A GLOBAL STRATEGY FOR INDONESIAN GAMBIER AGRO - INDUSTRY DEVELOPMENT

E. Gumbira-Sa'id
Department of Agro-industrial Technology, Faculty of Agricultural Technology and Engineering, and Graduate Program of Management and Business, Graduate School, Bogor Agricultural University, Bogor, Indonesia. Tel/Fax: +62251621974 (egum@mma.ipb.ac.id)

Khaswar Syamsu
Department of Agro-industrial Technology, Faculty of Agricultural Technology and Engineering, Bogor Agricult ural University, Bogor, Indonesia (khaswars@yahoo.com)

Etik Mardliyati
Agency for The Assessment And The Application of Technology, and University of Al Azhar Indonesia, Jakarta, Indonesia (etikmard@yahoo.com)

Alexie Herryandie Bronto Adi
Faculty of Engineering, University of Andalas, Padang, Indonesia (alexie@telkom.net)

Nur Afni Evalia
Research Assistant in Agribusiness, alumni of the Graduate Program of Management and Business, the Graduate School, Bogor Agricultural University, Bogor, Indonesia (evalia.37@mma.ipb.ac.id)

ABSTRACT

Despite the fact that Indonesia is the main gambier producer in the world, a study on gambier (Uncaria gambier Roxb) agro-industry development in facing global business challenges and opportunities found that simple technology of gambier processing has not improved for more than 150 years, causing low production capacity and low quality of exported gambier products. Almost all of the high added values of gambier from trading and products diversifications are enjoyed by other countries, especially India. Therefore, some strategies to improve process technologies and introduction of higher added value products h for in Indonesia are proposed to increase national income from gambier domestic users and from exports.

INTRODUCTION

Gambier is one of the most important estate commodities in Indonesia, especially in West Sumatera Province and with Lima Puluh Kota Regency as the main producer. Since the colonial period, Indonesian gambier production has been oriented to the export market, while gambier domestic consumption has been limited.

In international trade, gambier is included into the group of "Tanning, dyeing extracts, tannins, derivatives, and pigments" with HS code 32. Furthermore, among the products with HS code 32, gambier which has HS code 320190100 is the main export product that

contributes more than 99 percent of exports in the group of HS Code 3201 (Vegetable tanning extracts nes, tannins, salts, and derivatives).

In 2008, total exports and imports of Indonesia were USD 137.02 billion and USD 129.20 billion respectively. Among the various groups classified as other products, the group with HS code 32 contributed USD 264.85 million (0.19 percent) for exports and USD 794.28 million (0.61 percent) for imports of Indonesia in that year (CBS, 2009). This indicates that Indonesia has been exporting gambier and other products at HS 32 code in the form of raw materials, while the imported HS 32 products, are in the form of higher value added HS 32 products. The export development of raw gambier (Appendix A) products from 2006 to 2008 is presented in Table 1. From this table, it can be seen that the volume and the value of gambier exports have been increasing, altogether with an increase of the average price of gambier, indicating that world gambier demand continues to increase to fulfil the increasing needs of down-stream gambier products for the health, cosmetics and chemical industries (Gumbira-Sa'id et al., 2009).

TABLE 1: EXPORT DEVELOPMENT OF INDONESIAN GAMBIER , 2006-2008.

Year	Volume (kg)	FOB Value (USD)	Average price (USD/kg)
2006	7,975,891	8,281,991	1.04
2007	13,589,694	22,871,209	1.68
2008	16,465,264	33,581,647	2.04

Source: CBS (2007); CBS (2008) and CBS (2009)

Even though Indonesia has been recorded as exporting raw gambier since 1850's, Indonesia's bargaining position in international trade has been weak and the selling price of gambier has been determined totally by the importing countries, especially India. This has happened because Indonesia has a limited number of countries as gambier export destinations. India, Singapore and Malaysia have been long time buyers of Indonesian raw gambier products (Appendix B). While the People's Republic of China (PRC)is recorded as a relatively new buyer, together with Australia, Republic of Korea, France, Italy, etc. This is not only true for gambier, but also happens withother products of HS code 3201, such as beetle nuts, wattle tannin, and quebracho. The proportion of Indonesian exports destinations to ten countries can be seen in Appendix C. As much as 92.69 percent of Indonesian export value for products with HS code 3201 during 2007-2008 was exported to India.

High dependency of the ambier market to only limited to destination countries, especially India which occurs because Indonesia has been exporting gambier in the form of raw gambier products with low quality and high variability. Gambier production activity conducted by micro level processors using traditional technology is the most important factor that makes Indonesian gambier unable to confirm with the standard of high quality gambier products. As a consequence, the demands of high quality gambier products from some new importing countries cannot be fulfilled. Therefore, to strengthen Indonesian gambier agro-industry in the future, it is necessary to formulate a strategic plan based on considerable and in-depth research on the actual problems of the Indonesian gambier agro-industry.

The aims of the study are to map present conditions of Indonesian gambier agro-industry development and to formulate a strategy for the development of Indonesian gambier agro-industry in the future. Mapping present conditions of gambier agro-industry is comprised of a technology audit and a SWOT analysis of Indonesia's gambier business and several important gambier importing or exporting countries, namely India, Singapore, PRC, and Malaysia. The comparisons of SWOT analysis of the gambier business in several countries is done to analyze the comparative benefits of Indonesian gambier business and to propose the strategic alternatives to be undertaken.

METHODOLOGY

This study commenced by mapping the current conditions of Indonesian gambier agro-industry through a technology audit and a SWOT analysis, involving 18 units of small scale gambier processors, three regional gambier traders (collectors), three exporters of gambier products, and three units of Indian gambier leaves processors. In addition, SWOT analysis was also conducted to compare Indonesian gambier business conditions with several most important gambier importing and exporting countries, namely India, Singapore, PRC, and Malaysia. The results are used as a basic consideration for the formulation of a strategy for the development of Indonesian gambier agro-industry in the future.

Technology Audit of Indonesian Gambier Agro-industry

The aim of the technology audit is to identify the state of the art of technology used in the gambier processing, based on indicators of technology transformation and indicators of technology capabilities according to Kelessidis (2000). The indicators of technology transformation assesments have been completed in four categories, namely technoware, humanware, infoware and orgaware. The assessment of indicators of technology capabilities involves operative capability, acquisitive capability, supportive capability and innovative capability (Ramanathan, 1993).

The SWOT Analysis of the Indonesian Gambier Agro-industry

The aim of the SWOT analysis of Indonesian gambier agro-industry is to identify the key internal and external factors that are important in achieving objectives. The internal factors are viewed as strengths or weaknesses depending upon their impact on the organization's objectives. The external factors include macroeconomic matters, technological change, legislation, and socio-cultural changes, as well as changes in the marketplace or competitive position (David, 2007).

Formulation of Strategy Alternatives for the Development of Indonesian Gambier Agro-industry

The SWOT strategy is formulated by mapping every factor as internal strategic factors (strengths and weaknesses) to the external strategic factors (opportunities and threats). These strategies are grouped into four categories, namely strengths-opportunities (SO) strategy, strengths-threats (ST) strategy, weaknesses-opportunities (WO) strategy and weaknesses-threats (WT) strategy (David, 2007). With this method, similar strategies in those four quadrants could be found. In the next steps, all of the strategy alternatives based on SWOT

analysis are grouped again to get some strategy alternatives that are used to develop the Indonesian gambier agro-industry in the future

Determination of the Strategy Priority to Develop Indonesian Gambier Agro-industry

Following strategy alternatives formulation, the strategies to develop Indonesian gambier agro-industry in the future are ranked. This step is done using the Analytical Hierarchy Process which starts with the formulation of criteria/sub-criteria to be used in comparing the strategy alternatives to each other (Saaty, 1980). Using pair-wised comparison, the weight of each criteria/sub-criteria is determined. Further, pair-wised comparison is conducted again to score each strategy for each criteria/sub-criteria. From this step, the strategy priority to be adopted is determined.

RESULTS AND DISCUSSION

Technology Audit of the Indonesian Gambier Agro-industry

The stakeholders in Indonesian gambier agro-industry are micro and small scale gambier processors, collectors (regional traders), and the exporter companies. The micro and small scale gambier processors are gambier producers who extract gambier and process it from leaves of *Uncaria gambier*. They supply raw gambier blocks to the traders (collectors) until the gambier is exported by the export companies. Therefore, the technology audit for Indonesian gambier agro-industry is done through studying the various activities undertaken and the technology used by those stakeholders. As a comparison, the technology used by the gambier leaves processor factories (three plants) belonging to an Indian company located in Lima Puluh Kota Regency and Pesisir Selatan Regency in West Sumatra Province, and Kampar Regency in Riau Province are also evaluated.

The first step in the technology audit is studying each of the process stages from the gambier leaves picking in the farm until the gambier blocks are exported to the destination countries. The technology used in each gambier production system is presented in Appendix D.

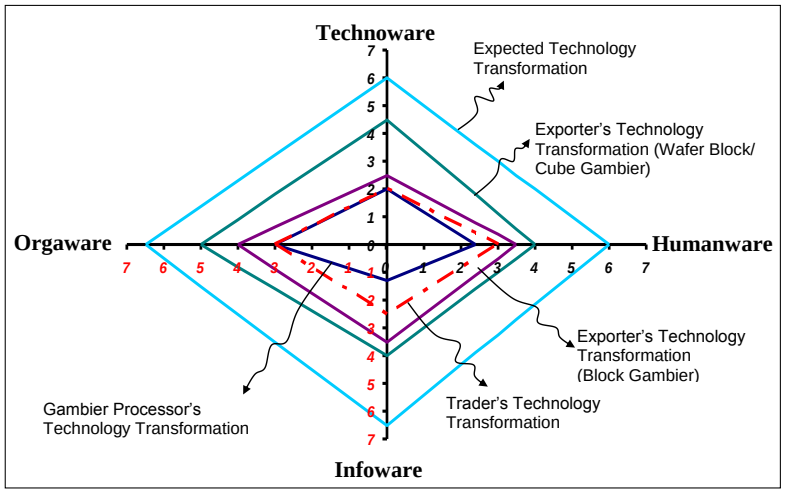
From Appendix D, it can be seen that almost all of the production and handling activities are done manually and use simple technologies. These simple technologies used has become the most important weakness of Indonesian gambier agro-industry, beside the dominance of India in controlling the gambier price in the international market. The evaluation results for the technology transformation indicators are presented in Figure 1, while the results for technology capability indicators are presented in Figure 2. Detailed results for this technology audit are presented in Appendix E.

In Figure 1, it can be seen that for the four technology transformation indicators (technoware, infoware, humanware and orgaware), all stakeholders have the technology state of conditions which have to be improved to achieve the expected technology level. It is also found that the micro and small scale gambier processors (the farmers) need the highest level of improvement to achieve the technology level expected (its tetragon has the farthest distance to the expected technology indicators tetragon). This means that the gambier stakeholders including the government have to give most effort to technology improvement needed to

enhance the technoware, humanware, infoware and orgaware conditions for the micro and small scale gambier processors.

FIGURE 1: INDICATORS OF TECHNOLOGY TRANSFORMATION FOR EACH OF GAMBIA AGRO-INDUSTRY STAKEHOLDERS

(micro and small scale processors, regional traders and two kinds of exporters, i.e. wafer block gambier and cube gambier versus block gambier)



Improvement efforts for the micro and small scale gambier processors will face great challenges since in the supply chain of gambier agro-industry, the micro and small scale processors who act as suppliers for all of the chain above it, consist of a large number of stakeholders. Therefore, technology improvement at the micro and small scale processors will need a large amount of funds. But, if the improvements succeed, it can give great benefit for the long-term gambier agro-industry sustainability. Another way to improve their technology is the use of mobile gambier processing units which can be used together by several farmers, so the costs of investment can be reduced (Herryandie et al.., 2010). Technology improvement in these micro and small scale processors will directly improve the production capability and the quality of gambier produced which will also give positive impact to the handling, transportation and processing stages at the subsequent stakeholders in the gambier supply chain.

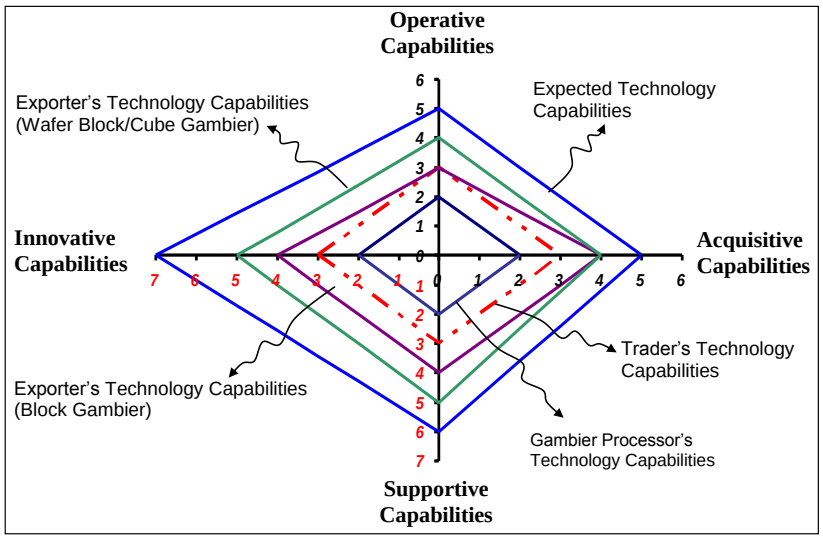
On the other hand, technology improvement in the gambier exporter's level is the easiest task to be undertaken, even though its success will only be enjoyed by the exporters, while the farmers will receive no financial benefit from this improvement. In fact, this can make the exporters and the collectors to maintain the farmers/processors to produce low quality gambier in order to keep the gambier price low. Next, since the exporters have a relatively large scale of business and there are only a few exporters, the technology improvement at this exporter level needs relatively low investment cost compared with that of the technology improvement at each of the micro and small scale gambier processors, so the government tends to select this alternative.

From Figure 2, it can be seen that all of the tetragons for each stakeholder lay in the tetragon of expected technology capability (they cross the four axes at lower scores than the expected

technology capability). This figure indicates that there is an identical result with the evaluation of transformation technology indicators (Figure 1), as it means that all stakeholders in the gambier agro-industry have lower technology capabilities than the expected level for each of the technology capability indicators (operative capability, acquisitive capability, supportive capability and innovative capability).

FIGURE 2: INDICATORS OF TECHNOLOGY CAPABILITIES FOR EACH GAMBIER AGRO-INDUSTRY STAKEHOLDER

(micro and scale processors, regional traders and two kinds of exporters, i.e. wafer block gambier and cube gambier versus block gambier)



From figure 2, it is also known that the micro and small scale processors' tetragon lay in the center and subsequently the outer tetragons are the collectors' tetragon, the exporters' tetragon (for the block gambier product) and the exporters' tetragon (for the cube gambier and wafer block gambier products). The exporters' technology capability for the cube gambier and wafer block gambier has the highest score, but it is still lower than the expected technology capability level.

From Figures 1 and 2, it can be concluded generally that the technology transformation and the technology capability in the gambier agro-industry stakeholders have to be improved. Since there are so many stakeholders involved in gambier agro-industry, along with any other improvement, human resources improvement is certainly required. Without the human resources improvement, whatever the strategy applied, it will not have any significant impact on the strengthening of the Indonesian gambier agro-industry .

The SWOT Analysis for Indonesia and Some Important Gambier Importing/Exporting Countries

The SWOT analysis and comparison between each country shows that Indonesia has excellence in the raw material availability and potential expansion of gambier estates. On the other hand, India has superiority in terms of market domination and technology capability, Singapore is excellent in financial support and experience in distribution and transportation,

Malaysia has a potential capability to expand their gambier estates while the PRC is well-known for its herbal medicine industry. The detailed results of SWOT analysis are presented in Table 2.

TABLE 2: The SWOT ANALYSIS FOR DIFFERENT COUNTRIES OF GAMBIER TRADERS AND DOWNSTREAM PRODUCT PROCESSORS (Note: In case of Indonesia, the SWOT analysis results are presented in Table 3)

SWOT COMPONENTS	INDIA	SINGAPORE	MALAYSIA	PEOPLE'S REP. OF CHINA
STRENGTH	• Gambier Import is free from tax • Have extensive networking of gambier suppliers in Indonesia (Gambier collection through subsidiary companies) • Importing from Indonesia is done in gambier blocks (easy to handle) • Have sophisticated gambier processing technology • Control broad markets for gambier • Control imports and exports of Gambier products worldwide • Have vast gambier products development	• Having long experience in gambier trading (since 1850's) • Have excellent distribution and transportation hub worldwide • Have experience in undertaking gambier blocks reprocessing with higher quality • Financially strong	• Have gambier estates in Sarawak and Sabah • Have manufactured gambier products such as aphrosidiacs, pharmaceuticals and burn medicine • Have growing and good bio pharmacy industries	• Have many internationally patented down-stream products from gambier • Have good reputation for herbal and bio-nature products being marketed globally

SWOT COMPONENTS	INDIA	SINGAPORE	MALAYSIA	PEOPLE REP. OF CHINA
WEAKNESSES	Heavily dependant on gambier supplies from Indonesia Formally, do not have their own gambier plantations in Indonesia	Heavily dependant on gambier supplies from Indonesia Formally, do not have any subsidiary company in Indonesia	Gambier processor in Sarawak and Sabah still produce low quality of gambier	There is no suitable land for cultivation of *Uncaria gambier* in China
	There is no suitable land for the cultivation of *Uncaria gambier* in India			
OPPORTUNITY	Diversifications of gambier products as anti-ageing and other cosmetics uses	Have excellent R&D units for products diversifications (e.g. through Biopolis, Temasek holding etc.)	Malaysia vision to become global halal products hub	Have broad and diverse cosmetics and anti-ageing products
THREATS	Investment in Indonesia in gambier leaves drying could fail due to short supply of gambier leaves from Indonesian farmers Business competition on gambier products with China is increasing	Business competition on gambier products with India and China is increasing	Business competition on gambier products supplies with India, Singapore and China is increasing	Business competition of gambier products supplies with India, Singapore and Malaysia is increasing

Indonesian Gambier Agro-industry Development Strategy

From the SWOT analysis, some strategy alternatives for Indonesian Gambier Agro-industry in the future are formulated. These formulations are presented in Table 3. After the strategy alternatives in the four quadrants (SO, ST, WO and WT) had been studied thoroughly, they were then grouped into six categories as follows:

1. The strategy related to the government policy required for Indonesian gambier agro-industry development in the future
2. The strategy related to the gambier estate expansion for the gambier raw materials supplies to be guaranteed.
3. The Strategy related to the market expansion (domestic and exports) and the networking between the stakeholders in the gambier supply chains.
4. The strategy related to the quality improvement of gambier produced by the processors.
5. The strategy related to product development through reprocessing of raw gambier to gain high added value for gambier products.
6. The strategy related to technology development and gambier process engineering

Based on the six categories, six strategy alternatives for the Indonesian gambier agro-industry development in the future are formulated as follows:

1. Production process engineering improvement
2. Investment on Indonesian gambier research and development infrastructures
3. Gambier product diversification for the domestic market
4. Improvement of product's added value
5. Improvement of domestic use of gambier
6. Market expansion for gambier products to new importing countries.

Based on the consideration from local government in the production location center (Head of Lubuk Alai Region in Kapur IX District), government of Lima Puluh Kota Regency, Gambier Association, Gambier Traders and Exporters and academic expert, the criteria/sub-criteria for ranking the priority of those strategy alternatives are formulated as follows:

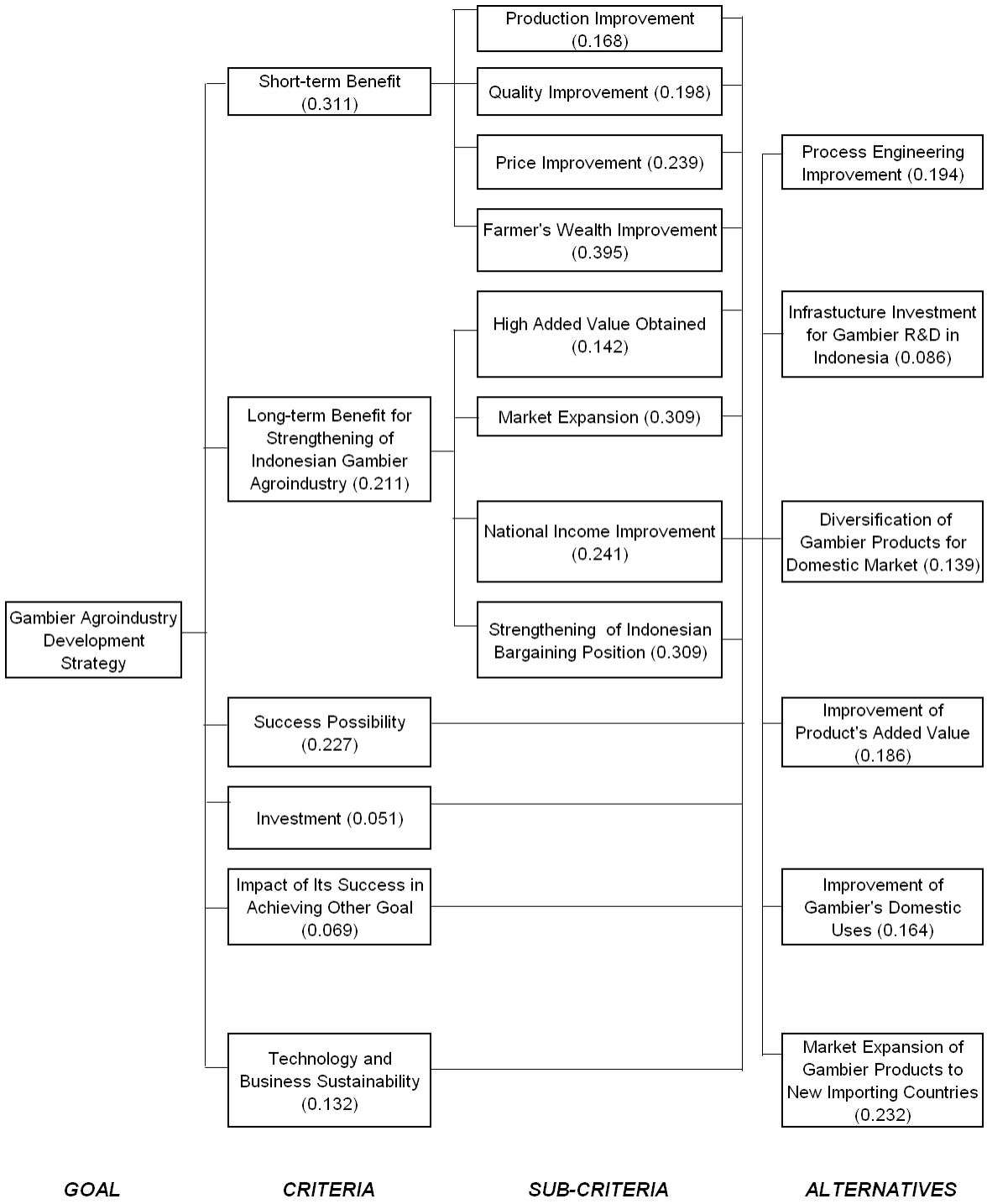
1. Short-term benefits
2. Long-term benefits for strengthening the Indonesian gambier agro-industry
3. Its impact for achieving other goals
4. Possibility of success
5. Investment needed
6. Sustainability of technology and business.

Using the Analytical Hierarchy Process, the strategy priority for gambier agro-industry development in the future is determined. The pair-wised comparison of each strategy alternative for every criteria/sub-criteria has been conducted based on the expert judgment. From the pair-wised comparison, the strategy for gambier agro-industry development is presented in Figure 3.

TABLE 3: STRATEGY ALTERNATIVES FOR THE DEVELOPMENT OF THE INDONESIAN GAMBIER AGRO-INDUSTRY BASED ON SWOT ANALYSIS

INTERNAL FACTORS / EXTERNAL FACTORS	**STRENGTHS**	**WEAKNESSES**
	1. Have vast suitable lands for *Uncaria gambier* cultivation in Sumatera island, 2. Have potentially suitable land to develop in new areas outside Sumatera, namely in Papua (Merauke) 3. Have long time experience in simple gambier processing 4. Globally known as the biggest producers of *Uncaria gambier* products 5. High commitment of Indonesian government to increase foreign exchange from gambier down-stream products	1. Technology of gambier processing at farmers level is still very traditional and inefficient 2. The quality of gambier blocks is low and varies from different producers 3. Have strong dependently on Indian buyers (Indian market) 4. Have low access to financial institutions 5. Gambier value-added in Indonesia is low 6. R&D in gambier products development is Indonesia is low
OPPORTUNITIES 1. Extensifying gambier production area to Papua 2. Technology processing improvement with gambier processing *mobile units* 3. Creation of domestic high value products from gambier, such as catechin and tannin-based products 4. Creating more domestic uses of gambier for food, health and cosmetic industries 5. Increasing use of gambier and catechin, tannin for batiks and skin tanning industries and also various pharmaceutical and cosmetics products	**SO STRATEGIES** 1. Extensifying suitable land cultivation for *U. gambier* to increase total gambier production 2. Intensifying the Transfer of technology to increase gambier productivity 3. Creating down-stream products processors to diversify gambier products for export 4. Establishing agribusiness partnerships between gambier farmers with domestic gambier processors	**WO STRATEGIES** 1. Utilizing domestic industries (users) to reduce dependency on the Indian market (W3;O4,O5) 2. Increasing science and technology to increase the quality of gambier products 3. Increasing integrated quality management for gambier agro-industry
THREATS 1. Development of substitute products of gambier (catechin and tannin from *Acacia catechu* and others 2. Environmental issues related to the cultivation of *U. gambier* at the land elevation of more than 40 %. 3. Gambier land conversion to other high value crops, such as oil palm, rubber and cacao 4. Gambier agribusiness is fully controlled by foreign players, especially from India	**ST STRATEGIES** 1. Government regulation for gambier land preparation (S5 ; T3) 2. Transformation of export from gambier blocks products to catechin and tannin 3. Mapping of suitable land cultivation for *U. gambier* (S1; T2) 4. Providing regulation to make better and fair gambier business in the country	**WT STRATEGIES** 1. Increasing R & D activities to innovate new gambier products for export (W5, W6; T4) 2. Increasing the quality of gambier to explore domestic uses, as well as more exports of gambier products. 3. Government regulation in facilitating access to financial institutions for the investment of down-stream products processors

FIGURE 3: DECISION HEIRARCHY IN STRATEGY FORMULATION FOR THE DEVELOPMENT OF INDONESIAN GAMBIER AGRO-INDUSTRY



It is obvious that the most important criteria in determining gambier agro-industry development strategy are short-term benefits (weight 0.311), success possibility (weight 0.277) and long-term benefits in the strengthening of Indonesian gambier agro-industry

(weight 0.211). Further, among various sub-criteria for short-term benefits, the sub-criteria improvement of the farmer's wealth and improvement of product price become the most important sub-criteria in strategy formulation (weight 0.395 and 0.239). The investment criterion has the lowest weight (0.059), since investment in business improvement is difficult to achieve. The high cost of investment will not be a limitation if the improvement can give higher economic benefits. In fact, the successful improvement will give direct financial returns for the strategy adopted.

The strategy priorities result by pair-wised comparison of each strategy alternative for every criteria/sub-criteria as presented in Table 3 with the description as follows:

1. Market expansion of gambier products to the new importing countries (score 0.232)
2. Improvement of production process engineering (score 0.194)
3. Improvement of product's added values (score 0.186)
4. Improvement of domestic uses of gambier (score 0.164)
5. Product diversification of gambier for the domestic market (score 0.137)
6. Investment on research and development infrastructure for gambier in Indonesia (score 0.086)

Therefore, the strategy recommended to be adopted is market expansion of gambier products to the new importing countries (score 0.232). This strategy should be adopted since market strengthening will support financial strengthening, technology improvement and new products development. To do this, the gambier quality improvement is urgently required, so is the creation of higher added value products.

Catechin product development is the main component in gambier becoming an improvement in the Indonesian gambier agro-industry and market expansion since large variations of products using catechin have been developed. As reported by some researchers, catechin can be used in the treatment of some diseases and disorders such as Alzheimer's disease (Castillo et al., 2002) and cancer (van Olphen et al ., 2007; Dorothy and Dorothy, 2004). Catechin can also be used for slimming (Kim et al., 2006), various supplement beverages (Yamamoto et al., 2006; Oishi et al.,, 2004) and skin care (American Catechin Research Institute, 2010).

Development of high value and useful catechin products in the Indonesian gambier agro-industry development has to be done since it can push the development of the gambier industry to the community. Development of gambier to produce catechin and tannin can give a 91.67 % and 83.81 % added value which means that the cost of raw material and all other processing costs are 8 % and 16 % of the catechin and tannin products' prices (Gumbira-Sa'id et al., 2009). Therefore, this development is highly profitable for Indonesian gambier agro-industry in the future.

Further, development of various catechin-using products will give new potential markets for gambier downstream products. Therefore, development of these downstream products will provide a chance to reach new markets such as pharmaceutical industries developed in many countries. The new markets will reduce the present high dependency of Indonesian gambier to certain countries.

To obtain these opportunities, intensive research and development activities in process engineering development and new product development are required. By applying this strategy, the quality and productivity problems of Indonesian gambier agro-industry can be overcome, so that Indonesia has better capability to fulfill customers' demands for gambier products in terms of quality, quantity and continuity.

The investment of research and development infrastructure strategy has the lowest priority (weight 0.086) because of not only the requirement of the physical facility for technology research and assessment is needed quickly but the more important requirement is the dissemination and implementation of many researches to the farmers and every stakeholder who can give feedback for the development of the Indonesian gambier agro-industry in the future. With strong cooperation between the government, gambier farmers, private coorporations, universities, and research and development institutions, continuous improvement of gambier agro-industry can be developed so that the gambier agro-industry can give maximum benefits for community economic development.

CONCLUSIONS

From this study, some conclusions can be drawn as follows:

1. In gambier international trading, Indonesia is excellent in raw material supply which does not belong to other countries. On the other hand, Indonesia has some weaknesses in technology and market acquisition, while India has excellence in technology capability and global market domination for the downstream products from gambier.

2. The low technology capability in gambier processing by the micro and small scale processors in Indonesia is related to the high dependency on India as it imports gambier in the form of raw gambier until the present time. On the other hand, limited financial capability makes that production activities in Indonesia occur using only simple technology.

3. To develop Indonesian gambier agro-industry in the future, the strategy to be adopted is market expansion to the new importing countries, which requires product quality improvement and development of new high-added value gambier products.

ACKNOWLEDGEMENTS

We would like to thank The Directorate General of Higher Education, Ministry of National Education of Indonesia for funding this study under the "Competitive Research Grant Program for National Excellence of Strategic Research on Oil Palm, Cacao and Gambier 2009". We also thank Mr. Aditya Hadiwijoyo for his technical assistance.

REFERENCES

American Catechin Research Institute. http://www.catechinskincare.com.

CBS. (2007). Ekspor 2006. Jakarta: Central Board of Statistics

CBS. (2008). Ekspor 2007. Jakarta: Central Board of Statistics

CBS. (2009). Ekspor 2008. Jakarta: Central Board of Statistics

Castillo, G.M. Paula Y.C., Joel AC., Beth P.N., Alan D.S. (2002). Catechins for the Treatment of Fibrillogenesis in Alzheimer's Disease, Parkinson's Disease, Systemic AA Amyloidosis and Other Amyloid Disorder. US Patent No. 2002/0151506 A1.

David, F. R. (2007). *Strategic Management: Concepts and Cases*. 11th ed. New Jersey: Pearson- Prentice Hall.

Dorothy,M and J.M.Dorothy. (2004). Compositions Based on Proanthocyanadin-Catechin Synergies for Prevention and Treatment of Cancer. US Patent No. 20040142048.

Gumbira-Sa'id,E. *et al*. (2009). Process Engineering Improvement, Products Development and Quality Improvement of Indonesian Gambier for Export: Case Study in Lima Puluh Kota Regency, West Sumatra. Final Report. Competitive Grant Program for National Excellence of Strategic Research on Oil Palm, Cacao and Gambier. Jakarta: Directorate General of Higher Education, Dept. of National Education.

Herryandie,A., E.Gumbira-Sa'id, K.Syamsu and Sukardi. (2010). Study on the Technology Improvement and Introduction to Increase Production and the Quality of Indonesian Gambier for Export. *Warta Kebijakan IPTEK dan Manajemen Penelitian*. Jakarta: Indonesian Institute of Sciences (LIPI) (*In press*).

Kelessidis, V. (2000). Technology Audit. Innoregio.
http://www.adi.pt/docs/innoregio_techn_audits.pdf

Oishi,S., K.Naito, Y.Matsui and Y.Ogura. (2004). Beverages Containing Catechin. US Patent No. 2004/0065207 A1.

Ramanathan, K. (1993). Application of Industrial Technology Indicators at Firm Level. *In* A Guide for Technology Management System. Vol. 1. Jakarta: Center for Analysis of Science and Technology Development (PAPIPTEK) and Indonesian Institute of Sciences (LIPI).

Saaty, T.L. (1980). *The Analytical Hierarchy Process*. New York: McGraw-Hill.

UN Comtrade. (2010). United Nation Commodity Trade Statistics Database.
http://comtrade.un.org.

Van Olphen,A., F.Herman, N.Show, Burdash and Roger. (2007). Catechin Adjuvants. US Patent No. 2007/0082073 A1.

Yamamoto,S., M.Iwasaki, N.Hosoya and E.Hoshino. (2006). Purified Product of Green Tea Extract and Packaged Beverage of High-Catechin Content with the Purified Product Mixed therein. US Patent No. 20060141119.

APPENDICES

APPENDIX A: The Amount and Values of Indonesian Gambier Exports (HS Code 3201901000) in the period of 2006-2008

Country of Destination	Weight (kg)			FOB Values (USD)		
	2006	2007	2008	2006	2007	2008
Australia	40,000			78,721		
Bangladesh	324,000	244,000	365,500	277,100	319,620	517,676
Philippines	88,000			5,500		
Hong Kong	1,610	34,500	26,999	2,508	114,010	72,305
India	6,712,037	12,221,456	15,044,577	7,030,879	20,824,144	31,587,822
Italy		40,250			56,375	
Japan	7,000	3,500	7,640	41,300	11,275	1,831
Malaysia	5,000	37,445	41,487	6,000	26,684	9,356
Nepal	250,000	375,000	232,000	366,509	604,824	378,643
Pakistan	499,294	444,980	554,732	328,822	638,366	753,963
France		100			150	
Republic of Korea		6,207			4,805	
Saudi Arabia	5,000			10,059		
Singapore	37,790	159,006	166,329	120,928	246,025	246,188
Sudan		11,250			2,813	
Taiwan	5,000	5,000		9,775	9,750	
Thailand	1,160	1,000		3,890	855	
United Arab Emirates			26,000			13,863
Yemen		6,000			11,513	
Total	7,975,891	13,589,694	16,465,264	8,281,991	22,871,209	33,581,647

Source: BPS (2007, 2008 and 2009)

APPENDIX B: THE APPEARANCE OF RAW GAMBIER PRODUCTS FOR EXPORT

(a: *Lumpang* Gambier, b: *Bootch* Gambier, c: Black Gambier Cube, d: Wafer Block, e: Brown Gambier Cube)

APPENDIX C: The Countries of Destination for Export of the HS Code 3201 Products in the period of 2007 - 2008

Export Destination Country	Export Values (FOB, US$)			Percentage (%)	Cumulative Percentage (%)
	2007	2008	2007-2008		
India	20,874,544	31,587,822	52,462,366	92.69	92.69
Pakistan	638,366	773,163	1,411,529	2.49	95.19
Nepal	604,824	378,643	983,467	1.74	96.92
Bangladesh	319,620	517,676	837,296	1.48	98.40
Singapore	253,945	246,201	500,146	0.80	99.29
Hong Kong	114,010	72,305	186,315	0.33	99.62
Malaysia	33,033	26,306	59,339	0.10	99.72
Italy	56,375		56,375	0.10	99.82
United Arab Emirates		33,810	33,810	0.06	99.88
People Republic of China	4,855	10,594	15,449	0.03	99.91

Source: UN Comtrade (2010)

APPENDIX D: Process Stages and Production Technology of Gambier at Various Stakeholders

Process Stages	Work Tools	Present State of Technology
PRODUCTION TECHNOLOGY OF GAMBIER AT MICRO AND SMALL SCALE PROCESSORS		
Gambier Leaves picking	Special knives *(Ani-ani)*	Manual
Transportation of leaves to the Processor	Rattan Basket	Manual (carry shoulder)
Compacting leaves for cooking	Cooking basket from metal or bamboo and nested ropes	Manual, (body weight)
Leaves Cooking	Metal vessel, Cemented stove	Manual, cooking processing is determined visually
Preparation for Pressing (Rolling)	Wooden stick	Manual (body weight)
Leaves Extraction	Hydraulic Press	Manual
Settling of leaves Extract	Wooden box	Manual settling
Gambier Extract Dewaterring	Plastic sack and sand load	Manual
Gambier Molding	Bamboo Mold (*Cupak*)	Manual
Sun Drying	Bamboo Tray	Manual
Packaging of Blocks Gambier	Plastic sack	Manual
PROCESS STAGE AT REGIONAL COLLECTORS (TRADER)		
Sun Drying of Blocks Gambier	Cemented Floor or Asphalted Road	Manual
Packaging of Blocks Gambier	Plastic Sacks	Manual
REPROCESSING STAGE AT GAMBIER EXPORTERS		
Gambier Blocks		
Blocks Gambier Receiving	Scale	Manual
Blocks Gambier Sorting and Grading	Hand Sorting	Manual
Reprocessing of Rejected Gambier Blocks		
• Resolving on Hot Water	Thermo resistant Plastic Sink	Manual
• Dewatering	Plastic Sack/ Metal Load	Manual
• Remolding of Gambier Blocks	Bamboo Molds	Manual
• Drying	Bamboo tray	Manual
Re-drying of Gambier	Cemented Floor	Manual
	Oven with electrical blower; oven burner fuelled by kerosene	Mechanized Motorized

APPENDIX D (*continue*)

Process Stages	Work Tools	Present State of Technology
Production of Cube Gambier and Wafer Blocks		
Resolving of Gambier Blocks on Hot Water	Metal Sink	Mechanized Motorized
Separation of Dirt	Metal Sink and Screener	Manual
Washing With Water (several times)	Metal Tanks	Manual / Mechanized
Molding of Gambier Paste	Wooden Mold, Metal Load	Manual
Cutting of Gambier	Knives	Manual
Drying	Oven with blower operated electrically; oven burner fuelled by kerosene	Mechanized Motorized
GAMBIER LEAVES FACTORY OF GT PLANTS		
Chopping of Gambier Leaves	Chopper	Mechanized, motorized
Drying of Chopped Gambier Leaves	Tunnel Dryer	Mechanized, motorized, Automatic Temperature Control
Milling	Mills	Mechanized, motorized

APPENDIX E: Scores of Technology Management Audit in Each Stakeholder of Gambier Agro-industry in Indonesia

No	Components Of Technology Management	ACTORS				Expected Technology State
		Gambier Processor of Micro and small scale Units	Trader/ Collectors	Exporters		
				Gambier Blocks	Gambier Blocks (PTA) and Wafer Blocks (CR)	
I	Indicators of Technology Transformation					
	• Technoware	2.0	2.0	2.5	4.5	6.0
	• Humanware	2.4	3.0	3.5	4.0	6.0
	• Infoware	1.3	2.5	3.5	4.0	6.5
	• Orgaware	3.0	3.0	4.0	5.0	6.5
II	Indicators of Technology Capability					
	• Operative Capability	2.0	3.0	3.0	4.0	5.0
	• Acquisitive Capability	2.0	3.0	4.0	4.0	5.0
	• Supportive Capability	2.0	3.0	4.0	5.0	6.0
	• Innovative Capability	2.0	3.0	4.0	5.0	7.0