

## Palm Oil Plantation Revitalization Model for The Agroindustry Development

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**Abstract**— The increasing need for vegetable oil about 5 million a year accompanied by the human population growth with the average increase 0.9% requires a consistent effort for Indonesia as the top CPO producer in the world. The efforts to increase the palm oil plantation production faces not only the constraint of the low plantation product but also the lack of downstream palm oil industry development. Also, there is not any specific fund for the plantation. Because of that reason, it is necessary to make an improvement effort for the revitalization of the palm oil plantation in North Sumatera-Indonesian through the huge potential benefits of North Sumatera by modelling palm oil plantation revitalization, to facilitate the relevant parties to find the solution of the constraints of palm oil plantation revitalization so that it can support the CPO agroindustry development in North Sumatera. The implementation of palm oil plantation revitalization in North Sumatera is not high, that is only 17.5 % out of the planned one. It indicates that it becomes the constraint of the palm oil plantation revitalization in North Sumatera. The result of the research shows that several dominant factors influencing the success of the regeneration are among others the land availability and the replanting, the increased productivity of plantation and CPO agroindustry, and the plantation financing. Therefore, it is strongly recommended that the relevant parties such as government, plantation companies, banks and farming community be able to synergize so that various influencing factors can be optimized and the maximum increase in the revitalization.

**Keywords**— plantation revitalization; palm oil; the land availability; plantation productivity; plantation financing

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### I. INTRODUCTION

In 2005, Government stated the palm plantation revitalization program to increase and build competition in the international market, especially in developing palm program and downstream product. The palm plantation revitalization program is the acceleration of developing community plantation through extending the area, replanting as well as rehabilitating plantation crop supported by investigation credit and subsidizing government interest by involving plantation company as expanding and processing as well as a marketing partner. This program is an effort to improve palm plantation productivity through better management and supporting the success of acceleration masterplan and economy extension in Indonesia (MP3EI) in the economic development strategy of North Sumatera by

the construction of the palm industry area at Sei Mangkei in North Sumatera [1]-[2].

The target of the revitalization for Indonesia in 2014 reaches 782 hectares (revised by the previous goal 1.5 million hectares), for North Sumatera area of 32 thousand hectares. By the end of 2013, out of the target area which is expected to be revitalized only realized at 17.5% which is an area of 5.7 thousand hectares [3]-[4]. The low target achieved shows that the palm revitalization in North Sumatera was not smoothly carried out. It is not good because from the end of 2009 the Ministry of State Owned Enterprise (BUMN). North Sumatera government, PT Perkebunan Nusantara in North Sumatera, the research center (IOPRI), training center (LPP) in the national workshop declared “North Sumatera Palm Oil Valley” for North Sumatera as national palm barometer as North Sumatera has a good potential for the production and trade

center. North Sumatera Palm Oil Valley (NSPV) becomes the starting point to build the integrated area from the head to downstream zone to produce a various palm generation product and becomes *multiplier effect* area [5]-[6]. It is difficult to achieve the big ideas to make North Sumatera as the National palm barometer if a manifold of North Sumatera natural resource potential is not optimally balanced with the carried out of palm revitalization. The palm revitalization in North Sumatera Province indicated by accelerating palm state construction in cooperation with banks and the palm company as a contracting partner. The partnership is one of the efforts to nurture the natural palm in North Sumatera Province as the national palm barnyard by increasing the competition through the improvement and development of downstream Crude Palm Oil (CPO) agroindustry.

Natural resource potential in North Sumatera to develop palm is enormous with the total plantation area reaches 15.2% out of 7.9 million hectares of plantation in Indonesia and the composition of plant width which has not yet been produced reaches 13,7%. This area covers the availability of 92% of CPO companies with the total capacities of production 3.8 ton of Fresh Fruit Bunches (FFB) per hour [5]. Meanwhile, the palm plantation in Indonesia especially North Sumatera has very low palm productivity with the age of colony more than 30 years [7].

The contract farming productivity per year is only about 10–13-ton FFB per hectares, while the private plantation companies and government reach 20-25 ton per hectare, which this contract farming product is almost the same as the personal plantation [8]. During that time the contract farming plantation faces difficulty in finding a partner from plantation companies to revitalized them [5].

North Sumatera contribution toward the CPO export in Indonesia reaches 16.33% every year. The extensive CPO export causes additional value for a downstream product to be more used by the importers to refine them into more valuable products. The role of Indonesia as global CPO producers highly increases along with the CPO product growth average 9.1% per year. This potential makes the government reached the biggest palm plantation up to 20 million almost in every province in Indonesia [9], even Indonesian Palm Oil Association (Gapki) and the Ministry of Forestry State claimed the width of potential plantation expand is around 30 million Ha in North Sumatera and Kalimantan [10]. The potential areas in North Sumatera have been limiting – only 115 thousand Ha out of 31.77 million Ha of the total palm field in Indonesia (around 0.36%).

The global needs of vegetable oil that continually increases around 5 million ton per year along with the fast growing of population from 7 billion to 9.5 billion during 2011 until 2015 (36 % with the average growth 0.9 % per year). It requires consistent effort from Indonesia as the top CPO global producer that is higher than Malaysia since 2006 [10]-[11]. The high demand for vegetable oil occurs because the various product is yielded using palm oil as the primary material [12]-[16]. However, Indonesia palm agroindustry low is far left behind from Malaysia because the productivity is relatively low and the contribution of Indonesia CPO export to overseas is significant (minimum 50 %) that it makes other importers use more and proceed them for other

product which is worth more. Indonesia has a mean percentage in using CPO product for the downstream area, only about 40-50 % [11], [17].

There are some efforts to increase the palm production, among other facing the constraints of low productivity, the lack of downstream and no special fund for palm plantation [18]-[19]. The limitations are attempted to be improved so that the palm is made more useful and revitalized in North Sumatera through the use of significant potential, that is, by creating palm plantation revitalization model, this will help and ease the relevant parties to overcome the constraint of plantation revitalization in North Sumatera.

The research is aimed to create a palm revitalization model that is applicable by the decision maker to support the development of CPO agroindustry in North Sumatera-Indonesia.

## II. MATERIAL AND METHOD

The research is done in several systematic steps consisting of four main steps namely, 1) defining the problems, 2) observation system, 3) formulating a model, and 4) verification model. The observation system is to see the parameter value influencing problems. The formulation stage to modeling Revitalization Plantation, which consists of sub-models of the availability of land and replanting using mathematical methods and simulation, optimization sub model for financing the feasibility of plantations using fuzzy AHP [16], and submodels increased the productivity of CPO agroindustry using ANP method [20]-[22]. The verification and validation models are conducted by face validity to determine whether the developed model is accurate and can represent the real condition of the problems [23]. The procedures of the research are described in Fig. 1.

### A. Defining the Problem

The problem appears from the effort to revitalize North Sumatera as the first region in Indonesia producing palm oil, so it is very famous as a National palm barn. Now, Indonesia is targeted to be National palm plantation barometer. Palm Plantation Revitalization Model supports this target in targeting to the achievement of National palm plantation productivity and quality to reach the target productively by developing downstream industry and increasing additional value. The problem faced in revitalizing palm plantation is equality or FFB continuity which is produced by palm plantation to fulfill overseas and domestic demand especially for CPO agroindustry and downstream industry in North Sumatera.

There are three problems found in doing Palm Plantation Revitalization Model in North Sumatera. The first is available for land and replanting palm oil industry to fulfill industrial CPO need as increasingly as to food industry need, non-food industry needs and also other alternative energy made from raw CPO. The second is the cost of the old palm plantation rejuvenation as a cause of decreasing palm plantation productivity. For that reason, for the palm plantation above 25 years old has not been productive anymore, this condition commonly happens in smallholder palm plantation or plasma palm plantation. The third is still about the lowest productivity from what it should be

produced. Thus, the productivity target to fulfill the market demand predicatively will not be enough for the future.

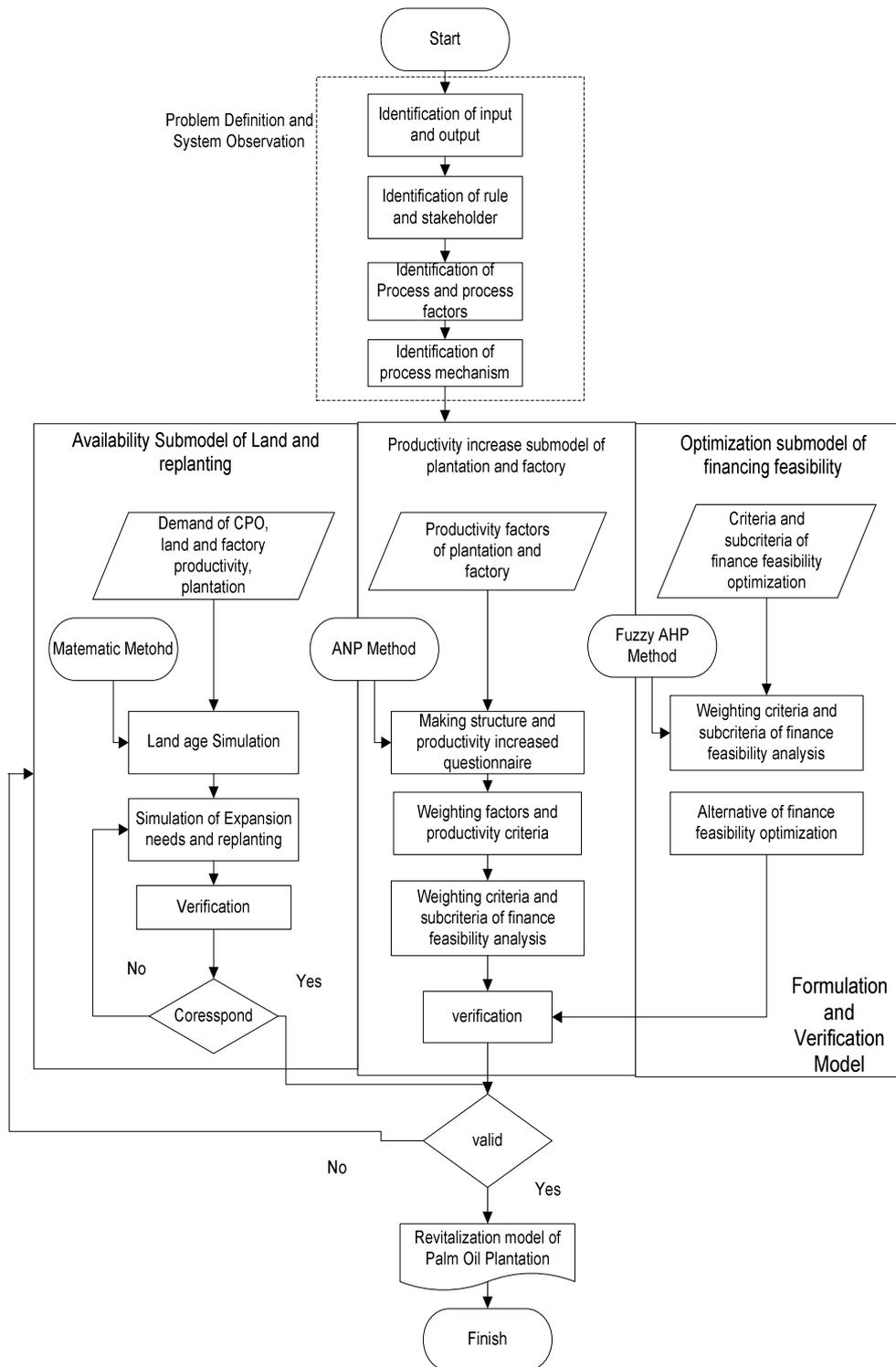


Fig. 1 The research procedure

### B. Observation System

Observation system is done by analyzing Palm Plantation Revitalization program in North Sumatera to predict some value parameters influencing the problem. There are three

sub-systems found needed to study in Palm Plantation Revitalization efforts, namely the land availability and the replanting or rejuvenation subsystem, the plantation

financing subsystem, and the increased productivity of plantation and CPO agroindustry subsystem.

The subsystem of land availability and replanting needs secondary data. That is, Fresh Fruit Bunches (FFB) productivity, plantation area, plantation production, demand for CPO, CPO production, the land area immature plants, the land area of productive plants and area of land plants do not produce.

The subsystem of plantation financing needs primary data from some of the criteria that need to be analyzed namely, outlook business criteria, juridical aspect criteria, management aspect criteria, cost aspect criteria, guarantee aspect and technique aspect criteria [19].

The subsystem of the increased productivity of plantation and CPO agroindustry needs primary data. That is, the suitable land, seed quality, plantation population per hectare and homogeneity, fertilizing, treatment plants, working methods, technology application, skill labor of CPO plantation and processing plant, supervision, and the quality of fresh fruit bunches and process technology [20]-[23].

### C. Model Formulation

For this step, a model of the problem is developed from the palm plantation rejuvenation to strengthen CPO agroindustry in North Sumatera. Information generated assembled so that the model of Revitalization oil palm plantations produced can be used decision-makers to support the development of CPO agroindustry in North Sumatera. The configuration of the Plantation Revitalization model is presented in Fig.2 below.

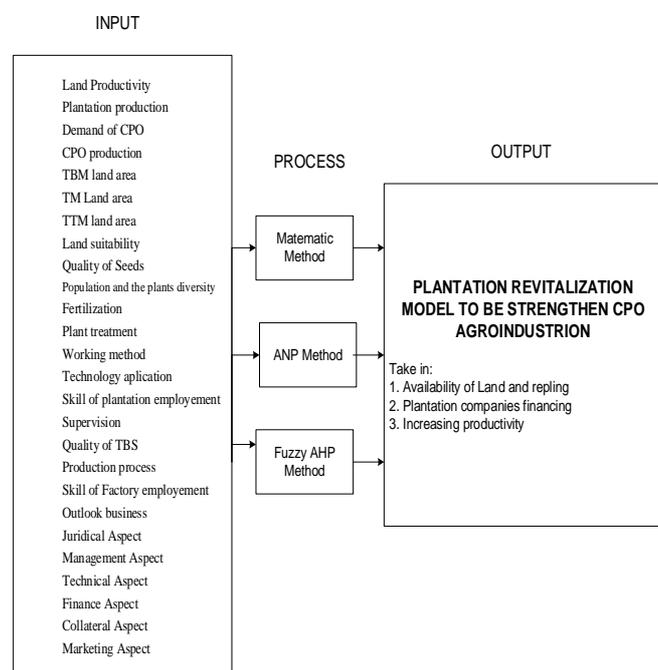


Fig. 2 The input and output processing model of palm plantation revitalization

Revitalization of oil palm plantations in North Sumatera is an effort to restore the resource potential of oil palm in North Sumatera as the granary of the oil palm. As Stein conducted a redesign of the manufacturing systems to improve the company from the financial, scheduling and managerial [23], Bhote to revitalize the cooperative

relationships with industry suppliers through improved quality, reduced cost and cycle time of procurement [24]. Gouillart and Kelly to revitalize the organization through three stages, namely a focus on the market to understand consumer needs, creating new business and information technology to improve efficiency and system integration [25]. Moreover, Bartic argues that the principal rationale for adopting policies to revitalize older industrial cities is to develop the per capita earnings of urban residents [26].

### D. The Verification and Validation

According to Sargent, a model verification measures to ensure that the stages on the model of computer programming have been done correctly. How testing to ensure the modeling process has been done right is a multistep procedure to test the correct computer programming. This procedure can be done by following the rules of appropriate modeling software instructions [24].

Validation of the model aims to determine the accuracy and precision of a model to perform its function as intended design models [27]. Validation of the model related to the effort to ascertain whether the model is built the most authentic representation of reality studied so that the model can produce a convincing conclusion. To meet the requirements, then do continuous testing which the results are used to enhance the computerized calculations. Validation of computer-based model when the model is intended to be applied in the real world, accuracy, and consistency will produce satisfactory results, by objectives by the model.

All of the research results is the simulation of fulfilling fresh raw fruit for the expansion and replanting of palm plantation, increased productivity and financing in implementing revitalization of plantation companies to meet the demand of CPO in the coming years. The result is verified to get the appropriateness between input and output model. If there is still a mistake, then, the model must be improved. Next, the model is validated to get a valid model by using face validity technique [27]-[28]. The questions are proposed to the expert who has the competence in palm plantation, the CPO processing factory and financing the plantation rejuvenation. The expert comes from the estate, banking revitalization credit supervisor, researcher palm plantation expertise, credit supervision of rejuvenation bank, Researchers of IOPRI (Indonesian Oil Palm Research Institute), leader of the plantation revitalization in local government of North Sumatera. Technical implementation is done by presented the models produced.

## III. RESULT AND DISCUSSION

Participants belonging to this Palm Plantation Revitalization program namely, Bank, government, the prominent citizen, cooperative/plasma and plantation company have the same hierarchy in this program. By applying linkage system to each other, where for all actions of each part will make a success of the program, but if it is not noticed, it will cause a failure of palm oil plantation and revitalization program [29]. To improve the performance of palm oil plantation revitalization in North Sumatera, it needs to apply an incentive strategy to banking organizer and to do crash program in government institution [19].

### A. The Configuration Model

The Palm Plantation Revitalization Model is to strengthen CPO agroindustry which is constructed in three parts, namely the land availability and the replanting or rejuvenation subsystem, the increased productivity of plantation and CPO agroindustry subsystem, and the suitable optimal cost plantation sub model as the palm plantation farmer partner by Banks.

The information obtained is designed so that the palm plantation revitalization produced can be used by the decision maker to support CPO agroindustry development in North Sumatera. Configuration model of palm plantation model is shown in Fig. 3.

### B. The Managerial Implication

The purpose of the revitalization of palm oil, at last, is the improvement of public welfare through increasing the role of the palm oil industry. That goal can only be achieved when stakeholders in the palm oil industry can make changes to achieve an increase in value added [29]. For this reason, implication management is suggested for this research are:

1) *The Institution Synergy*: It is clear that the realization of palm oil revitalization in North Sumatera proposed by the government until 2013 is excessively minimal, only about 5.7 thousand Ha of the targeted 32 thousand Ha which is agreed by Bank (17.5% of the plan). The target reached is the indication of the constraint of the action of palm plantation revitalization in North Sumatera. One of the causes is the imperfect synergy of palm stakeholder industry.

This imperfect synergy is reflected from the significant cost of bank agreement which is still under the rejuvenation target and the reality of rejuvenation action with the extension and rejuvenation following palm plantation revitalization, also, under the cost agreed by the Bank.

Some dominant factors are identified which influence the success of revitalization, namely, the land availability and replanting, increased productivity and plantation financing. Therefore, it is recommended that all relevant parties such as government institution, plantation companies, Banks and also farmer/plasma be more synergy so that some factors influencing be optimal and at last the success of revitalization be more optimal.

Focus on the achievement of institution synergy is the existence of the palm authority institution functioning as the regulator and facilitator in palm industry development, which unites various authorities (such as, Dewan Minyak Sawit Indonesia (palm plantation council of Indonesia), Indonesian Oil Palm Research Institute (IOPRI), Kantor Pemasaran Bersama Kelapa Sawit (joint palm plantation marketing office), etc). Furthermore, it is more straightforward such as in making license or determining the cost. One of the activities that can be run by this institution is to facilitate this research continuously toward the palm industry including the upstream to downstream, where the result of research indicated is easy to access by palm industries especially domestics, so the competitive power palm industry is increasing. This competitive power might be from the palm industry itself such as royalty, the large amount of percentage of palm product value produced.

Next, relating to institution synergy, it is the right time for Indonesia to have laws focusing on the palm as the reference of the operational palm industry because of not only the significant potential in the palm industry but also the exclusive right of countries lying on the equator line.

2) *The Special Education on Palm Plantation*: The role of palm commodity in supporting Economy is getting enlarged; this is because of the increasing human needs toward the increasing of product demand from palm oil process. However, the preparation of the palm plantation domestic industry worker especially in North Sumatera is not meaningful. Human Resources involving in palm plantation industry are recruited from the sources of general education, not from the vocational palm industry institution. Whereas to increase the productivity of plantations and palm factory requires trained human resources, so it is hard to expect the available human resources to bring the value added of palm industry being able to compete in the global era.

North Sumatera as a pioneer of palm plantation industry is expected to become a barometer of National palm plantation industry. It seems necessary to bring special education on palm institutions, starting from palm Vocational High School in the palm oil plantation such as Langkat, Deli Serdang, Serdang Bedagai, Asahan, Labuhan Batu, Padang Lawas and Mandailing Natal. The Palm Vocational High School is dedicated to training employees or palm plantation farmers. Furthermore, the necessary presence of the Polytechnic palm plantations in the central regions are namely Rantau Prapat and Tebing Tinggi. Palm Polytechnic is designed to prepare the plantation assistant and assistant manager of palm or larger community gardens. At the higher levels required the presence of the Institute of Palm in Medan educating assistant managers or palm plantation factory.

3) *The Special Financing for Palm Oil Plantation*: Part of the cost rules of a bank is channeled to the areas of business that can be controlled so that the financing risks can be managed properly. The palm industry as a business is always risky, and relating to the lack of understanding of the ability of a bank officer on the palm industry in turns it makes the banks not much involved in the financing of the palm industry. On the other hand, the ability of capital entrepreneur or limited community created the potential for the palm industry, especially in North Sumatera is still a lot of pent-up, it can be seen, especially in the agricultural lands belonging to the community. The plantation productivity is far below the plantation community run by private companies or PTPN, part of the causes is the lack of public access to sources of capital banks.

Related to the low plantation productivity above, it is recommended that banks in North Sumatera reproduce personnel who understand the palm industry or equip itself with particular education palm cost industry.

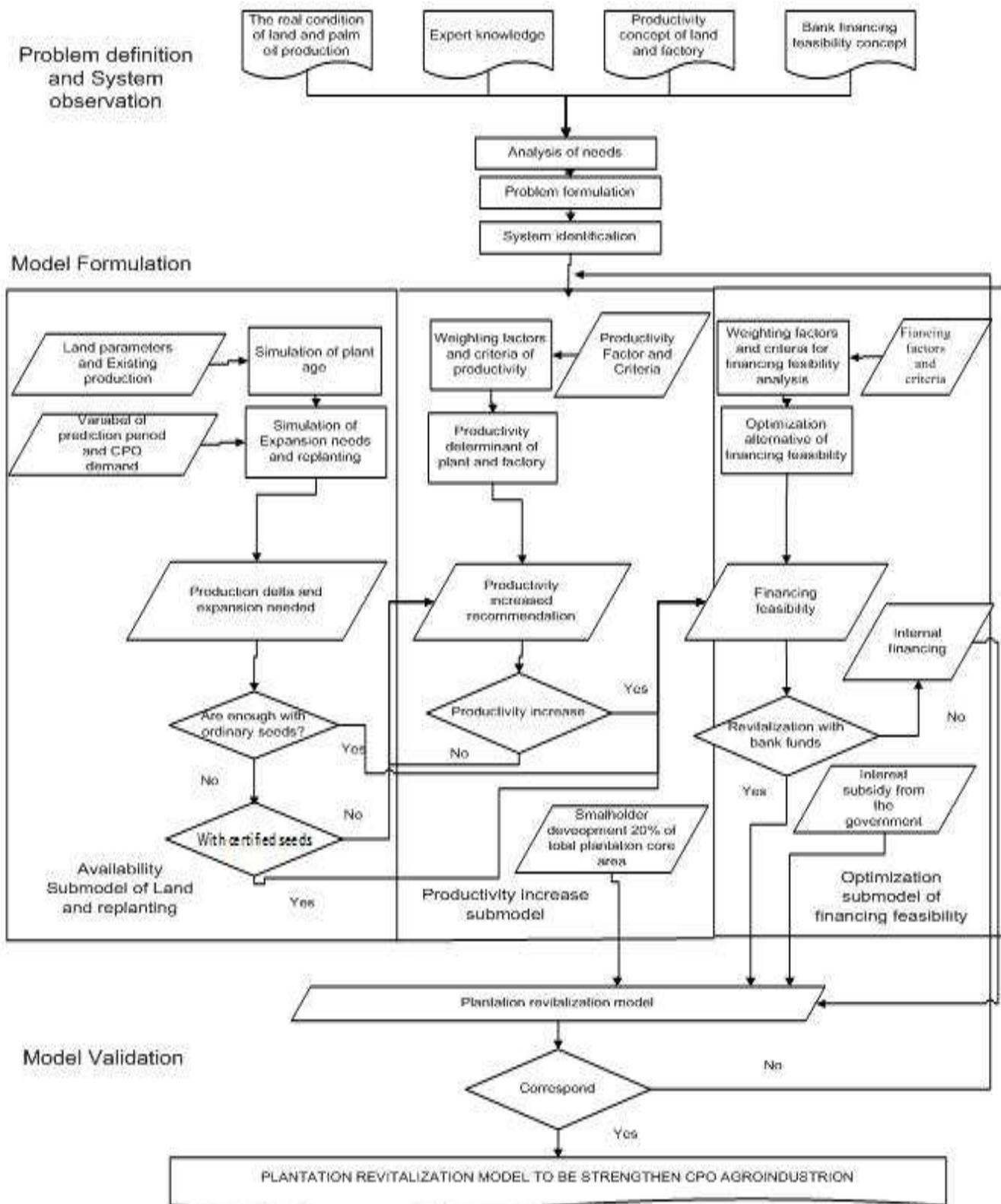


Fig. 3 The configuration of palm oil plantation and revitalization model to strengthen the agroindustry CPO

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Besides, by the presence of many companies plantations in North Sumatera partially plantation enterprises and state-owned enterprises as well as banking institutions, there

should be a particular scheme in financing palm plantations owned by the community in North Sumatera. Financing patterns can adopt plasma-core cost, the core is private plantation enterprises (BUMD)/state (BUMN), while the plasma is a community garden owners around the garden or palm oil mill enterprises (BUMD)/state (BUMN) in question.

By the open access to banking and the availability of competent personnel and supported by a tremendous institutional synergy, the application model of the plantation revitalization of the research will be allowed so that the embodiment North Sumatera as a barometer of the Palm Industry is not just a hope.

#### IV. CONCLUSIONS

The palm plantation Revitalization model is to strengthen CPO agroindustry consisting of three integrated submodels that are the land availability and replanting sub-model, the increased productivity sub-model, and the sub model of financing the feasibility of large plantation by the banks.

Sub-models of land availability and replanting are necessary to support the development of oil palm agroindustry in North Sumatera to anticipate the needs of CPO by improving productivity. This productivity improvement is due to the demand for CPO continues to increase not matched with the availability of potential land for palm oil in North Sumatera. The land for oil palm cultivation has been limited. The application of land availability and replanting sub model yields minimum field output that can be extended and revitalized by using regular or the best-certified palm seeds.

The productivity increase sub model of palm plantation indicates the priority criteria that give big impact to the productivity improvement, that is, plant health, the insertion of seedling, the type of fertilizer, the amount, and dosage of fertilizer, the suitability of the tool and the working materials. The population of plants per Ha and the homogeneity of the plants become the main factors that need observing and following up.

Optimization of oil palm plantation revitalization through productivity improvements will be realized if the factors of plant health and seed insertion continue and be a top priority for the success of productivity improvements. Healthy plants can only be produced from the treatment of seeds quality, fertilizer, and care of plants are complete.

While the factors working methods with conformance criteria tools and working materials, and procedures to be a factor supporting the implementation of fertilization, treatment plants, and nursery activities. Factors quality seeds, fertilizers, plant care, and the other element supporting the increase in productivity (working methods, application of technology, skill labor, and supervision) into factors that can be controlled and can be adjusted needs [30]-[31]. As a factor that can be controlled and adjusted as required, these factors must be the key continues to be followed to optimize the productivity of oil palm plantations. This is necessary to revitalize the oil palm plantations in North Sumatera can succeed. Especially activities to obtain quality seeds (i.e., fertilizing seedlings, nursery soil media usage, seed selection, seedling watering, pest and disease control of seeds and weed control), followed by the activity of plant fertilization and plant care [32].

To increase the productivity of CPO agroindustry done by training, working procedures, experience, the level of fruit quality and the origin of fruit, as the priority criteria which give a critical impact. The priority order CPO productivity improvement factor is skill labor agroindustry, process technology, and quality fresh fruit bunches. The employees'

skill becomes the primary factor which needs developing to increase the CPO agroindustry productivity (about 45%) [33]-[34].

Sub model of financing the feasibility of large plantation by the Banking provides optimization solutions feasibility analysis, the correct analysis is made higher, and the regulations are more explicit so that the big risks faced by the banks are minimalized. Optimization is done by using nine critical sub-criteria, namely Business Outlook, Business Licensing Legal, Core Business Experience, Land Suitability, Quality Seeds, Market Opportunities, Liquidity, Profitability, and legality Collateral.

The application of plantation revitalization model gives benefits to the decision makers to analyze the improvement of plantation revitalization to supporting the development of palm agroindustry in North Sumatera to anticipate the CPO needs by increasing productivity and the revitalization fund. The model generates output minimal land area that can be expanded and rejuvenated by using common palm seeds or the certified ones. The application recommends the factors that can increase plantation and fabric productivities to increase CPO productivity to reduce the needs of extending the field and optimal appropriateness analysis of the plantation company to get revitalization banking fund to minimalize the banking risks in funding plantation revitalization.

Further research is needed to make the revitalization of the institutional role of oil palm plantations in North Sumatera succeed because of the plantation revitalization related to many parties, such as banks, government agencies, large plantations as the core, plasma plantation as a cooperative, and community leaders. Also, more research is needed on the factors plant populations per hectare and crop uniformity as the dominant factor to examine in more detail the level of plant health and seed insertion optimal intensity in improving the productivity of oil palm plantations.

It is advisable to develop the critical factors in the increase in productivity of plantation for the owners of oil palm plantations and also the Plantation Office of North Sumatera. As a government agency, which is authorized in the area, the Plantation Office provides a guide in the efforts to revitalize oil palm plantations in North Sumatera were particularly successful, and in oil palm plantations throughout Indonesia.

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