Scheme to support coconut replanting program on smallholder plantation

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Abstract. Coconut plantations are dominated by smallholders characterized by limited land area, low productivity, and low added value. The low productivity is partly due to the old age of the plants. The performance of coconut plantations can be improved, among others, through replanting smallholder plantations, but the implementation is still low, mainly due to financing constraints. This study aims to develop a financing scheme to support coconut replanting programs in smallholder plantations. The analysis used is Interpretative Structural Modelling for strategy mapping. The strategy for accelerating the smallholder coconut replanting program is related to developing the seed system, capacity building of farmers and farmer organizations, and technology support. The implementation of coconut replanting consists of nursery establishment, seed distribution, and planting and cultivation management. The financing scheme is a replanting financing method that includes the provision of funds, the scope of the use of funds, and the mechanism for using funds. Various financing models were built, consisting of the Self-Financing Scheme, the Companion Fund Financing Scheme, and the Program-Based Financing Scheme. These various schemes accommodate variations in conditions in coconut development centers in Indonesia. Through the financing scheme, it is also possible to map the roles of each stakeholder involved.

1. Introduction
The integrated coconut industry encourages the optimal use of coconut-based products with a broad spectrum of functions and uses [1]. The coconut industry has a significant role and importance in nutrition and food security [2]. On the other hand, the performance of coconut plantations in Indonesia tends to decline, which can be seen from the declining area and low productivity. Various strategies for improving the performance of the coconut commodity system are faced with obstacles due to the limitations of coconut smallholders. The major portion of coconut plantations in Indonesia belongs to smallholders (98.7%), while the rest belong to private and state-owned enterprises [3].

The coconut smallholder is not yet organized well and is thus performance far below optimal levels. There are several programs and policy attempts to develop smallholder coconut plantations. However, the expansion was dominated mainly by self-funded smallholders [4]. The characteristics of smallholder coconut plantations in Indonesia are small land ownership, limited use of certified and superior seeds [5], limited Good Agricultural Practises (GAP) application, low technology adoption, and a low increase in added value [6]. Small farm size and low productivity are the main characteristics of the coconut plantation industry [7].
More specifically, the low productivity is partly due to old plant age [8-10]. Production risks will affect production, consumption, investment, and savings activities in coconut farmer households [9]. The average productivity of coconut plantations is around 1.1 MT copra/ha/year under potential productivity, that more than 2.8 MT copra per ha/year for superior coconut tall varieties and 3-4 MT copra per ha/year for hybrid varieties.

To increase the performance of coconut plantations can be improved, among others, through replanting smallholder plantations programs, but the implementation is still low due to various problems. The constraints on replanting are related to technical aspects, economic aspects, and institutional aspects, where the financing problem is a strategic issue [11]. The study aims to develop a financing scheme to support coconut replanting programs in smallholder plantations for the Indonesia case.

2. Materials and methods

2.1. Research approach

The study consists of two parts are analysis of existing conditions using literature studies and development of financing schemes to support coconut replanting programs in smallholder plantations. The analysis stages are (1) description of the performance of the national coconut industry; (2) identification of obstacles to implementing coconut replanting programs in smallholder plantations; (3) formulating institutional support for the implementation of coconut replanting programs in smallholder plantations; and (4) designing financing schemes to support coconut replanting programs in smallholder plantations.

Stages 1 and 2 were carried out using a literature study. In stage 3, the analytical method used is Interpretative Structural Modelling (ISM), which describes the general strategy from an institutional perspective. In stage 4, the financing scheme to support coconut replanting programs in smallholder plantations is designed.

2.2. Analysis methods

ISM is a group learning process in which structural models are generated to portray complex system matters through carefully designed patterns using graphics and sentences. The analysis stages consist of (1) identification of variables related to the problem; (2) formation of contextual relationships between variables; (3) development of Structural Self-Interaction Matrix (SSIM) of variables that indicate pairwise relationships between variables in the system; (4) formation of reachability matrix from SSIM and transitivity checking; (5) separation of reachability matrix in several different levels; and (6) elimination of intersecting variables [12]. The assessments used “V”, “A”, “X”, and “0”. “V” indicates that variable i affects variable j and “A” indicates that variable j affects variable i. While “X” indicates that variable i affects variable j and conversely variable j affects variable i, and “O” indicates that the variables i and j are not related.

3. Results and discussion

3.1. Performance of Indonesian coconut plantation

The use of coconut is intended for households and industry. The increasing demand for coconut products is in line with the increasing awareness of healthy food. Coconut products and coconut derivatives commonly traded in the global market can be broadly divided into primary and manufactured products.

The main commercial products marketed in the global market were originally copra, but it has shifted to processed products [13]. Added value-oriented and health-oriented products would dominate the future market of coconut. Processed coconut products are food products and non-food products such as activated carbon, shell powder, fiber, charcoal, handicrafts, furniture, and roofs. Coconut is also used in health and disease aspect for antibacterial, antifungal, antiviral, antiparasitic, antidermatophytic, antioxidant, hypoglycemic, hepatoprotective, and immune stimulant [14].
The development of coconut plantations in Indonesia spreads throughout the country by involving 6,163,053 farmers. Most of Java and Sumatra are the largest coconut producers in Indonesia. Riau Province is the largest area with 422,594 hectares, followed by North Sulawesi with 275,331 hectares, East Java with 263,347 hectares, Central Sulawesi with 219,964 hectares, Central Java with 218,436 hectares, and North Maluku with 201,684 hectares. The development of coconut plantation areas tends to decrease. In the 2011-2020 period, the average coconut area decreased by 0.99% per year. The decrease in the area was also followed by a decrease in production by 1.22% per year. Coconut production in the form of copra in 2011 was 3.17 MT, but in 2020 it was only 2.80 MT [15]. Coconut productivity has decreased by 0.42% per year, wherein 2011 it was 1,158 kg/ha and then decreased to 1,111 kg/ha in 2020 [15]. This figure is relatively low compared to the potential productivity that can be achieved. The average productivity of coconut plantations in Indonesia is around 1.1 MT copra/ha/year under potential productivity of more than 2.8 MT copra per ha/year for superior coconut tall varieties and 3-4 MT copra per ha/year hybrid varieties.

The number of old and damaged plants in 2018 was 403,998 ha (11.82%). The proportion of old and damage plants of more than 15% occurred in 10 development provinces, of which Riau Islands was the largest province (29.12%) [15]. The proportion of old and damaged plants is not expected to decrease. Coconut replanting is one of the government programs applied to coconut development centers and rehabilitation and intensification. Replanting is proposed for coconut plants aged less than 60 years if the plant is no longer productive or the production is less than 30 grains/tree/year due to cultivars planted are not superior types or cultivated in inappropriate climate and soil.

3.2. Identification obstacles for conducting coconut replanting programs in smallholder plantations

Several strategies that can be taken related to increasing coconut production are accelerating replanting the senile plantations and increasing the extent of coconut growing lands by promoting the planting of coconut in new areas. However, it is an exception in the coconut sector that growers are reluctant to uproot a coconut tree even when it attains senility and becomes less productive due to the obstacles faced by farmers. In addition, coconut has a long juvenile phase, so the benefits of coconut take a long time.

Table 1. Constraints for conducting coconut replanting programs in smallholder plantations.

| Constraint type         | Description                                                                 |
|-------------------------|------------------------------------------------------------------------------|
| Economic aspect         | Availability of working capital to purchase seeds                            |
|                         | Availability of alternative income when coconut has not yet produced          |
|                         | Availability of working capital                                             |
|                         | Low investment support for the implementation of integrated farming system   |
| Technical aspect        | Availability of superior seeds on time, quantity, quality, and price         |
|                         | Availability of production inputs                                           |
|                         | Availability of assistance for replanting programs program                   |
| Social and institutional aspect | Farmers’ negative perception of coconut replanting                          |
|                         | There is no regional-based replanting program                               |
|                         | Limited transfer of knowledge and technology so that knowledge of farmers is still limited |
|                         | Farmer groups do not operate in a substantive way                            |
|                         | Economic institutions such as cooperatives have not been developed            |
|                         | Low support from formal financial institutions                               |

Several obstacles faced by farmers related to replanting consist of economic constraints, technical constraints, as well as social and institutional constraints. Coconut replanting is related to the availability of superior varieties and farming models that provide benefits to farmers [16]. Technically, farmers in general have not used superior seeds, run a traditional cultivation system with limited use of technology,
while from the economic aspect, farmers’ capital is relatively low [5,17]. Financial constraints affect farm management and replanting decision in smallholder plantations [18]. The synthesis of constraints for conducting coconut replanting programs are listed in Table 1.

Economic constraints are related to the ability of farmers to carry out replanting which consists of logging costs, costs for procuring seeds, and working capital. Economic constraints are also related to the ability of farmers to divert productive activities in the form of implementing the Integrated Farming System to earn income during immature coconut plantations. Technical constraints are related to the availability of superior seeds, technology, and assistance for replanting programs. Social and institutional constraints are related to farmers’ views, extension services, farmer institutions, and financial support.

3.3. Strategies to accelerate replanting programs for coconut smallholders

Several strategies can be developed to overcome the existing problems. The strategy to accelerate replanting programs for coconut smallholders is related to seed systems development, capacity building of farmers and farmer organizations, and technology support. In detail, the strategy includes (1) coconut nursery establishment; (2) logistic management to accessing coconut seed nuts and transporting seedlings; (3) coconut seed distribution to farmers; (4) financial support for seed system development; (5) transfer knowledge and technology to accelerate coconut gap adoption; (6) information system management; (7) integrated farming system introduction; (8) seed technology availability; (9) farmer organization development; and (10) breeder farmer capacity development.

Figure 1. Analysis of strategies to accelerate replanting programs for coconut smallholders.

Description: (1) Coconut Nursery Establishment, (2) Logistic Management to Accessing Coconut Seed Nuts and Transporting Seedlings, (3) Coconut Seed Distribution to Farmers, (4) Financial Support for Seed System Development, (5) Transfer Knowledge and Technology to Accelerate Coconut GAP Adoption, (6) Information System Management, (7) Integrated Farming System Introduction, (8) Seed Technology Availability, (9) Farmer Organization Development, and (10) Breeder Farmer Capacity Development.

Quadrant 4 is “strong drive weak dependent” variables (independent). The variables in this sector are independent variables that have high leverage. The strategies in quadrant 4 are financial support for seed system development, seed technology availability, and breeder farmer capacity development.
Quadrant 3 is “strong driver-strongly dependent” variables (linkage). The variables in this sector must be studied carefully because the relationship between variables is unstable. Each action on that variable will impact the other, and the feedback on its effect can magnify the impact. The strategies in quadrant 3 are coconut nursery establishment, transfer of knowledge and technology to accelerate coconut GAP adoption, and farmer organization development.

Quadrant 2 is “weak driver-strongly dependent” variables (dependent). Generally, the changes here are not free. The strategies in quadrant 2 are integrated farming system introduction, coconut seed distribution to farmers, logistic management to accessing coconut seed nuts and transporting seedlings, and information system management.

The financial support for seed system development strategy is the most critical strategy to accelerate replanting programs for coconut smallholders. This strategy has high leverage, which is characterized by its influence on other strategies. Therefore, implementing this strategy is expected to encourage implementing other strategies so that a holistic system of accelerated replanting programs for coconut smallholders will be built.

3.4. Financing scheme for conducting coconut replanting programs in smallholder plantations
The method of coconut replanting consist of (1) clear cutting replanting, where new plantings are made after all the old trees have been cut down; (2) gradual cutting replanting where the planting and felling of old coconuts are gradual; and (3) insertion replanting where the cutting of old coconuts is carried out after the young coconuts [8]. The gradual cutting technique is the recommended technique for smallholder. Coconut replanting through a clear-cutting system can cause the farmer’s source of income to be cut off as long as the new coconut has not been produced. Replanting needs at least four years if the substitute coconut used is a hybrid type and seven years for a deep coconut [10]. By considering the role of coconut as an industrial raw material, it is recommended that replanting in a region is carried out around 15% of the total area. At the farmer level, the recommended method of replanting is 20% incremental cutting per year.

The implementation of coconut replanting consists of several stages: (1) nursery establishment; (2) seed distribution; and (3) planting and cultivation management (Figure 1).
In stage 1, the procurement and maintenance of seeds are carried out. At this stage, superior seeds are provided as needed. Seeds available must be of the right quality, quantity, time, price, and place, as part of the procurement of seeds, research on new superior varieties, and the construction of mother gardens. The support needed includes the availability of superior seeds, increasing the capacity of breeder farmers, and developing logistics management supported by information system development.

In stage 2, seed distribution is carried out. Seeds are distributed to farmers to be planted on farmers’ plantations. Stage 3 is planting and cultivation management. Good quality seedlings produced in nurseries are transferred to smallholder coconut plantations at this stage and carried out plant maintenance following GAP. Support that needs to be built at this stage includes knowledge and technology transfer, farmer organization development, and integrated farming system introduction.

Financial support for seed system development is related to designing a financing scheme according to the circumstances. The availability of appropriate financing schemes is expected to overcome economic, technical, social, and institutional constraints. The financing scheme is a replanting financing method that includes the provision of funds, the scope of the use of funds, and the mechanism for using funds. Technically, the financing scheme will support the implementation of strategies for accelerating replanting programs for coconut smallholders. The financing scheme allows various technical upgrade scenarios to be designed and implemented. Alternative sustainable oil palm financing schemes include corporate financing schemes, independent smallholder financing schemes, and plasma smallholder financing schemes [19]. The financing schemes to support coconut replanting consist of (1) self-financing scheme; (2) matching fund financing scheme; and (3) program-based financing scheme.

The self-financing scheme is a financing scheme carried out by farmers through farmer organizations, namely cooperatives and farmer groups (Figure 2). The economic activities of farmer groups are carried out formally through cooperatives. Cooperatives provide investment and working capital for nursery establishment, seed distribution, and planting and cultivation management. This financing scheme can...
be applied because farmers have strong financial capabilities and farmer institutions are well organized and running effectively.

![Diagram](image-url)

**Figure 3.** Model 1 “self-financing scheme”.

The Matching Fund Financing Scheme is a financing scheme carried out by coconut agroindustry enterprise (Figure 3). Coconut agroindustry enterprise finances investment and working capital for nursery establishment, seed distribution, and planting and cultivation management activities. Farmers’ contributions are made through cooperation in the form of Nucleus Estate and Smallholders (NES), where farmers carry out cultivation activities under the coordination of coconut agroindustry enterprise and sell their produce to coconut agroindustry enterprise. This financing scheme can be applied to conditions where the coconut agroindustry enterprise already exists and has good performance and has good economic and social relations with farmers.

![Diagram](image-url)

**Figure 4.** Model 2 “matching fund financing scheme”.

A program-based financing scheme is a financing scheme prepared based on the coconut plantation replanting program by the local government, which in its implementation works in collaboration with associations and financial institutions (Figure 4). Through the coconut replanting program, the government provides support in physical development and the initiation of cooperation with coconut-
The program will arrange investment financing and working capital for nursery establishment, seed distribution, and planting and cultivation management activities. Financial institutions will provide credit in various forms, namely working business loans, working capital loans, and investment loans. The association will encourage institutional arrangements and provide guarantees to financial institutions. This financing scheme can be applied to smallholder plantation-based coconut production centers where the role of coconut processing is still limited.

Figure 5. Model 3 “program-based financing scheme”.

The three financing schemes are complemented by the determination of loan ceilings, interest rates, credit periods (tenors), and credit costs [20]. The determination of the four elements is expected to be following the existing scheme to be implemented effectively.

4. Conclusions
Coconut replanting can improve the performance of smallholder plantations in Indonesia. The limited financial capacity of smallholder plantations is a significant obstacle in the implementation of replanting. The implementation of coconut replanting consists of several stages are nursery establishment, seed distribution, and planting and cultivation management. Various financing models were built, consisting of the self-financing scheme, the matching fund financing scheme, and the program-based financing scheme. Stakeholders involved in financing the coconut replanting program are financial institutions, local governments, farmer groups, cooperatives, coconut agroindustry companies, agricultural extension agencies, and research institutions. Effective implementation of recommended financing schemes will result in sustainable productivity improvements. In addition, increased productivity can help ensure supply consistency and result in profitable contracts within SMEs and processing organizations, resulting in more sustainable relationships and marketing benefits.

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