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A PRO-CONSERVATION ADAPTATION POWER MODEL FOR COCOCRAFT CRAFTSMEN USING COCONUT WASTE IN PURBALINGGA, CENTRAL JAVA, INDONESIA

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Abstract

The coconut industry is centered on organic material, which is easily damaged and can decay and stink. The volume of waste produced requires the expansion of landfill sites. Piles of coconut waste can negatively affect the health, cleanliness, beauty, fertility, and environmental productivity of the surrounding area. This waste harms both humans and natural resources. In Purbalingga, Indonesia, these problems have been solved by the creative and productive efforts of pro-conservation cococraft craftsmen. Cococraft is produced from coconut industrial waste using environmentally friendly technology and no chemicals. An established national cococraft market has increased the demand for raw materials. Consequently, cococraft craftsmen must deal with scarce raw materials and low incomes. The fragile adaptability and vulnerability of these craftsmen also interfere with continuity in the production of cococraft. This study formulated a pro-conservation adaptation model for cococraft craftsmen. The research model was based on the interrelationships of raw material efficiency, external–internal cooperation, economic potential, and zero coconut industrial waste production. The model design emphasized techniques that maintain the balance of economic, social, environmental, and technological interests. The model is useful as a theoretical reference for local governments and other parties that would like to adopt pro-conservation community development policies.

Keywords*: Coconut industry waste; Pollutants; Adaptability; Models; Pro-Conservation*

Introduction

Coconut (*Cocos nucifera* L.) is a strategic multi-functional plant, with both functional and economic benefits. All parts of the coconut plant are useful, producing food, drink, medicines, beauty products, and even fuel [1-3]. Coconut wood is strong and can be used to make furniture or buildings [4-5]. The waste from coconut products can also be processed into various craft designs and motifs [6, 7]. Fine coconut waste is also a raw material for organic fertilizer mixtures used for seedling and planting medium [8].

Coconut plants are classified in the Palm family (*Arecaceae*) and thrive in the tropics. Indonesia is the largest coconut production center in the world [9], with a total of 3,544,393 hectares of coconut plantations in 2017 and 18.3 million tons produced annually [10]. Approximately 98.98% of the plantations are managed by small businesses involving 6,517,486

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farmers and 17,232 supporting workers. Central Java Province is the largest coconut-producing region in Indonesia, with a planting area of 230,014 hectares and production of 181,131 tons per year. Within this region, the Regency of Purbalingga has 13,732 hectares of coconut plantations and an average production of 12,657 tons per year. The coconut production from Purbalingga is used to produce food, beverages, furniture, building material, copra, and grated coconut.

Each of these industries produces waste that cannot be consumed and has adverse environmental effects [11], including waste pieces of coconut wood, coconut shells, coir, coconut water, outer shells, and fibers. The problem of coconut waste is becoming increasingly complex, with wasted scattered in markets and around coconut-processing areas [12]. Coconut waste is organic, rots easily, and can cause environmental problems, including greenhouse emissions [13]. Coconut waste tends to become a residual product in the environment.

The piles of various types of coconut waste in Purbalingga need to be discarded in landfill sites, which require expansion. If too little is recycled, the landfill locations will become sources of environmental pollution. Each waste disposal site generates additional space problems, which require some integrative arrangements [14].

Stacks of waste wood and coconut shells create unhealthy conditions. When the piles of powder, debris, and sawn wood are soaked by rain, they create a stench. Waterlogged shell waste can become mosquito-breeding sites, which can lead to epidemics of dengue fever and malaria in nearby communities. Coconut waste in Purbalingga also disrupts the flow of water channels and causes waterlogging at the disposal sites. This has a negative effect on the preservation of natural biotic and abiotic ecosystems. Over time, piles of coconut waste can harm both humans and the environment.

In Purbalingga, cococraft craftsman have solved the problem of coconut waste. The craftsmen transform the waste into a variety of designs and cococraft motifs. The technology is environmentally friendly, and the craftsmen produce cococraft without using chemicals, employing a semi-manual mechanical technique that uses little electrical power. The contribution of these craftsmen has gone a long way toward resolving the coconut waste problems in Purbalingga and constitutes a pro-conservation activity.

The micro-cococraft business is a socio-economic safety valve that provides employment for teenagers who have dropped out of school and the unemployed in general. However, it is still difficult for craftsmen to earn a decent income; the average income is 310,000 rupiahs per production facility [15]. The income is not sufficient to cover the daily needs of the craftsmen's families, although they live in a subsistence economy. However, this does not prevent them from producing cococraft [7].

The craftsmen usually work using a conservative management system. The cococraft micro-businesses are run without formal planning, analysis, or evaluation. These conditions make it difficult for them to adapt to raw material scarcity. The threat of scarcity, combined with low incomes, disrupts the continuity of cococraft production. Therefore, this study formulated a model of pro-conservation adaptation for the cococraft craftsmen. This theoretical model provides valuable guidance for local governments when developing policies for environmentally friendly local resource-based community development. The model is useful for increasing the ability of craftsmen to maintain profitable cococraft production.

Material and Method

This research was conducted in Purbalingga Regency, Central Java Province, Indonesia, a cococraft center, where problems relevant to the research theme have been identified [7, 15]. Some of the coconut industries in Purbalingga produce waste that could become pollutants. However, the cococraft craftsman have solved the problem of coconut industrial waste in Purbalingga.

The research design uses development research methods based on the flow of the Courseware Development Process (CDP) Model [16], which includes six phases: analysis,

design, prototype model, formative evaluation, summative application, and evaluation. In the analysis phase, a survey was conducted to collect primary data as material for consideration in model formulation. The survey used a combination of dominant qualitative and less dominant quantitative approaches [17]. The combination of these two approaches increased the completeness, depth, and strength of the data.

The research population included all coconut waste cococraft craftsmen in Purbalingga. The determination of respondents is done by purposive sampling technique. Other primary data sources are key informant: coconut industry business manager, raw material scavenger, cococraft trader and expert judgment. The technique of selecting this key informants is using snowballing method.

The qualitative data analysis technique is carried out with Interactive Model [18]. Quantitative data were analyzed using descriptive statistics: percentage values, tabulation, frequency distribution, prevalent, scoring and graphic display. Model decision making is done by Multi Expert-Multi Criteria Decision Making or ME-MCDM Technique [19]. The ME-MCDM technique is relevant for evaluating the selection of alternative models on a non-numeric or qualitative scale. Each alternative model results are from focus group discussions with craftsman representatives that being evaluated and judged by experts through consultative discussions. The ideal alternative model is also formulated with the use of a scale in multi criteria function satisfaction. The model is adapted to conditions, problems and needs that being faced by craftsmen. The ME-MCDM technique is one of the best decision making processes that has alternative options in creating decision choices, decision criteria, decision weighting, assessment methods, model calculations and final decision making [19].

The decision-making criteria for the ideal model are: guaranteed in available volume of raw materials, variations types of raw materials from coconut waste, product diversification and network collaboration. Those four criteria are the basis for achieving key conditions within the model for the development of pro-conservation adaptation. The targeted key conditions: economic potential, zero coconut waste, raw material efficiency and external internal cooperation. The Analytical Hierarchy Process (AHP) technique is applied to assess the dominant criteria from both expert and innovator craftsmen. All results of the analysis are interpreted and presented in qualitative and quantitative descriptions.

Result and Discussion

The coconut industry in Purbalingga produces various types of waste in both urban and rural areas. Until recently coconut waste was left scattered or piled in disposal areas near settlements, markets, and coconut businesses. As the volume of waste increases, more extensive disposal areas are needed. Most landfills areas are in open locations and cause serious environmental problems and social threats [20].

The problem of accumulating coconut waste in Purbalingga was finally overcome by micro-cococraft businesses, in which individuals or groups produce cococraft products from coconut waste. The products include cococraft, briquettes, charcoal, coconut fiber mattresses, coconut fiber brooms, nata de coco, organic fertilizer, seedling and planting medium, and fish feed. Coconut shell has high economic value and can be used for fuel and to produce wood vinegar through pyrolysis. This wood vinegar is a good raw material for agro-industry [21].

The most abundant coconut industrial waste (61%) is affir wood pieces, including wood hemispheres, wood chips, and shells. Such waste requires more land for disposal. This is important because 76.6% of the industrial coconut waste in Purbalingga is in solid form, while 11.4% is liquid and 12% is dust. Waste has different characteristics and composition according to its source [14]. Table 1 summarizes the coconut-processing industries in Purbalingga and the types, shapes, and average volume of waste.

The micro-cococraft business requires solid coconut waste in the form of pieces of affir wood, wood hemispheres, wood chips, and shells. The survey respondents obtained this coconut

waste from scavengers with whom they deal regularly. Initially, the scavengers delivered the coconut waste every day in small volumes. Subsequently, the delivery frequency decreased to once every 3 days. For the past year, the scavengers have delivered raw materials once a week to save shipping costs.

Table 1. Industrial Activities, Types and Volumes of Coconut Waste

No.	Coconut Processing Industries	Varieties of waste	Form of coconut industry waste			Average Volume (Kg/day production)	Persentage (%)
			solid	liquid	dust		
1.	Building construction industry	Affir coconut wood pieces	√			62	10
		Cleavage of coconut wood	√			58	9
		Coconut wood sawdust			√	24	4
		Coconut wood saw blade			√	16	3
		Coconut wood chips	√			29	5
	Total					189	
2.	Furniture industry	Affir coconut wood pieces	√			47	8
		Cleavage of coconut wood	√			38	6
		Coconut wood sawdust			√	16	3
		Coconut wood saw blade			√	12	2
		Coconut wood chips	√			23	4
	Total					136	
3.	Copra industry	Coconut coir	√			38	6
		Shell	√			41	7
		Coconut water		√		42	7
	Total					121	
4.	Coconut grater industry	Coconut coir	√			22	4
		Coconut water		√		25	4
		Shell	√			29	5
		Outer coconut skin	√			29	5
	Total					105	
5.	Young coconut water beverage industry	Shell	√			19	3
		Coconut fiber	√			16	3
		Coconut water		√		3	0,4
	Total					38	
6.	Food industry	Shell	√			11	2
		Coconut pulp	√			7	1
		Coconut coir	√			9	1
	Total					26	4
Total (1+2+3+4+5+6)						615	100

Another factor contributing to this reduction in delivery frequency is the increasing number of consumers using coconut waste. The scavengers have to share it with various users, but they are often unable to meet the increasing demand because of the limited supply. The increased demand has actually reduced the amount of waste in landfills, constituting a pro-environment conservation behavior.

Coconut waste transactions between scavengers and the survey respondents happen continuously. After collecting the waste from various sites, the scavengers store it in their houses for a few days before delivering it to the workshops of the cococraft craftsmen. As the scavengers removed the coconut waste each day, it no longer had to be stacked at disposal sites. figure 1 shows the cycle of the coconut waste transactions.

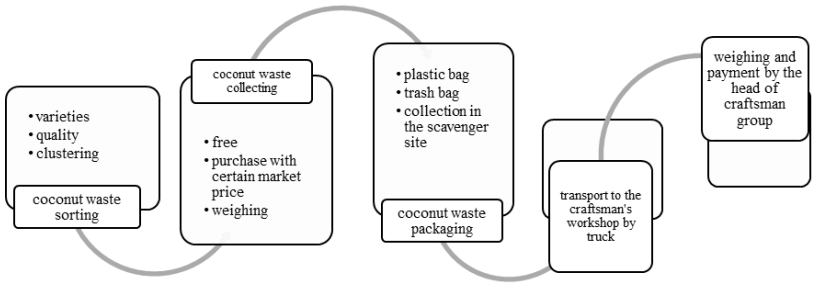
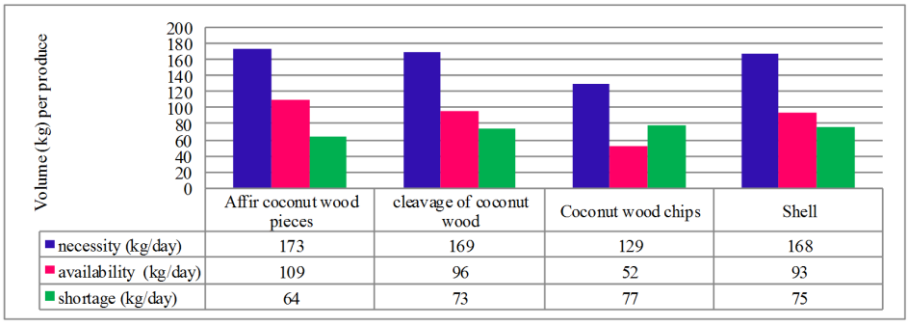


Fig. 1. Coconut industrial waste transaction cycle

The growth in the market and consumer requests for cococraft has increased the demand for raw materials. The cococraft respondents usually worked from 7:00 a.m. until 10:00 p.m. to process the coconut industrial waste into various designs and cococraft motifs according to market trends, producing briquettes, fuel charcoal, cocodust, and seedling and plant growth medium from coconut pieces, fragments, debris, fiber, powder, flour, or dust [8].

For the past 2 years, the respondents have experienced shortages of raw materials. They have solved this problem by ordering coconut waste collectively. The head of a craftsmen group coordinates the orders, pricing, and distribution to other craftsmen. When individuals run out of raw materials, they can borrow from other craftsmen. Once a craftsman has material, any borrowed material must be returned immediately. Figure 2 summarizes the demand for, availability of, and shortages of raw materials.

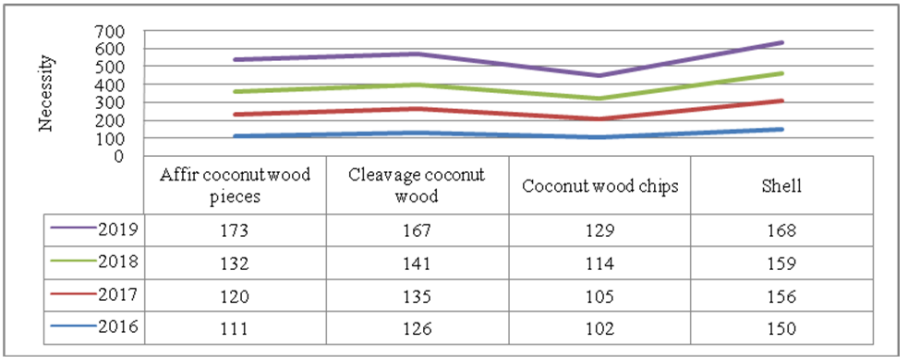


	Affir coconut wood pieces	cleavage of coconut wood	Coconut wood chips	Shell
necessity (kg/day)	173	169	129	168
availability (kg/day)	109	96	52	93
shortage (kg/day)	64	73	77	75

Fig. 2. Needs, availability and shortage of cococraft raw materials

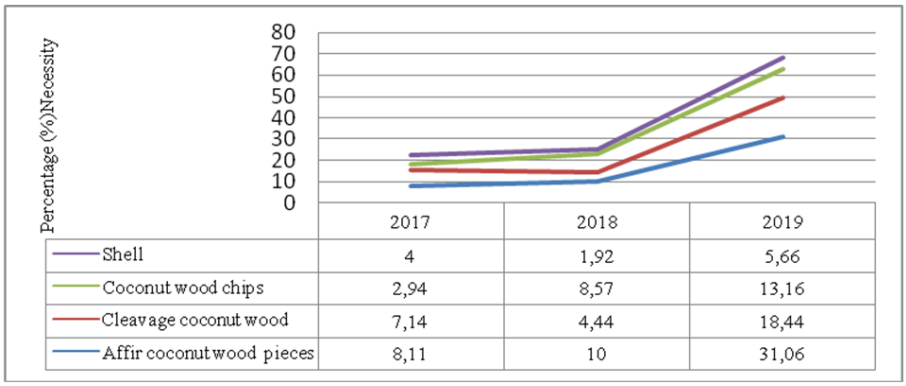
The increased demand for materials for cococraft was difficult for the respondents to avoid. From 2016 to 2019, the demand for all types of coconut waste continued to increase. Consequently, more than 50% of respondents paid less attention to the characteristics of the coconut waste, although this affected the quality of their cococraft [15]. The cococraft market has not only expanded locally in Purbalingga but also in other cities in Java, Kalimantan, Sumatra, and Bali. Market expansion has increased the demand for raw materials. Figure 3 shows the increased demand for cococraft raw material from 2016 to 2019.

The increase in demand for coconut waste has varied among the different types. The increase has been greatest for solid waste in the form of affir wood, which can be processed into a variety of special cococraft motifs with artistic decorations. The increase in the demand for wood fragments and wood chips has been moderate, while the trend for coconut shell has been relatively low. The increasing demand for coconut waste has affected the demand for landfills and has reduced the negative effects of coconut waste. Figure 4 shows the trend of increased demands for coconut industrial waste for cococraft raw materials.



	Affir coconut wood pieces	Cleavage coconut wood	Coconut wood chips	Shell
2019	173	167	129	168
2018	132	141	114	159
2017	120	135	105	156
2016	111	126	102	150

Fig 3. The Growth of Coconut Industrial Waste Requirement for the 2016-2019 Period



	2017	2018	2019
Shell	4	1,92	5,66
Coconut wood chips	2,94	8,57	13,16
Cleavage coconut wood	7,14	4,44	18,44
Affir coconut wood pieces	8,11	10	31,06

Fig. 4. Trend of increasing coconut waste volume for cococraft

The problems with scarcity of raw materials are creating some dilemma for respondents. On the one hand, this problem proves that the micro-cococraft business has a significant contribution in the conservation of disposal land. However, on the other hand, the problem of this scarcity of raw materials for cococraft is prone to disturb the achievement from their production targets. If the scarcity of raw materials continues then in a short period of time it certainly resulted with the production of cococraft threatened to stop, and this kind of condition is not expected by the respondent. This is an urgent matter, consider that the cococraft micro business is the main source of livelihood for the respondents. The highest severe intensity in the scarcity of raw materials lies in the difficulty of volume element growth, the long interarrival time, the distance of the industrial waste source location being further away and the increasing price of raw materials. The intensity of problems from some scarcity elements of coconut industrial waste is shown in figure 5.

The cococraft micro business has a variety of uses both for human and natural resources. Their functional benefits are considered high for reducing the volume of coconut industrial waste. The cococraft production also includes real actions that basically are pro-conservation. The other indirect environmental functional benefits from cococraft production are to maintain the health, cleanliness, beauty, fertility and productivity power from the land at the location surrounding the coconut industry, markets and landfills. Still the problem it's difficult to overcome the consistency of cococraft production since it only provide a minimal benefits with the economic empowerment of respondents. Conversely, the existence of a cococraft micro business are indeed contributes meaningfully for the absorption of labor and fulfillment of market and consumer demand in cococraft.

The economic value of cococraft production is highest when it meets market and consumer demand. This has pushed the cococraft market onto a national scale. The economic benefits of cococraft production include reduction of industrial coconut waste, land conservation, economic empowerment, and employment. Consequently, the development of micro-cococraft businesses has high social benefit. Cococraft production has solved the problem of the accumulation of coconut waste in the areas surrounding markets, furniture factories, and building and landfill sites in Purbalingga. The productive, creative behaviors of the survey respondents can be considered pro-conservation actions. Figure 6 illustrates the environmental, economic, and social benefits of the micro-cococraft business.

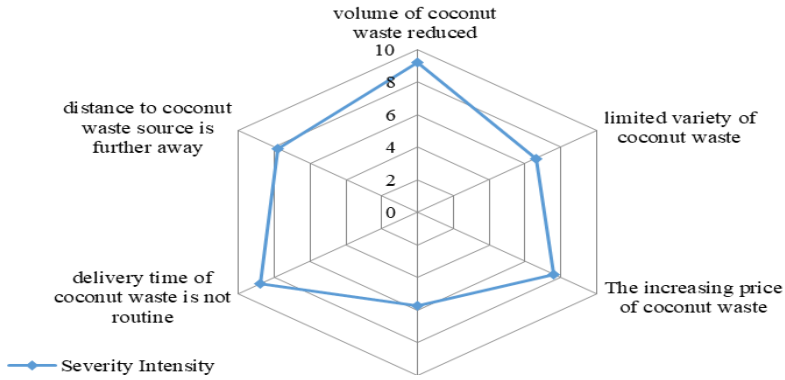
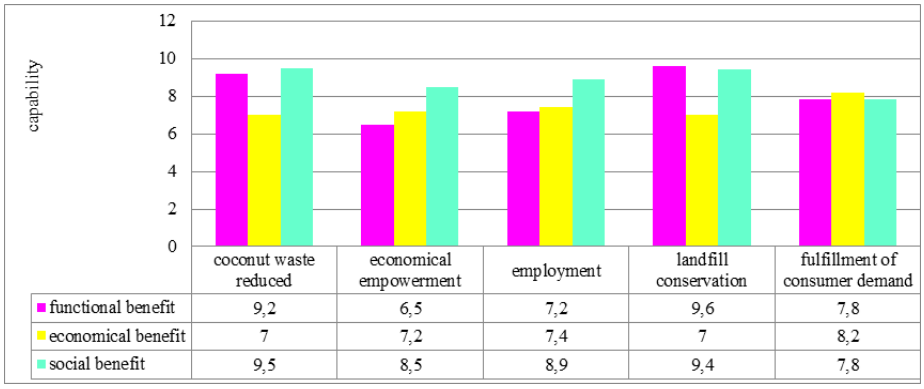


Fig. 5. Intensity of severity in scarcity element of coconut industrial waste



	coconut waste reduced	economical empowerment	employment	landfill conservation	fulfillment of consumer demand
functional benefit	9,2	6,5	7,2	9,6	7,8
economical benefit	7	7,2	7,4	7	8,2
social benefit	9,5	8,5	8,9	9,4	7,8

Fig. 6. Cococraft's functional, economic and social business benefits

The management of cococraft micro-enterprises requires a model for development of adaptation that remains as a pro-conservation. The model which formulated in favor of cococraft production can last continuously and provide benefits to the respondents. The design model of adaptation development from the results of analysis using the ME-MCDM Technique shows that one of the key target conditions which need to be prioritized are the efficiency of raw materials usage. Achieving this key condition requires the accuracy of the respondents in identifying the characteristics of coconut waste which has the potential to produce cococraft with good quality [15]. The efficiency of raw materials usage also includes the awareness and ability of respondents to use cococraft waste for processing products with economic value. Another key condition that being targeted is strengthening internal and external cooperation. This is important considering the respondents' dependence as a costumer with waste collectors to provide raw materials is relatively high. Respondents also deserve to develop some

cooperation with other coconut industrial waste providers. The next key target condition to achieve is to increase the economic potential of cococraft production and maintain the act of making zero coconut waste.

Achieving these four key conditions is a passage to increase pro-conservation adaptability. The ideal design model is formulated using the Analytical Hierarchy Process (AHP) technique. The model is built based on conditions, problems, needs and potential resources of cococraft craftsmen. Model formulation also refers to welfare theory that pays attention to economic interests based on the view that individual desires must be fulfilled first in order to achieve their maximum limits according to resource allocation [22]. The model also emphasizes the urgency of maintaining a balance between economic, social, environmental and technological interests [23]. In figure 7, the design of the development model in pro-conservation adaptation for cococraft craftsmen was observed.

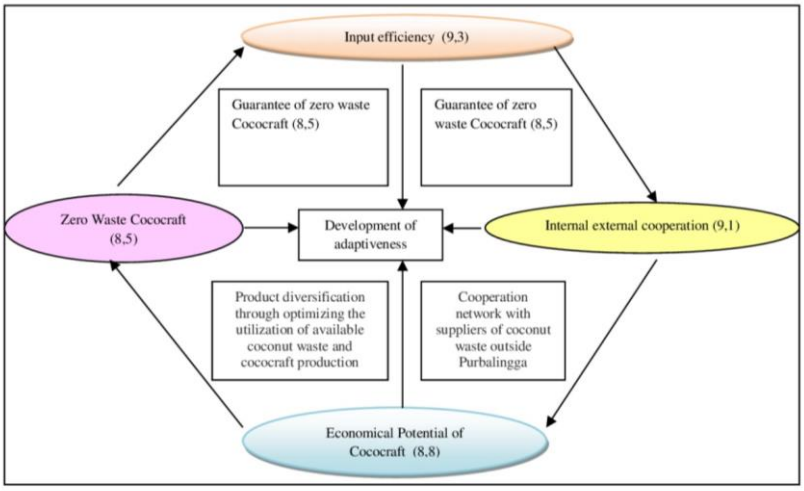


Fig. 7. Pro-conservation adaptation power development model

The increase in demand for coconut waste has varied among the different types. The increase has been greatest for solid waste in the form of affir wood, which can be processed into a variety of special cococraft motifs with artistic decorations. The increase in the demand for wood fragments and wood chips has been moderate, while the trend for coconut shell has been relatively low. The increasing demand for coconut waste has affected the demand for landfills and has reduced the negative effects of coconut waste.

Conclusions

Coconut industry waste is prone to became pollutants that contaminate the environment. Piles of coconut industrial waste continue to grow and scatter in various disposal locations. There are various types and forms of this coconut industrial waste. The volume of coconut industrial waste that is in solid form from wood cuttings, wood halves, wood chips and shells turns out to be the most form of waste that can be found in Purbalingga. Waste collection in several disposal sites disrupts health, cleanliness, beauty, fertility, productivity of the area in the disposal site. Puddles in coconut shells could become a den for mosquitoes which results in residents around the dumping sites prone to infected by dengue and malaria epidemics. The omission of this coconut industrial waste is a complex problem for both human and natural resources. However, the problem of coconut waste in Purbalingga has been overcome by the productive behavior of cococraft craftsmen, since the cococraft craftsmen obtain their raw

materials from scavengers who provide coconut industrial waste regularly. Both parties have this mutual transaction for a long time.

The micro-cococraft business has functional, economic and social benefits. Functional benefits are proven from the ability to significantly reduce the volume of coconut industrial waste in Purbalingga. Economic benefits are shown by the existence of a cococraft micro-business as a basic livelihood of craftsmen. The social benefits of this business are from the chance to absorbing workers who come from school dropout teenagers and other unemployment.

The problem of the cococraft craftsman is the scarcity of raw materials. The volume of coconut waste provided by scavengers is started to became more limited. Provision of this raw materials is done collectively. Other issues regarding the income of craftsmen are still relatively low. The adaptability of craftsmen to faces this problem is also still fragile. Even so, craftsmen keep on continuing to maintain the consistency of making cococraft production. The majority of craftsmen are in a subsistence economy condition. These problems are feared to disrupt their continuity in creating cococraft production within the short term. The potential impact that might arises is that the craftsmen started to lose their productive work and the volume of coconut industrial waste began to overloaded again.

This study formulated an adaptation power development model of the cococraft industry in Purbalingga, Indonesia, grounded in four key conditions: efficient use of raw materials, external–internal cooperation, economic potential, and zero cococraft waste. The model emphasizes the equal maintenance of economic, social, environmental, and technological interests. The model is based on a pro-conservation, environmentally friendly design and is useful as a theoretical reference for local governments when developing local policies for resource-based community development programs.

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