulp/paper.</p>
	<ul style="list-style-type: none"> <li>Has the enzyme technology been continued to develop?</li> </ul>	<p>For enzyme technology, an application with other plants such as Eucalyptus bark and Kenaf targeting high-quality fiber is being developed.</p>
	<ul style="list-style-type: none"> <li>Has the utilization and environmental management technology for pulping wastes and plant material residues been continued to develop?</li> </ul>	<p>For waste management, KAPI has continued several projects concerning the waste management system in paper mulberry pulp/paper production, and the utilization of micro organism enzymes and photo catalyst/UV for color removal of waster waste management in the paper mulberry pulp/paper industry.</p>
	<ul style="list-style-type: none"> <li>Has the bio-pulp technology been continued to develop?</li> </ul>	<p>For bio-pulp technology, bio bleaching utilizing hydrogen peroxide is continuously conducted and the technique of utilizing hydrogen peroxide instead of chlorine is being transferred to several paper mulberry producing groups and industries.</p>

Evaluation Questions		Results
Main Questions	Sub Questions	
	<ul style="list-style-type: none"> <li>Has the post harvest technology been continued to develop?</li> </ul>	<p>For post harvest technology of paper mulberry bark, the research found that UV light is a form of radiation for killing microorganisms in stead of using chemical treatment which is commonly applied during storage and risky to workers at handmade paper mills. However, this post harvest technology is only in “Lab Scale”. The results need to be confirmed by conducting the research more in “Pilot Scale”.</p>
2. Has the financial condition of KAPI sustained?	<ul style="list-style-type: none"> <li>Are the research activities of KAPI supported by the Kasetsart University?</li> </ul>	KAPI has equal opportunity with other organizations in KU to propose research budgets to KURDI.
	<ul style="list-style-type: none"> <li>Does KAPI secured necessary financial and human resources for continuing the research activities?</li> </ul>	KAPI has been supported its annual budget from KU and other organizations.
	<ul style="list-style-type: none"> <li>How many counterparts have been still working related to the project?</li> </ul>	Most of the counterparts are still working in KU. Only a permanent staff and some temporary staffs have resigned.
	<ul style="list-style-type: none"> <li>Has Kasetsart University allocated a sufficient budget for repairing and replacing the laboratory equipments?</li> </ul>	The budget provided by KU is not sufficiency for the maintenance or purchasing high cost, new equipments.
	<ul style="list-style-type: none"> <li>Is there additional recruitment of the staff?</li> </ul>	KAPI is inclined to secure more staff for further research. It is likely to retrieve two staff members currently studying in Japan to be permanent staffs of KAPI <b>with in this year.</b>
	<ul style="list-style-type: none"> <li>Can KAPI and Faculty of Forestry do some maintenance the provided equipment <b>and machines?</b></li> </ul>	KAPI and Faculty of Forestry are able to maintain equipment and machines used on a daily basis. Most of the equipment is in good condition and well-maintained. The institutes also got cooperation from the Faculty of Engineering in repairing more sophisticated equipment and machines but still has to rely on outsourcing agents for highly sophisticated machines or in case of severe damage.

Evaluation Questions		Results
Main Questions	Sub Questions	
	<ul style="list-style-type: none"> <li>Is it possible to make equipment repairing at local agents?</li> </ul>	Most of the equipment can be repaired at the local agents. However, the repairing cost of some equipment is rather high. On the other hand, for some machines directly imported from Japan, there have been problems concerning the limited capacity and inadequate maintenance capability of Thai resources.
3. What are the factors contributing or inhibiting the projects outcomes?	<ul style="list-style-type: none"> <li>What are contributing factors of the project outcomes?</li> </ul>	The existence of equipment provided by JICA allows all personnel to conduct further research.
	<ul style="list-style-type: none"> <li>What are the obstacles of your work?</li> </ul>	The maintenance cost of some equipment is rather high.
4. Are there any other financial support in this project after the project termination?	<ul style="list-style-type: none"> <li>What are those financial supporters?</li> </ul>	KAPI has been supported by other organizations, such as MTEC, NRCT, in term of research, while in technology transfer, there had been support from KURDI for 3 years after the HUFA project termination. However, recently, there has been financial support from PPTC and BAAC.
	<ul style="list-style-type: none"> <li>How much budget is available?</li> </ul>	All the budgets depend on the number of researches conducted, whereas there is budget for technology transfer 300,000-1,700,000 Baht per year.

## Annex 4

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### *Questionnaire to Counterparts*

Questionnaire Sheet for Ex-post Evaluation of the Research Project for Higher Utilization of Forestry and  
Agriculture Plant Materials in Thailand (HUFA)

General

**for HUFA Project's Participation Thai Staffs (1996-2001)**

This questionnaire sheet is prepared to collect basic information for Ex-post Evaluation of HUFA project. The evaluation shall be conducted with JICA Project Cycle Management (JPCM) Method which evaluates the project objectively in order to draw some meaning recommendations and previous lessons for other similar projects in the near future. Because you are one of valuable HUFA Project's Participants (total 99 persons), which we would like to gather your outputs and your comments regarding HUFA after your participation.

Please write your name and institution/position

Name:	Institution:		
Position:	Tel:	Date:	/ /

Methods

The Questionnaire sheet shall consists of several questions which have several answers for your selection. Please

1. Read carefully each question.
2. Choose your answer by putting a circle on the item you choose.
3. Write reasons with simple sentences.

After finishing, please **FAX to 0-2937-0704 within 11 February 2548**. Thank you for your kind cooperation. If you have any questions, your questions are welcome. Ms.Nuengnam Tel. 0-1927-9579

**About Sustainability**

1. Are you still working in research related to HUFA project?

1. Yes
2. No If "No", please write reason:

2. **After participation HUFA Project**, whether your knowledge is improved?

1. Yes (a) A Little improved (b) Improved (c) Very much improved
2. No If "No", please write reason:

3. **After participation HUFA Project**, have you used the training knowledge in your daily work?

1. Yes (a) Little (b) Some (c) Very much
2. No If "No", please write reason:

4. What level does your HUFA related knowledge still valid?

- (a) Low (b) Medium (c) High (d) I don't know

5. Have you updated the training/research knowledge?

1. Yes by (a) Once a year (b) Once a month (c) Once a week
2. No If "No", please write reason:

<p>6. <b>After participation HUFA Project</b>, how do you update related research knowledge?                  (a) Join overseas training (b) Attend domestic seminar (c) Attend overseas seminar (d) Others.....</p>
<p>7. <b>After HUFA Project finished in 2001 or 2544</b>,                  Have you provided suggestion to private companies/communities/students by using acquired knowledge?                  1. Yes If "Yes", please select level                  (private companies) (a) Little (b) Some (c) Very much                  (communities/people) (a) Little (b) Some (c) Very much                  (students) (a) Little (b) Some (c) Very much                  2. No If "No", please write reason:</p>
<p>8. <b>After HUFA Project finished in 2001 or 2544</b>,                  Have you cooperated with other institutions in extending technology and research?                  1. Yes If "Yes", please select level                  (in institution/faculty) (a) Little (b) Some (c) Very much (d) Not at all                  (other institutions in KU) (a) Little (b) Some (c) Very much (d) Not at all                  (other government sectors) (a) Little (b) Some (c) Very much (d) Not at all                  (other academics in Thailand) (a) Little (b) Some (c) Very much (d) Not at all                  (Other Japanese academics) (a) Little (b) Some (c) Very much (d) Not at all                  (other overseas academics) (a) Little (b) Some (c) Very much (d) Not at all                  2. No If "No", please write reason:</p>
<p>9. <b>After HUFA Project finished in 2001 or 2544</b>,                  How many thesis/papers/publications, seminars, and manuals/guidelines have you contributed?                  (thesis/papers/publications) (a) 1-6 (b) 6-20 (c) &gt;21 (d) Not at all                  (seminars) (a) 1-6 (b) 6-20 (c) &gt;21 (d) Not at all                  (manuals/guidelines) (a) 1-6 (b) 6-20 (c) &gt;21 (d) Not at all</p>
<p>10. Do you have <b>any problem</b> in utilizing the knowledge you acquired through training and up to present jobs?                  1. Yes (a) Lack of budget (b) Lack of Equipment (c) Lack of personnel (d) Others.....                  2. No If "No", please write reason:</p>
<p>11. Do you think that HUFA Project have <b>positive impact/effect</b>?                  1. Yes, please specify:                   2. No, please write reason:</p>

12. Do you think that HUFA Project have **negative impact/effect?**

1. Yes, please specify:

2. No, please write reason:

13. Do you think that HUFA Project have **unintended impact/effect?**

1. Yes, please specify:

2. No, please write reason:

14. Since Overall Goal of HUFA Project: “The effectiveness of the new model of agroforestry system is verified through a verification study on a model community, and the model is introduced into the rural communities in Thailand”

How far has the overall goal been achieved?

(National Policy Aspect)      (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

(Institution Policy Aspect)      (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

(Financial Aspect)              (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

(Technical Aspect)              (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

15. Any lesson learned & recommendation to improve future JICA project in Thailand/other countries



16. What factors are contributing or inhibiting the project effects or sustainability?

Contributing factors

(Policy Aspect)

(Institution Policy Aspect)

(Financial Aspect)

(Technical Aspect)

(Human Resources Aspect)

(Others)

Inhibiting factors

(Policy Aspect)

(Institution Policy Aspect)

(Financial Aspect)

(Technical Aspect)

(Human Resources Aspect)

(Others)

## Annex 5

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### *Questionnaire to Counterparts Who Received Overseas Training*

Questionnaire Sheet for Ex-post Evaluation of the Research Project for Higher Utilization of Forestry and  
Agriculture Plant Materials in Thailand (HUFA)

General

**for Overseas Training of Thai Staffs in JAPAN (1996-2001)**

This questionnaire sheet is prepared to collect basic information for Ex-post Evaluation of HUFA project. The evaluation shall be conducted with JICA Project Cycle Management (JPCM) Method which evaluates the project objectively in order to draw some meaning recommendations and previous lessons for other similar projects in the near future. Because you are one of valuable HUFA Project Input human resources on getting training in Japan (total 15 persons), which we would like to gather your outputs and your comments regarding HUFA after you have got training and after the project is terminated.

Please write your name and institution/position

Name:	Institution:		
Position:	Tel:	Date:	/ /

Methods

The Questionnaire sheet shall consists of several questions which have several answers for your selection. Please

1. Read carefully each question.
2. Choose your answer by putting a circle on the item you choose.
3. Write reasons with simple sentences.

After finishing, please **FAX to 0-2937-0704 within 11 February 2548**. Thank you for your kind cooperation. If you have any questions, your questions are welcome. Ms.Nuengnam Tel. 0-1927-9579

**About Sustainability**

1. Are you still working in research related to HUFA project?

1. Yes
2. No If "No", please write reason:

2. **After overseas training in Japan**, whether your knowledge is improved?

1. Yes (a) A Little improved (b) Improved (c) Very much improved
2. No If "No", please write reason:

3. **After overseas training in Japan**, have you used the training knowledge in your daily work?

1. Yes (a) Little (b) Some (c) Very much
2. No If "No", please write reason:

4. What level does your HUFA related knowledge still valid?

- (a) Low (b) Medium (c) High (d) I don't know

5. Have you updated the training/research knowledge?

1. Yes by (a) Once a year (b) Once a month (c) Once a week
2. No If "No", please write reason:

<p>6. <b>After overseas training in Japan</b>, how do you update related research knowledge? (a) Join overseas training (b) Attend domestic seminar (c) Attend overseas seminar (d) Others.....</p>																														
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<p>9. <b>After HUFA Project finished in 2001 or 2544</b>, How many thesis/papers/publications, seminars, and manuals/guidelines have you contributed?</p> <table> <tr> <td>(thesis/papers/publications)</td> <td>(a) 1-6</td> <td>(b) 6-20</td> <td>(c) &gt;21</td> <td>(d) Not at all</td> </tr> <tr> <td>(seminars)</td> <td>(a) 1-6</td> <td>(b) 6-20</td> <td>(c) &gt;21</td> <td>(d) Not at all</td> </tr> <tr> <td>(manuals/guidelines)</td> <td>(a) 1-6</td> <td>(b) 6-20</td> <td>(c) &gt;21</td> <td>(d) Not at all</td> </tr> </table>	(thesis/papers/publications)	(a) 1-6	(b) 6-20	(c) >21	(d) Not at all	(seminars)	(a) 1-6	(b) 6-20	(c) >21	(d) Not at all	(manuals/guidelines)	(a) 1-6	(b) 6-20	(c) >21	(d) Not at all															
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<p>10. Do you have <b>any problem</b> in utilizing the knowledge you acquired through training and up to present jobs?</p> <p>1. Yes (a) Lack of budget (b) Lack of Equipment (c) Lack of personnel (d) Others.....</p> <p>2. No If "No", please write reason:</p>																														
<p>11. Do you think that HUFA Project have <b>positive impact/effect</b>?</p> <p>1. Yes, please specify:</p> <p>2. No, please write reason:</p>																														

12. Do you think that HUFA Project have **negative impact/effect?**

1. Yes, please specify:

2. No, please write reason:

13. Do you think that HUFA Project have **unintended impact/effect?**

1. Yes, please specify:

2. No, please write reason:

14. Since Overall Goal of HUFA Project: “The effectiveness of the new model of agroforestry system is verified through a verification study on a model community, and the model is introduced into the rural communities in Thailand”

How far has the overall goal been achieved?

(National Policy Aspect)      (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

(Institution Policy Aspect)      (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

(Financial Aspect)              (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

(Technical Aspect)              (a) Low              (b) Medium              (c) High              (d) I don't know

If “I don't know” please explain reason:

15. Any lesson learned & recommendation to improve future JICA project in Thailand/other countries

16. What factors are contributing or inhibiting the project effects or sustainability?

Contributing factors

(Policy Aspect)

(Institution Policy Aspect)

(Financial Aspect)

(Technical Aspect)

(Human Resources Aspect)

(Others)

Inhibiting factors

(Policy Aspect)

(Institution Policy Aspect)

(Financial Aspect)

(Technical Aspect)

(Human Resources Aspect)

(Others)

## Annex 6

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### *Questionnaire to Trainees for Technology Transfer*



**Questionnaire Sheet for Evaluation of Training Program**  
**“Transfer of Technology for Pulp Industry and Mulberry Paper”**

**Name:**

**Position:**

**Name of Your Organization/Establishment/Farmer Group:**

**Address:**

**Telephone:**

**Facsimile:**

This questionnaire sheet is to be used in the evaluation of the above-mentioned training program during ..... at ..... The training was a part of the project in collaboration with Japan International Cooperation Agency (JICA). Therefore, your answers and comments will be valuable reference material for improving the training and JICA's project in the future.

**This questionnaire has 2 pages. Please fill and send back to the Evaluation Team at facsimile No. 0-2937-0704 by Friday, 11 February, 2005. In case you are inconvenience to reply by fax, please send back by post mail where the envelope and stamp are attached herewith.**

1. Does your work is related to mulberry paper?  
 Yes, I am an expert/government officer and need knowledge for dissemination.  
 Yes, I am a private manufacturer.  
 Yea, I am in a paper mulberry group  
 Yes, I am a product designer.  
 No, not at all.
2. After the Training, do you think you have gained more knowledge regarding paper mulberry manufacturing or not?  
 Same as before  
 A little bit increased.  
 Average increased  
 Much increased  
 I don't know
3. Do you utilize the knowledge you have gained from the Training in your own work?  
 Never use  
 Sometimes  
 Often use  
 Always
4. Do you think the Training is practical to your work?  
 Not at all  
 A little bit  
 Fairy  
 Very much



5. What advantages do you get from this Training? (can choose more than 1 answer)
- Enhancing incomes
  - Supporting environment
  - Promoting effective productivity
  - Nothing
6. Do you face any problem regarding utilizing knowledge and skills you have gained from the Training?
- 6.1 Yes, (can choose more than 1 answer)
- Lacking of equipments
  - Lacking of labors
  - Lacking of capital
  - Others, (please, specify).....
- 6.2 No, not at all. (please, elaborate).....
7. In your opinion, what should be added in the Training?
- Production and design of paper mulberry products
  - Marketing of paper mulberry papers and other products
  - Foreign technology in paper mulberry papers manufacturing
  - Tissues of other plants beyond paper mulberry
  - Others:.....

### **Thank you for your cooperation**

Any further opinions or suggestions regarding the Paper Mulberry Training, Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI), or JICA, please write down in the provided spaces.

#### **Opinions/Suggestions**

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