

**RESEARCH, DEVELOPMENT AND APPLICATION OF NATIONAL
INNOVATION SYSTEM OF SCIENCE AND TECHNOLOGY FOR THE
DEVELOPMENT OF SUSTAINABLE OIL PALM AGRIBUSINESS IN
INDONESIA**

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ABSTRACT

Strong efforts of the government, private sector, farmers and other stakeholders in developing oil palm agribusiness in Indonesia has succeeded in placing Indonesia as the highest producer of palm oil in the world since 2007. However, global challenges have put a lot of pressure on the sustainability of oil palm agribusiness in Indonesia, due to the issues of climatic change, the worries of environmental degradation, and business rivalry from other vegetable oils producers. Therefore, a national innovation system that supports research, development and business networking for sustainable oil palm agribusiness has to be established in Indonesia.

This study was done to observe research and development activities within the framework of the national innovation system, and to find the networking of R&D and business activities among the national innovation systems' actors in the Indonesian oil palm agribusiness. Some methods were used in the study, namely assessment using questionnaires, focus group discussion and surveys on the relevant objects. Some experts, and oil palm agribusiness and agro industry practitioners were involved in the study, as well as postgraduate students pursuing Masters' and Doctoral degrees in Agribusiness management and Agro industrial technology. The results of the study show that the assessment's scores of the postgraduate students on the main elements of the national innovation system were higher than that of the experts and business practitioners. However, using the successful role of the Malaysian Palm Oil Board (MPOB) as a reference, the experts and business practitioners required that the Indonesian government give better political support in improving the education and R&D system, industrial system, providing an intermediaries research institution, and providing complete supra and special infrastructure. In the framework conditions, it was found that R&D promotion, institutional networking, availability of a business park or business cluster, as well as business ventures in developing sustainable oil palm agribusiness were still weak. The only good results of the assessment were found on the human resource development of oil palm, while the commercialization of R&D results, science and technology infrastructure and the availability of business incubators were not well established. Some R&D activities and business networking have been identified, in which, at the present, the Indonesian Oil palm Research Institute (IOPRI) plays as a main player, and which have R&D and business network linkages with government R&D and policy units, the R&D units of the private sector and big industry players, leading universities in both national and local levels, as well as with the national oil palm business associations are also important players.

Key Words: National Innovation System, research and development, business networking, sustainable oil palm agribusiness, focus group discussion.

INTRODUCTION

The fast development of the oil palm agribusiness in Indonesia in the last ten years, has led Indonesia to replace Malaysia as the highest producer of palm oil in the world since October 2007. In May 2009, IOPRI (2009) reported that Indonesia produced nearly 19 million tons of crude palm oil (CPO) from about 7.52 million hectares of oil palm plantation. In 2009, export of CPO and its derivatives became USD 12.3 billions (GAPKI, 2009), a figure which is much higher than it was in 2007, which was USD 7, 9 billions, and giving employment to more than 3.3 million workers, working both on and off farms (Info Sawit, 2009). In 2020, it is expected that Indonesia will produce 50 million tons of CPO (Minister of Industry RI, May, 2009).

The ambition to produce 50 millions tons of CPO by 2020 which was made in 2009, has attracted complaints and criticism from foreign parties, with specific reasons, among others, due to the risks of global warming, environmental degradation, and business competition from other vegetable oils. Ardiansyah, *et al.* (2009) outlined that the World Wildlife Fund is concerned with three key elements of land requirement for oil palm agribusiness, namely biodiversity, change in carbon stocks and land right issues.

There are several challenges in developing the oil palm agribusiness in the years to come, especially with regards to technology and business innovation, ecological risks, biodiversity, and poverty implication, as follows (Gumbira-Sa'id, 2008): (1) Environmentally friendly and considering the RSPO guidelines or protocols, (2) Transparency and auditing, (3) Complicated shareholders, (4) Global vision on global warming, (5) Unlimited capital for expansion, (6) Hyper competition, especially now in the Asian region, (7) Driven by scientific innovation, and (8) High flexibility in broad utilization of CPO as food, feed or fuel.

According to Sharif (2006), in general the network development of the national invention and innovation system of science and technology research, development and application can be approached using three essential innovation triangle linkages (R&D Units in the Public sector; R&D Units in the Academic Sector; and R&D Units in the Private Sector). There are six active intermediaries supporting the innovation triangle, namely (1) Design and Tool Engineering Agencies, (2) Intellectual Property Regulation Agencies, (3) Knowledge Networking Agencies, (4) Information Services Agencies, (5) Venture Capital Financing Agencies, and (6) Standardization and Certification Agencies (Gumbira-Sa'id, *et al.*, 2009).

This study is aimed at exploring research and development activities and business networking in oil palm agribusiness in Indonesia. In addition this study is also intended to explore activities in the production of sustainable palm oil which is compatible with the global needs of natural vegetable oils, and anticipates the concerns on global warming, environmental degradation and any other negative risks associated with the oil palm agribusiness development in the future.

RESEARCH METHOD

This study uses the descriptive research method. Descriptive research is used to obtain information about the current status of R & D and business network activities between all the National Innovation System (NIS) actors in the Indonesian oil palm agribusiness, especially in applying the innovations generated. This method involves a variety of techniques as described below.

a. *Desk Study*

This activity was conducted to study the existing policy and regulation which provides support to all network and partnership activities between the NIS actors; the existence of the elements in innovation triangle (R&D Units in the Public Sector; R&D Units in The Academic Sector; and R&D Units in the Private sector).

b. *Literature Review*

This activity was conducted to provide a good conceptual foundation related to the network of the NIS actors in the Indonesian oil palm agribusiness.

c. *Survey and Case Study*

A Survey was done to identify NIS development and R&D products application in West Java and Lampung Provinces oil palm plantations in Indonesia.

e. *Focus Group Discussion*

Focus Group Discussion was done in which six experts of the Indonesian Oil Palm Society (MAKSI; represented by three academics and three executive officers of private companies) were involved in the discussions in Bogor, Indonesia, and 13 experts, representing academia, government research institution and private company executives participated in the FGD in Lampung, to review the results of NIS elements assessment, and to explore more detailed information on the R&D networking in the Indonesian oil palm agribusiness.

f. *Data Collection Through Questionnaires*

16 respondents were involved in the assessment of the elements of NIS, they were eight experts and palm oil agribusiness (agro industry) practitioners in the country and eight postgraduate students pursuing Masters or Doctorate degrees in Agribusiness Management or Agro Industrial Technology at Bogor Agricultural University, Indonesia, and also academic staff at many universities. Data obtained from the questionnaire was about the assessment scores of the respondents on the success or the achievements of the NIS components, R&D development and institutions networking conditions, and R&D level in the national development based on R&D national programs. All the assessment scores were calculated to obtain the average scores from the respondent groups, to know the overall evaluation scores and to compare the evaluation scores from both respondent groups. For the purpose of analyzing the assessment scores of the achievement or the success of the national NIS elements, that is adopted from the National Innovation System Model (Arnold and Kuhlmann, 2001) and developed to be a diagram of the National Innovation System (KNRT, 2008), was used.

RESULTS AND DISCUSSION

Perspectives on The General Main NIS Components

The overall results of the respondent's perspectives on the national innovation system performance in the Indonesian oil palm industry cluster is shown in Figure 2. Two respondent groups involved in the study, namely the experts and oil palm agribusiness and agro industry practitioners (blue number or right side number) and postgraduate students pursuing Masters and Doctoral degrees in the fields of agribusiness management and agro industrial technology (red number, or left side number). Post graduate students were involved in the analysis to represent their view on the future sustainability of Indonesian oil palm agribusiness, and their readiness in improving sustainable agribusiness practices for oil palm.

Based on the analysis results of the respondents' assessment on NIS components performance (Figure 1), graduate respondents assessment on the general performance

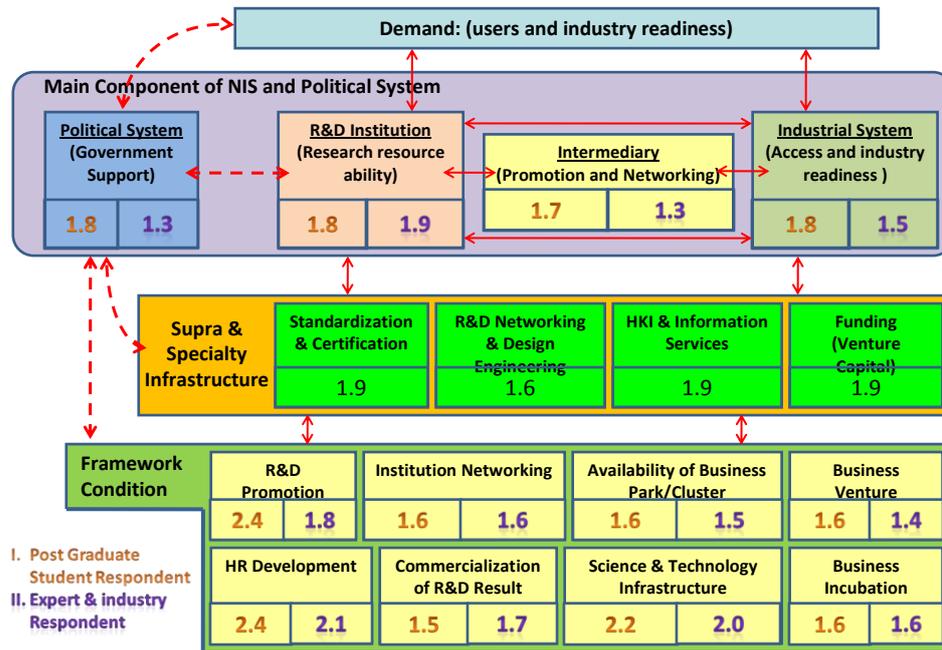
of NIS components was better than that of the experts and business practitioners. The perspectives values can be seen from the graduate respondent assessment score which is higher than that of the experts and business (industry) practitioners assessment scores. The average score for the whole NIS components performance based on the graduate student respondent's assessment was 1.8 (with means medium or moderate achievement). On the other hand, the assessment results of the experts and the business practitioner respondents had an average score of 1.6 (low or under achievement). Statistical analysis of the respondent's assessment scores indicated that the perspectives between the two respondent groups were significantly different.

From the four NIS components groups, the NIS of the political system and R&D framework conditions has an average assessment of 1.8 (moderate achievement) from the graduate student respondents. On the other hand, the experts and the business practitioner respondents assessed both of the NIS components as relatively low, namely 1.5 or under achievement. They assessed the performance of supra and specialty infrastructure components with a medium level of achievements (1.8). Despite the importance of supra and specialty infrastructure to support sustainable oil palm agribusiness, however, the graduate student respondents assessment on the performance of supra and specialty infrastructure components could not be used, because not all of the graduate student respondents were able to access this, or there is a highly uncertainty level in the assessment performance of supra and specialty infrastructure components. It could be understood that their knowledge and experiences are lower than that of the experts and business practitioner respondents who not only have more experience but have direct knowledge from this experience.. However, there is no reference to confirm this evidence since there is no similar research involving postgraduate students in the NIS evaluation.

In the NIS main component and political system, both of the respondent groups assessed that the subcomponents of the political system and intermediary components had low levels of performance, even though the government's ambition is to place Indonesia as a permanent world leader of palm oil producer and this is very strong (Ministry of Industry, 2009). On the assessment of subcomponents performance in R&D institution and industry system components, the graduate student respondents assessed the performance level as being moderately successful. However, the results of the assessments were again different from that of the experts and business practitioner respondents who assessed a low value (under achievement) for the subcomponents performance level.

Within the supra and specialty infrastructure, subcomponents of standardization and certification; information and intellectual right services; and the venture capital were assessed with a medium performance (moderate success) level by both of respondent groups. It was only the subcomponent of R&D networking and engineering design performance which had a low assessment score (under achievement) by both respondent groups. Unfortunately, the assessment's score on the business venture from respondents' perspectives was not addressed as a true business venture activity as is normally known, but was misinterpreted as the general and common banking or funding institution's activities. Some respondents stated that the business venture scheme model in Indonesia does not exist.

FIGURE 1 : RESPONDENTS’ PERSPECTIVES OF NIS COMPONENT PERFORMANCE IN THE INDONESIAN OIL PALM INDUSTRY CLUSTER



(Perspective of R&D performance: $1.0 \leq \text{low} \leq 1.7$; $1.7 < \text{medium} \leq 2.3$; $2.3 < \text{high} \leq 3.0$)

The assessment of performance on the R&D framework condition was given as a medium achievement of success level by graduate student respondents, but it was assessed as low by the experts and business practitioner respondents. The difference in those assessments could be analyzed in more detail from the assessment of the six R&D framework subcomponents, namely R&D promotion, networking cooperation, Business Park availability, human resource development, R&D products commercialization, and business incubation in the oil palm agribusiness. The graduate student respondents assessed those subcomponents with a medium success level, while the experts and the business (industry) practitioners assessed it differently. The only similar results occurred in the assessment on human resource development. Both groups of respondents assessed that the HRD development has a medium achievement level.

In general, the difference perspectives between the graduate student respondents and the experts and business (industry) practitioner respondents could be caused by the lack of the graduate students’ experiences on the NIS reality and actual business conditions. The graduate student respondents evaluated that performance of NIS as generally good enough, so their score of assessment was higher than that of the experts and business (industry) practitioners. The experts and business (industry) practitioner respondents which are NIS internal actors in the oil palm agribusiness are more knowledgeable on the reality of NIS conditions, the needs of the NIS components and their weaknesses in developing sustainable oil palm agribusiness.

Perspectives On The Political System, R&D Institution and Intermediary Elements (Promotion and Networking)

The Perspective scores of the oil palm industry cluster on political system, R&D institution and intermediary elements subcomponents performance from both groups of respondents are shown in Table 1, with the following discussion.

Political System

Different to that of the graduate students' assessment results for the two subcomponents in the political system (link and match between government, industry, and university; and government's active roles in technology transfer within the oil palm industry) which gave moderate success performance (1.8), the experts and the business (industry) practitioner respondents assessed those subcomponents with a low value performance (under achievement) (1.3). Between the two subcomponents of political system assessment, the score from the experts and the business (industry) practitioner respondent's assessment on the link and match between government, industry, and university was lower compared to that of the government's active role in technology transfer. This implies that there might be a possibility that R&D activities on sustainable CPO production system in the universities and R&D institutions were only based on technology push but not on market pull, so the compatibility of the R&D results with industry needs are low. Once more, the difference of the assessment results between the two groups of respondents may possibly be because the experts and the business practitioners demand the same strong support from the Indonesian government, as the Malaysian government provides for MPOB and other Malaysian oil palm industry cluster actors. MPOB, for example, in 2008 published and launched a booklet claiming so many success factors in developing the oil palm agribusiness in Malaysia (MPOB, 2008).

TABLE 1 : THE PERSPECTIVE SCORES OF THE INDONESIAN OIL PALM INDUSTRY CLUSTER RESPONDENTS AND INTERMEDIARY ELEMENTS SUBCOMPONENTS PERFORMANCE

No	NIS Components	Score	
		I	II
1	Political System Components		
a	<i>Link & match</i> between government, industry, and university	1.8	1.1
b	Government active roles in technology transfer	1.8	1.5
2	R&D Institution		
a	Resource of research in Indonesia	2.5	2.1
b	Technology inventory which is applied in R&D	2.0	1.6
c	R&D innovation that can enter the commercial stage	1.6	1.3
d	Capability to develop science and technology solution	1.9	1.9
e	National R&D capacity	1.8	1.8
f	National innovation capacity	1.8	1.9
g	Scientific and popular publications to increase society intelligence	1.5	1.5
3	Intermediary		
a	Promotion of research results	1.6	1.1
b	Networking between business, researcher and government	1.6	1.3
c	Cooperation with international R&D institution	1.5	1.3
d	Cooperation with regional R&D institution	1.6	1.3
e	Cooperation with local R&D institution	1.9	1.5
f	Technology utilization progress monitoring	1.6	1.3
g	SME's assistance in research application	1.8	1.1

Perspective of R&D performance : $1.0 \leq \text{low} \leq 1.7$; $1.7 < \text{medium} \leq 2.3$;
 $2.3 < \text{high} \leq 3.0$

I = Graduate student respondents

II = Expert and business (industry) practitioner respondents

Research and Development Institutions

From seven subcomponents performance assessment on R&D institutions, there were four subcomponents that had assessment score of moderate performance both by the graduate student respondents and the experts and business (industry) practitioner respondents. The four subcomponents were resource of oil palm research in Indonesia; technology inventory which is applied in R&D; national R&D capacity; and national innovation capacity. The results indicate that R&D of oil palm in Indonesia has a basic strength and foundation to become developed. Unfortunately, three other subcomponents performance were assessed as under achievement by the experts and business (industry) practitioners. Those three subcomponents were technology inventory which is applied in R&D; innovation of R&D especially in the downstream processing of crude palm oil that can enter the commercial stage; and scientific and popular publications to increase society awareness and intelligence on sustainable oil palm agribusiness in the future .

Intermediary Elements (Promotion and Networking)

Almost all the subcomponents in the intermediary elements performance assessment had a low score by both groups of respondents. Only two subcomponents namely R&D cooperation with local R&D institutions and SME's assistance in research application were given moderate success by the graduate student respondents, especially with regard to the works of IOPRI. Subcomponents of networking between business, R&D institutions and government; R&D cooperation with regional, national and international R&D institutions; technology utilization progress monitoring; and SME's assistance in research application were assessed as having low achievement performance by the experts and business (industry) practitioners. Although IOPRI (IOPRI, 2009) have been putting in a lot of effort to increase its performance, especially in international R&D cooperation (for example with Malaysia parties), it was not successful enough to increase its performance on the promotion and networking spread of sustainable oil palm agribusiness.

Perspectives On The Industry System, Framework Conditions of R&D, and Supra and Specialty Infrastructure

The average score of the industry system, framework conditions and supra and specialty infrastructure performance assessment scores from the graduate students and the experts and business (industry) practitioner respondents are shown in Table 2.

Industry System

The perspective scores of the experts and business (industry) practitioners on the oil palm industry cluster categorized four subcomponents in the industry system performance assessment as having a low achievement. They include readiness of business actors to adopt research results; industry development based of science, technology and competitiveness; business actor access to technology information; and cooperation with SME's agribusiness might be the main reason why big oil palm organizations such as SMART, Wilmar Group, Lonsum and Sampoerna Agro have established their own R&D stations (Liwang, *et al.*, 2009).

TABLE 2 : THE RESPONDENTS' ASSESSMENT SCORES ON INDUSTRY SYSTEM , R&D FRAMEWORK CONDITIONS , AND SUPRA AND SPECIALTY INFRASTRUCTURE SUBCOMPONENTS PERFORMANCE OF INDONESIAN OIL PALM INDUSTRY CLUSTER

No	NIS Components	Score	
		I	II
1	Industrial System		
a	Readiness of business actors to adopt research results	2.0	1.5
b	Industry based of science and technology and competitiveness	1.5	1.6
c	Business actors access to technology information	1.8	1.6
d	Cooperation with small and medium scale enterprises (SME)	1.8	1.4
2	Framework Condition		
a	National promotion about strategic R&D	2.4	1.8
b	Human resource development	2.4	2.1
c	Creation of link between R&D institution, government, academic and industry	1.6	1.6
d	R&D product commercialization	1.5	1.7
e	Availability of business park and business cluster	1.6	1.5
f	Provision of complete science and technology infrastructure	2.2	2.0
g	Business Incubation	1.6	1.6
3	Supra and Specialty Infrastructure		
a	Intellectual Property Rights Institution	2.3	1.8
	- Information Service Institution	-	1.8
	- Human intellectual right institution	-	1.9
b	Business Loan Institution (Venture Capital)	-	1.9
c	Science and knowledge network and engineering design	-	1.6
	- Tools and machinery design and engineering institution	-	1.6
	- Science Networking Institution	-	1.5
d	Standardization and certification institution	-	1.9

Framework Conditions of R&D

The scores of the assessment on subcomponent performance in R&D institution from the graduate student respondents and the experts and business (industry) practitioners indicated some similar perspectives. Subcomponents in R&D institution performance assessment that had a moderate level of performance by both groups of respondents were human resource development; national promotion about strategic R&D, including oil palm agribusiness as a backbone of the economy; and science and technology infrastructure. Performance in the R&D institution subcomponent that was given a low achievement performance by both respondents was the creation of links between R&D institutions, government, academia and industry; R&D product commercialization; availability of business parks and business clusters; and business incubation in the oil palm industry. Up to the present time, the role of a business incubator for government owned oil palm plantations is held by LPP Yogyakarta and LPP Medan.

Supra and Specialty Infrastructure

In general, the average performance of assessment score on supra and specialty infrastructure in the oil palm agribusiness was categorized at a moderate level of performance. However, there were two subcomponents that had low scores of performance. Those components were tools and machinery design and engineering institutions and science networking institutions in the oil palm agribusiness. One of the reasons that caused Indonesian oil palm development is not as good as Malaysia is due to lower capacity of the Indonesian engineering and manufacturing capability which is behind that of Malaysia. As an example, Malaysia has some companies that can supply machineries and equipment needed by oil palm industries, such as MBL

Engineering Sdn Bhd, MSHK Engineering Sdn Bhd, KH Engineering Works Sdn Bhd, CHD Engineering Sdn Bhd and CL Engineering and Trading Sdn Bhd (MPOB, 2008).

From two focus group discussions involving 19 experts in the oil palm agribusiness it is clear that the discrepancy of the assessments results between the postgraduate students and the experts might have happened due to different experience and focus of evaluation. Postgraduate students focus their view on technology or knowledge push, while the experts, driven by their own needs in the business focus on the market pull factors. Therefore, balancing R&D focus on knowledge push and market pull factors (Sharif, 2007) in the Indonesian national innovation system should be done to improve the work of the national innovation system.

Some R&D topics were collected from FGD's which need to be supported by the Indonesian government, academic and oil palm business practitioners to make Indonesia become the real oil palm world champion as follows:

- (1) An integration approach of agricultural suitability, land availability or displacement and sustainability of oil palm agribusiness.
- (2) Making up of a wider planting materials to solve oil palm disease problems, and boosting research and development to produce high yielding planting materials which are more adaptive to local conditions both biotic and abiotic factors, as suggested by Purba, *et al.* (2009).
- (3) Improving oil palm productivity per unit area by replanting with high yielding planting materials with the potential of eight tons commercial oil yield per Hectare, as described by Chandran (2009).
- (4) The use of CPO for better food quality (cooking oil, margarine, shortening, salad dressing, vanaspati and ghee, cookies etc.) production; emulsifier (MDAG, etc); Palm Oil for Cocoa Butter Substitute (CBS); Palm Kernel Oil (PKO) for oleo chemicals production; CPO and PKO for Health and Nutrition (Vitamin A, E, nutraceuticals etc.) and Multiple use of cooking oil during frying of snack foods by micro and small scale industries, and street vendors
- (5) The use of membrane of filtration to increase high value of cooking oil; Bulk cooking oil for micro and small scale industries; and the use of CPO as raw material for industrial coatings and adhesive .
- (6) To maximize the use of oil palm harvest materials, including the by products into valuable products, following the success of Malaysia in diversifying sustainable and eco friendly oil palm products.

Research and Development Networking and Business Development on Oil Palm Industry Clusters

Networking of R&D and business development at the Indonesian Oil Palm Research Institute (IOPRI; PPKS) Medan which is one of a semi-government R&D institution was used as a case study in palm oil industrial base R&D and business development networks. IOPRI's R&D networking has been applying the concept of ABG triangle innovation networking (academia, business and government). Academic group at IOPRI networking are some Indonesian universities who have developed oil palm R&D. Business actors in IOPRI's networking are big scale oil palm industries, the owners of oil palm plantations, and association of palm oil based products producers (oleo chemical producer, vegetable oil producer and bioenergy producer). IOPRI has

also cooperation networking with public R&D institutions, and the Indonesian Oil Palm Society (MAKSI). Figure 2 illustrates the scheme of IOPRI R&D networking and business development.

The roles of each actor in IOPRI's R&D networking and business development are as follows:

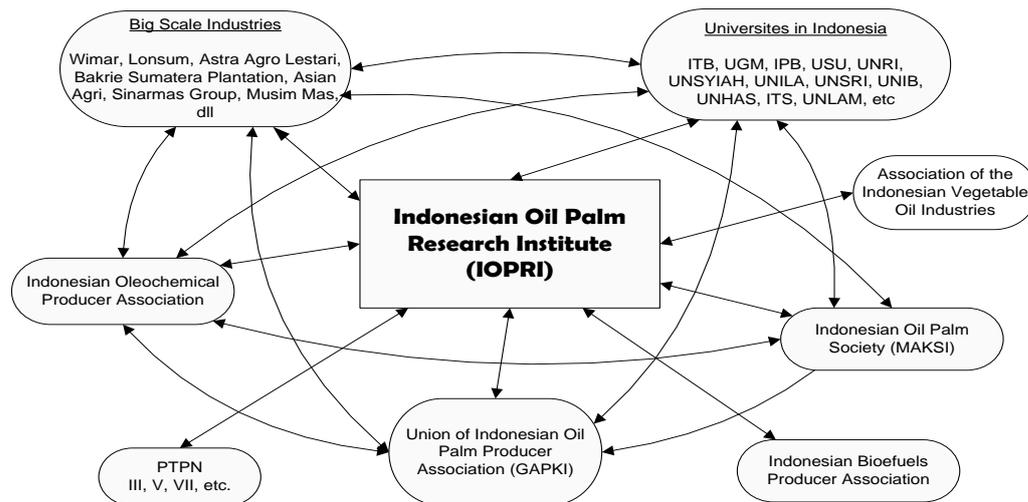
a. Indonesian Oil Palm Research Institute (IOPRI)

IOPRI has been proactive in oil palm research program which includes seed supply, plant cultivation technology, water and soil management, CPO production technology, until business and palm oil based products marketing.

b. Indonesian Oil Palm Producer Association (IOPPA)

IOPPA is active in the advocacy of oil palm agribusiness, CPO international trades, RSPO discussion, etc.

FIGURE 2: SCHEME OF OIL PALM RESEARCH INSTITUTE , MEDAN, INDONESIA



b. Some Indonesian Universities

Almost all Indonesian big universities and local universities in the regions with large oil palm resources are active in the R&D of oil palm downstream and upstream products activities which are useful for oil palm business development. However, their activities are limited by the availability of research funds.

c. Large scale oil palm industry

Several large scale oil palm businesses in Indonesia do their own R&D activities related with their interest in the downstream or upstream oil palm sector. They also do several oil palm agribusiness advocacies in the global market.

d. Indonesian Palm Oil Society (MAKSI)

MAKSI is active in oil palm R&D, promotion and advocacy of sustainable oil palm agribusiness, and tighten R&D networking with other institutions.

e. PT Perkebunan Negara (PTPN III, V, VII, etc.)

PTPN's do many applied R&D cooperations with IOPRI and the Plantation Education Institution (LPP) in Medan and Yogyakarta and other oil palm stakeholders. PTPN is one of IOPRI R&D products users.

f. The Association of the Indonesian Oleochemical Producers (APOLIN)

APOLIN is active in the business advocacy of oleochemical based oil palm, especially for global market.

g. The Association of Indonesian Vegetable Oil Industry (GIMNI)

GIMNI is active in the advocacy activities of Indonesian oil palm business development besides of other vegetable oils such as coconut oil.

h. The Indonesian Biofuels Producer Association

The association does some biofuel R&D (biodiesel and bioethanol) in cooperation with biofuel related institutions.

With the establishment of the Indonesian Oil Palm Council (IOPC, DMI), a strict guidance on sustainable oil palm agribusiness practices should be accelerated, since the institution will play a central role in developing sustainable oil palm agribusiness in Indonesia. The roles of IOPRI have also to be increased to secure better oil palm business networking and development of sustainable oil palm agribusiness in Indonesia, in the future. .

SMEs business development case study

From focus group discussions and field visits to Lampung, it is obvious that oil palm industry clusters almost do not have any R&D linkage with SMEs. The reason might be due to its nature that oil palm business is a big business, which needs a big investment. Other reason is because the oil palm business is an integrated industry, a cluster itself, so that the volume of business is also at a large scale. However, some SMEs types were identified to have networking scheme with the oil palm business, as listed below.

- i) SMEs on lorry or truck transportation, with lorries or trucks to be hired for fresh fruit bunches or empty fruit bunches transportation.
- ii) SMEs on general trading that service the labor of oil palm big players some daily needs, such as food and beverage provider.
- iii) SMEs on the CPO processing at a mini pilot scale type that process fresh fruit bunch of oil palm at a low quality capacity. However, since the volume of business is low, the sustainability of the business is not long.

CONCLUSIONS

The assessment's scores of the postgraduate students on the main elements of the national innovation system were higher than that of the experts and business practitioners, due to the lack of real experience and exposure to the real oil palm agribusiness. Therefore, it is recommended that government and Oil Palm Associations provide more advocacy materials to increase students and society knowledge on the development of the sustainable oil palm agribusiness in Indonesia.

The experts and business practitioners require that the government of Indonesia provides a better national innovation system, as well as R&D and business infrastructure for sustainable oil palm agribusiness development in the future. They recommend Indonesian oil palm stakeholders to benchmark the success of Malaysia in advancing oil palm agribusiness in increasing its contribution to the national economy.

ACKNOWLEDGEMENTS

We would like to thank Recognition and Mentoring Program (RAMP) of Bogor Agricultural University, Indonesia, especially Dr. Aji Hermawan (Director) for sponsoring this study, and all the respondents and resource persons in the surveys and focus group discussions.

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