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Empowerment of Subsistence Craftsmen through the Adoption of Environmentally Friendly Cocodust Production Technology

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***Abstract*— The adoption of environmentally friendly production technology supports the empowerment of subsistence craftsmen through product diversification. However, a study of cococraft craftsmen in Purbalingga District, Purbalingga Regency Province, Central Java, Indonesia, revealed that the factors restricting the adoption of technology in cocodust production were technological complexity, limited capital, and social rigidity. The craftsmen had little awareness of the functional and economic benefits of cocodust. The adoption of new technology was unsuccessful due to a lack of evaluation of the cocodust characteristic regarding compatible, complex, observable, and triable aspects. Subsistence craftsmen were unsure of the characteristics of the facilitators of new technology, especially concerning economic value, a sense of belonging, production costs, accessibility, and social benefits. The key research output of this in-depth case study was a management scheme that could be used to facilitate technology adoption. The essence of this management scheme was to prompt a change in behavior at each stage of adoption through counseling, networking, sharing, and continuous advocacy. Continuous cocodust productivity would also reduce cococraft waste. Market security and price feasibility were also supporting elements, helping to guarantee additional income and thereby leading to the empowerment of the craftsmen. If the management scheme were to lead to technology adoption, it would provide a solution to the problem of the scarcity of agricultural land. Cocodust products can also be used effectively as a seedling or planting media on organic farms, especially those on the narrow and marginal area.**

***Keywords*—adoption; empowerment; product diversification; production technology; subsistence craftsmen.**

I. INTRODUCTION

The empowerment of farmers remains one of the top priorities in most developing countries with agriculture-based economies. Empowerment requires farmers to act productively, creatively, and innovatively. Such empowerment is urgently needed, considering that the vast majority of farmers are prone to be caught in a poverty trap. The vulnerability of farmers to poverty is a consequence of weak human resources in the socio-economic environment. It included low levels of education, low income, lack of entrepreneurship, poor health status, limited access to technology, low credit utilization, and limited ability to adopt innovation [1]–[4]. The primary source of farmers' incomes is derived from small-scale agricultural businesses, often based on single commodities. Farmers in developing countries have limited access to technology, additional production capital, and markets. However, farming communities still have intense social energy, especially in terms of local wisdom, collectivity, cohesion, community sentiment, local institutions, social capital, and solidarity [5]–[7]. Social energy provides effective support for the empowerment of farmers. Therefore, various empowerment programs utilize social power to ignite the spirit of farmers, encouraging them to participate actively through a group approach. Achievement of the goal of empowering farmers remains a slow process. The willingness, intentions, and actions of farmers are built collectively, but individual actions must be enabled to encourage farmers to embrace innovation [8]. Unique ability as an agent in the innovation

system encourages individuals in farming communities to be more productive, creative, and innovative.

Empowerment projects have the strategic function of increasing self-capacity and improving the quality of human resources to produce something with added value [9], [10]. The goal of empowerment is not focused solely on developing economic causes; an essential objective is the development of sociocultural behavior. Such behavior is key to individuals' self-awareness and motivation, enabling them to improve their potential as independent individuals actively.

The empowerment process should not stop at a certain point where farmers are still not fully independent. Empowerment should be achieved by following a method in a continuous cycle. Farmers who have developed a dual livelihood pattern also need to empower themselves to increase their capacity to become more self-reliant. Empowerment is a multidimensional activity with economic, social, cultural, psychological, ecological, and other aspects [11]. An empowerment process based on livelihood diversification in on-farm, off-farm, and non-farm locations cannot be separated from entrepreneurship and the adoption of technology [12].

Determinant factors in the empowerment of farmers have different strengths at various stages of the process. One of the most important factors that drive motivation is the quality of human resources [13]. The quality of human resources is a reflection of social behavior in the act of economic morality within the scope of subsistence ethics. Another important determinant is the power of individual adoption in the context of social network-based collaboration [14], [15]. Social networks can be considered to be channels for the adoption of agricultural technology. Still, the problem of innovation characteristics, in terms of the complexity, suitability, and simplicity of testing by farmers, must be considered [16]. Farmer household empowerment is also determined by the ability to develop livelihood diversification in on-farm, off-farm, and non-farm situations using commodity choices based on market trends [17].

In the dynamics of village community empowerment based on livelihood diversification, farmers often transition from an on-farm to an off-farm lifestyle [18], [19]. Farmer's work moves from on-farm to off-farm locations because farmers do not have ownership of the agricultural land to be cultivated [20]. About 75% of farmers in the world manage small-scale agricultural businesses (land area < 2 ha) and have low-income levels [21]. The scarcity of agricultural land is a result of the pressure to convert arable land for non-agricultural uses combined with extreme trends in the degradation of land fertility. The empowerment of farmers through livelihood diversification has led to a transition from an on-farm to an off-farm lifestyle. The cococraft craftsmen provide one example of a group of farmers who switched from on-farm to off-farm working conditions in the subdistrict of Purbalingga Wetan, Central Java, Indonesia. In this subdistrict, cococraft micro-businesses are managed by craftsmen, most of whom have subsistence-level socioeconomic characteristics, including conventional and straightforward business management practices [2], [22].

The incomes received by the craftsmen who own the cococraft micro-businesses are relatively small, ranging from IDR. 3,000,000 to IDR 5,800,000 per month. The income of an assistant craftsman is only IDR 1,200,000–IDR 2,500,000 per month. The assistant craftsman wage rate depends on the ability to produce cococraft products on every working day. The small incomes make it difficult for the craftsmen to increase the scale of their businesses. Their production capital is also limited, which means that the craftsmen remain at the subsistence boundary. They earn relatively small incomes due to their slow integration of empowerment actions through product diversification. Only a few craftsmen have begun to diversify their products through innovative, creative, and productive activities, namely through cococraft and cocodust production. Like cocopeat, coconut fiber, and coconut coir, cocodust is an effective alternative planting medium for various types of plants in pots or polybags [23], [24]–[27]. The only difference is the raw material; coconut peat, coconut fiber, and coconut coir are obtained from coarse-sized coconut belts. Whereas, cocodust is processed from cococraft production waste (wood and coconut shells in the forms of dust particles, flour, and fine powder). According to particle size, cococraft waste used as cocodust material is classified as fine (< 0.5 mm), medium (0.5 to < 0.3 mm), and coarse (3 to < 4 mm) [25]. Cocodust is an innovative, environmentally friendly product. By producing cocodust, the craftsmen are making a real effort to reduce the environmental pollution caused by the piles of cococraft waste that cannot be processed.

Cocodust can be used by craftsmen to grow vegetables and flowers in their backyard with viticulturally technology. Cocodust products provide various functional and economic benefits. Something that becomes an important issue turns out to be the slow progress in the empowerment of those craftsmen through the adoption of cocodust technology. Few craftsmen willingly adopt cocodust production technology. The majority of them are still reluctant to adopt. Craftsmen who are unenthusiastic to adopt usually have a subsistence and non-innovators trait. The willingness to adopt is slow after the initial stage of being conscious and interested in technology. They do not dare to continue to the stage of assessment, testing, and adoption. The problem of being reluctant and have a passive attitude of those craftsmen were influenced by their background of subsistence conditions and their difficulty of managing cococraft micro-businesses. This made the subsistence craftsmen find it challenging to increase their revenue since their products are monotonous.

The empowerment of craftsmen became stopped, and it creates difficulty in helping them from their economic problems. The determination of the research theme was based on those problems. After that, the focus of the study is the design of the empowerment mechanism for the adoption of environmentally friendly cocodust production technology by the subsistence craftsmen. The findings of this research became a solution to the problem of reluctance and passive behavior of some subsistence craftsmen in adopting cocodust production technology. The design of empowerment mechanisms can be used as reference material, comparisons and considerations to obtain the

solutions to similar problems. The technology of cocodust production is significant for resolving the issue of scarcity of agricultural arable land. This product can become a seedling media and alternative planting media for organic farm farmers in a narrow area.

II. Materials and Methods

The research location was Purbalingga Wetan Subdistrict, Central Java, Indonesia. Purbalingga Wetan itself is a center of cococraft production from coconut waste, specifically wood and shells. Upon receipt of orders, the craftsmen produce cococraft items from the coconut belt. The operation of cococraft micro-businesses is the main activity of the craftsmen who own these businesses. These micro-businesses absorb other workers who serve as assistant craftsmen. Cococraft craftsmen are typically school dropouts, fired employees, farmers who are incapable of securing arable land, and other unemployed residents. The Regional Government of Purbalingga Regency provides some assistance to this group of craftsmen in the form of workshops, product showrooms, work tools, and entry to market channels (e.g., exhibitions).

The research presented here was a descriptive case study conducted using a combination of qualitative and quantitative approaches, with a quantitative-dominant model [28]. A qualitative approach is appropriate for examination of the issues of subsistence conditions, causes of inaction, and the design of adoption mechanisms. The quantitative approach was applied to capture data regarding the production ability, type, shape, source, and availability of cococraft waste and its functional usefulness, together with any factors inhibiting the adoption of innovation.

The primary data for the study was a group of craftsmen, including micro-business owners and their assistant craftsmen, who worked on a daily or weekly wage system. Information was collected using a purposive sampling technique. The criteria used to determine whether individuals were included in the study are as follows:

- Subsistence craftsmen who had developed the process of adopting cocodust production technology.
- Ability to produce a finely shaped 4-mm cococraft waste product.
- Ability to use processed or unprocessed waste.

Individuals who had not adopted cocodust production technology were also considered. In total, 31 individuals were ultimately selected from the craftsmen. Another primary data source was a group of individuals classed as innovator craftsmen, who had adopted cocodust production technology to obtain functional and economic benefits. The key informant in the study was the owner of a cococraft micro-business, identified using the rolling snowball sampling technique. Those who were selected as respondents can be classified as two groups of respondents based on the working units, i.e., some craftsmen work in Manunggal Karya Workshop and craftsmen who work in their houses. Data were collected primarily through in-depth interviews, participant observation, and focus group discussions. The sources, technique of data collection, and types of data used in this study are presented in Table 1.

TABLE I
Sources, Types, And Techniques Of Data Collection From The Craftsmen Of Purbalingga Wetan

No	Type of Data	Data Collection Techniques		
		In-depth Interviews	Participatory Observations	FG D
1.	Subsistence condition	60	10	20
2.	Production ability	60	30	10
3.	Types, forms and sources of cococraft waste availability	70	20	10
4.	Factors causing inaction of adoption	40	20	40
5.	Functional benefits	60	30	10
6.	Economic benefits	70	10	20
7.	Inhibition power at each stage of adoption	50	25	25
8.	Adoption potency in the general characteristics of cocodust innovation	70	10	20
9.	Adoption potency in the specific characteristics of cocodust innovation	70	10	20
10.	Mechanism design for adoption technology with subsistence craftsmen	30	20	50

Data processing and analysis were quantitative and qualitative. Quantitative data were processed using simple statistics, namely the calculation of average values, percentages, and frequency distributions, as well as scoring and tabulation. The description of data analysis techniques is shown in Table 2.

TABLE II
Data Analysis Technique Adjusted By Each Of The Problem Formulation Focus

No.	Problem Formulation Focus	Data analysis technique
1.	Subsistence condition	*Interactive Model* [29]
2.	Production ability	Frequency distribution and histogram
3.	Types, shapes, and sources of cococraft waste availability and ratio	Percentage value and tabulation and frequency distribution
4.	Factors that cause inaction of adoption	*Interactive Model*[[29] Reflection Model [30], [31]
5.	Functional benefits	Scoring and histogram
6.	Economic benefits	Scoring and histogram
7	Inhibition power at each stage of adoption	Scoring and frequency distribution polygons
8	Adoption potency of the general characteristics of cocodust innovation	Scoring and frequency distribution polygons
9	Adoption potency of the general characteristics of cocodust innovation	Scoring and frequency distribution polygons
10.	Mechanism design for adoption technology with subsistence craftsmen	*Interactive Model* [29] Model Refleksi [30], [31]

III. Results and Discussion

Cococraft craftsmen are a part of the farming community who have diversified their livelihoods in recent years. Their livelihood pattern has developed into an off-farm lifestyle. Craftsmen process coconut waste into various design plans for cococraft motifs. The type of design and cococraft motifs are adjusted according to market trends [32]. Although they obtained small incomes, many respondents still maintained cococraft micro-businesses as their basic livelihood pattern. Coconut waste is a resource that can be processed into a variety of designed craft products with functional and economic value [33], [34].

The majority of respondents (> 50%) remain to live in the subsistence condition. The average income level was IDR. 2,750,000 per month. The economic burden of their family was on average of 5 people. The cost of living per individual family was an average of IDR 550,000 per month or IDR 18,333 per day. That circumstance illustrates how subsistent respondents are vulnerable to experiencing urgent economic problems. However, the minimum cost of living, especially to meet their basic family needs, is not a problem for them. A micro cococraft business is still maintained as their main source of family income. This situation is closely related to the confidence of subsistence respondents who feel safe and secure in their income since the cococraft has a market certainty.

The outflow of time for subsistence respondents and innovators to produce cococraft is, on average, 14 hours per day. The work starts at 7 am and ends at 9:00 pm. If the order peaked, the respondent worked until late at night (24.00 pm). Each respondent works every day without holidays. High time allocation for producing cococraft. The condition is under the explanation of the respondent whose initials Wd (34 years old):

> *"Working to process coconut shells and coconut wood waste takes a long time. From morning to night. There are no holidays. This is done for the pursuit of time. Promises to consumers and traders must be kept. Work continues. Although the benefits are only a few."*

The work of processing coconut waste into cococraft was carried out by some respondents in the workshops belonging to the *Manunggal Karya Group*. Others work in their own homes. Their workshops are usually combined with the kitchen, living room, or a particular room in their home yard. Respondents' lags in processing fine-form waste from cococraft production because product modification technology is still minimal. In connection with this problem, a respondent whose initials Tr (45 years old) explained several reasons for letting cococraft waste scatter around the workshop:

> *"Not yet had time to process cococraft waste. Not skilled in waste treatment technology into useful products. We are too busy every day to work producing cococraft. So, there is no time to produce other products."*

Differences among working units were found to constitute a factor determining production capability. The production ability of craftsmen and innovators working in the *Manunggal Karya* workshops was higher than that of those who worked at home. Respondents who produced goods in workshops consistently maintained business relationships with collectors, retailers, and customers. The quantity and quality of their cococraft products were also maintained. All study participants completed the product finishing process well. They adhered to the time limit for the completion of product orders, based on the initial agreement. Respondents indicated that they would feel guilty if an order not finished in time. The quality of the cococraft products was consistent, and consumers were not disappointed. The design and cococraft motifs were adjusted to meet market demand. The ability of the craftsmen to adjust the design of the cococraft motif according to market trends, together with customer demand, supported the continuity of business relationships. The craftsmen commonly gave customers bonus pieces of cococraft as a hospitality service.

The working conditions were very different for craftsmen who produced their products at home. Product completion was often delayed. The respondents were often negligent, forgetting to prioritize the first customers when accepting other orders. They lacked warnings from fellow craftsmen to keep them on track in completing orders on time, whereas this practice was common in the *Manunggal Karya* workshops. Some respondents also paid little attention to the maintenance of product quality because they were rushing to meet order deadlines. These respondents rarely perceived the unique nature and neatness of cococraft, and they tended to hold the principle of "goods ready and goods sold." Fig. 1 shows the production capacities of the craftsmen in the two work locations.

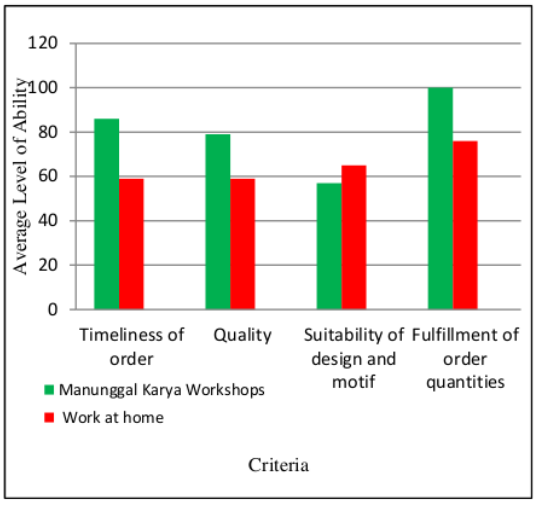

Fig. 1 Craftsmen's production capacity in two different working units

Consistent cococraft production by the subsistence craftsmen and innovators generated a constant stream of various types and forms of waste. Respondents used some types and forms of waste functionally and economically. Utilization of this waste, however, was of little value for subsistence craftsmen and innovators. The various types and forms of cococraft waste detailed in Table 3 are classified according to size, namely coarse, medium, and fine waste. Coarse cococraft waste in the form of a piece of wood and

coconut shell becomes cococraft material. Another crude waste is an unused product due to some defects, broken (bent, hollowed), unsold, and molded. The amount of crude waste (23 percent) is more than medium waste (9 percent) but less than the fine one (68 percent).

Medium-sized waste is only 9 percent in the hemisphere or fraction shape. This waste is obtained from the process of splitting and stripping coconut wood or by solving shells. The amount of medium-sized waste is the least amount of waste compared to coarse and fine size waste.

TABLE III
VARIOUS TYPES, SHAPES, SOURCES, AND AVAILABILITY OF COCOCRAFT WASTE PRODUCED IN PURBALINGGA WETAN

Types based on size	Waste types	Waste Sources	Average Volume of Waste Per Production (Kg)	Total waste per types (Kg)	Percentage (%)
Fines	Powder	Coconut wood sanding	9	50	27
		Coconut shell sanding	7		
		Coconut sawmills	5		
		Shrinkage of coconut wood	10		
		Shrinkage of shell	15		
		Coconut wood scrape	8		
		Coconut shell scrape	6		
	Dust	Drilling of coconut wood/shell	11	58`	32
		Coconut wood sanding	14		
		Shell sanding	14		
		Coconut wood scrape	12		
		Scraping of coconut shell	7		
	Flakes/slices	Shredding of shell	9	16	9
		Coconut sawmill	7		
Medium	Fractions	Wood cleavage	5	17	9
		Stripping coconut wood	5		
		Breaking coconut shell	7		
Coarse	Pieces	Coconut sawmills	7	19	10
		Cutting of coconut shell	7		
		Cutting of coconut wood	5		
	Unused Product	Infected by mushroom Spots	6	23	13
		Not sold	4		
		Wrong design and motifs	2		
		Defective product (broken, rough, curved, perforated and incomplete product texture)	11		
Total				183	100

The finely shaped cococraft waste was initially obtained from cococraft product which made from coconut waste. Based on the size, those will be distinguished in very fine categories around < 0.5 mm, while 0.5 mm to<0.3 mm is a medium size, and the coarse size is 3 mm to < 4 mm [25]. The cococraft waste, which includes coarse fine material, is contained from shredded shells and sawdust of coconut wood waste. There are not many pieces or slices produced from the cococraft processing process, only 12 percent in amount.

Medium fine waste in the form of the powder obtained from the process of shredding, sanding, sawing, and erosion of coconut wood and shell. The amount of this fine waste is more than the number of pieces and slices by 40 percent. Dust and flour are a very fine-sized waste produced from the process of drilling, sanding, and erosion. Dust or flour waste (48 percent) is the most produced waste by the respondents. In Fig. 2, the categorization of cococraft waste could be observed.

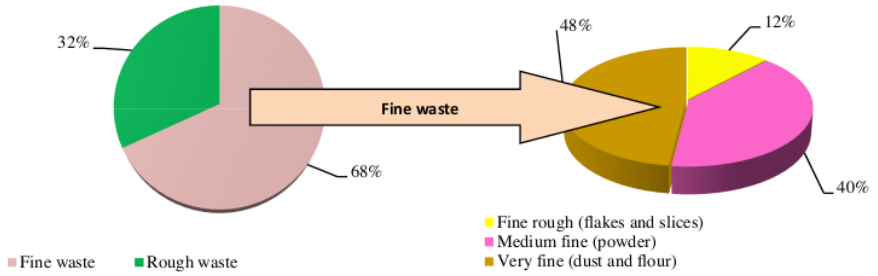

Fig. 2 Cococraft waste ratio based on the fineness of waste

Cococraft waste in the form of rough, medium, and fine-sized has minimal functional benefits. Most crude waste (68 percent) is carried by scavengers to be used as fuel for cooking stoves. Only a few respondents obtained the functional benefits of crude waste for their cooking stoves (35 percent) and charcoal (1 percent). Respondents let this crude waste to be piled up on the edge of the workshop before being collected by scavengers. Craftsmen with assistance status also utilize some crude waste that can still be processed for small and mini-sized cococraft materials such as brooches, shirt buttons, key chains, badges, or accessories. The value of the functional benefits of crude waste for respondents is low because it is only in level 3. However, the amount of crude waste that becomes waste in the workshops is only a small amount of percentage, which is 2 percent.

There is a variety of functional benefits of medium-sized cococraft waste. Respondents used it to cover waste bins, taken by scavengers, as a mixture of planting media and organic fertilizer or as a fuel for cooking stoves. Scavengers sell medium-sized waste to coconut sugar craftsmen for cooking briquettes. Most of this waste (52 percent) is left stacked or scattered on the edge of a small river at the back of the workshop. If this allowed to continue, especially during the rainy season, the piles and scattered waste become pollutants that pollute and cause a foul odor. The method taken by respondents to avoid the problem of this pile of medium-sized waste is by burning it during their leisure time. The level of functional benefits of waste is reaching level 5. Only a few respondents are utilizing moderate waste functionally; their innovative trait characterizes those respondents. Some farmers routinely come to cococraft workshops to take medium-sized waste to be used as a mixture of organic fertilizer. Some respondents also began to process this medium size waste into seedling media and alternative growing media for planting vegetables and flowers. Seedling media products and alternative organic media made from waste are being called cocodust. The range of functional benefits is detailed in Fig. 3.

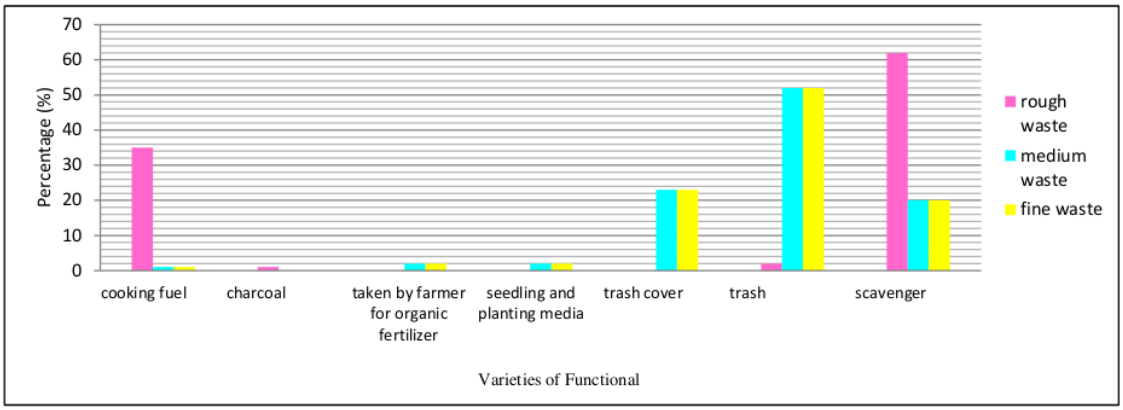

Fig. 3 Varieties of functional use of cococraft waste

The practical use of fine cococraft waste is not having many differences with the medium size one. Most (52 percent) fine waste is still in the form of fibrous garbage that is piled around the workshop environment. At a specific time, the piles of refined waste are also burned by respondents to reduce the risk of pollution. The processed waste is also used to cover waste bins. Some scavengers take some fine waste to sell to coconut sugar craftsmen. Waste used by craftsmen becomes briquette material when they cook coconut sugar. Some respondents, who were categorized as innovators, proceeded the fine waste into seedling media and planting media for vegetable flower. Some farmers also diligently take this fine waste to mix paddy organic fertilizer in their fields. Cococraft waste has minimal economic benefit. The respondent's actions to provide this raw, medium, and fine waste are free of charge for scavengers, and farmers comprise the factors that cause it low economic benefits. There are not many respondents who sell medium and fine-sized waste without processing it first. Respondents also sell this waste to street food traders who cook using charcoal, made from pieces of coconut wood or shell.

Other buyers are farmers who use waste to mix their organic fertilizer. The price of crude waste is relatively low, which is IDR. 1500 per plastic bag. The cost of medium and fine-sized waste is the same as IDR 1,000 per plastic bag. Respondents sell crude waste, on average, four plastic bags per transaction. So, the economic benefits of cococraft waste received by respondents in unprocessed conditions averaged around IDR 10,000 per transaction. Transactions take place twice in one week.

The less economic benefits of cococraft waste resulted in the majority (64 percent) of respondents choosing to leave waste piled into the garbage or taken freely by scavengers. Few (6 percent) of respondents sell medium and fine-sized cococraft waste in the form of processed products. The products sold are in the form of charcoal from coarse waste and cocodust (seedling media and planting media). Cocodust is sold for IDR. 10,000 per pack containing 5 kilograms of fine-sized waste. Cocodust consumers come from among housewives who want to grow vegetables and flowers organically in the yard of their house with the narrow land condition. Cocodust sells an average of 20 packs per week. Respondents receive additional income from the sale of

cocodust IDR 200,000 per week. The additional amount of income from cocodust is 100 percent higher than selling some unprocessed waste. It's just that the number of respondents who sell waste in the form of processed cocodust is so small.

The willingness of innovator craftsmen to diversify their products certainly strengthens survival resilience because it increases the source of their income [35], That is why product diversification is an effort to increase their income [36]. Diversification requires perseverance and willingness supported by qualifications, skills, and suitability of innovation. Fig. 4 shows the economic benefits of cococraft waste.

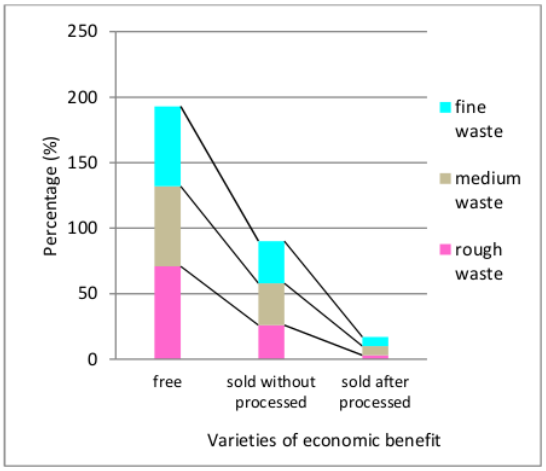

Fig. 4 Varieties of economic benefit generated from cococraft waste

Although cocodust has a higher economic value, the majority (93 percent) of respondents have not been interested in producing this alternative seedling or planting media. Some reasons behind this problem are related to social, economic, and technological factors. The social factor causing the respondents not to start managing the cococraft production business was the collectivity of fellow craftsmen who focused on the micro-business of cococraft production.

Respondents had some difficulties in managing time because they felt they were responsible for completing the order. That sort of behavior creates the diffusion process of cococraft production technology that has not spread to the respondents evenly. Information on cocodust technology that was received by subsistence respondents from innovator craftsmen was still not that intensive, which makes it difficult to generate motivation. The benefits of this technology have not been able to convince respondents to act both for their own functional and economic interests. Meanwhile, the relationship between innovators and subsistence respondents had some social stiffness during the process of transferring knowledge in adopting cocodust production technology.

Cococraft production technology was a sealed innovation for the majority of the subsistence craftsmen. Key innovators adopted the production technology for seedling and planting media after several rounds of experimentation. They experimented by using the products to grow vegetables and flowers in a viticulture planting system. After proving the usefulness of a functional cocodust product, innovators began to produce the product repeatedly and marketed it to housewives and farmers with small farming yards on their properties. Another social factor that resulted in production delays among subsistence craftsmen was their weak entrepreneurial ability. Subsistence craftsmen were reluctant to take risks and feared income loss. The majority of subsistence craftsmen also did not take advantage of the economic opportunities offered by the processing of cococraft waste into cocodust.

Several economic factors that prevented subsistence craftsmen from diversifying their products by processing cococraft waste into cocodust were identified. Several costs are involved in the procurement of the fermented materials (EM 4 and molasses) required as nutrient sources in cocodust production, which comprised one of the main inhibitory economic factors. The other costs burden the subsistence craftsmen were the purchase of plastic tarps, plastic sacks, soaking buckets, stirring shovels, polybags, and plastic packaging. Waste as a nutrient source could be obtained for free, e.g., waste cabbage from the vegetable traders in the local market. Goat manure could be obtained from farmers in the area. The problems were explained by respondent whose initials Tn (49 years old), he stated that:

> *"It is still hesitant to produce cocodust straightforwardly. Profit is still minimal, whereas the capital to make cocodust is needed. Meanwhile, the farmers here are often asking for free. The price is cheap. Though making cocodust is quite complex. Must go through the fermentation process first for sources of nutrients."*

Respondents showed an unwillingness to bear the costs of cocodust production due to their subsistence-level economic conditions. The incomes of subsistence craftsmen fulfill only their basic daily needs, with no surplus. Subsistence respondents thus had difficulty allocating any of their incomes to purchase additional cocodust production materials and tools. The business capital of each subsistence craftsman was limited to around IDR. 500.000–1,700,000. Another inhibiting economic factor was reflected in respondents' doubts about the certainty of prices and cocodust market conditions. Respondents still wanted to confirm the sustainability of cocodust micro-businesses by observing innovators. Technological factors also contributed to subsistence craftsmen's reluctance to produce cocodust.

Cocodust is processed using cococraft waste material classified as fine, medium smooth, and very smooth. This waste material is mixed with nutrient sources from compost (cabbage waste) and goat manure. Both cocodust nutrient sources are first fermented with a solvent produced from EM 4 and molasses. In addition to changes in the type of technology used to create cocodust, the process can be improved by product modification and material substitution. Before being mixed together, the cococraft waste is first soaked for 2–3 hours with flowing water to remove tannins, which are known to interfere with plant growth. After soaking, new cococraft waste is fermented with EM 4 solvent, molasses, and water for 3–5 days. The fermented cococraft waste is mixed with the other fermented nutrient source material at a ratio of 60:20:20. The series of stages

required for cococraft production was confusing for many subsistence craftsmen. Only innovators adopted new cocodust production technology. Respondent whose initials Wd (46 years) explained several reasons for the ability to process cococraft waste as follows:

> *"I have started trying to process cococraft waste. The resulting product is growing media for vegetables. I am interested in that. Many benefits to reduce cococraft waste in* the *form of a fine. Even better, it is useful for an organic farm in a narrow area. We can grow vegetables using only cocodust growing media from cococraft waste."*

Subsistence craftsmen indicated that cococraft production technology was complex and challenging to understand. They were aware of the functional and economic benefits of cocodust, but their interest in cocodust innovation was minimal. They did not assess the usefulness of cocodust production, and none of them attempted it, even on a small scale. As a consequence, most subsistence craftsmen did not adopt cocodust production technology. The primary factor causing the slow adoption of new technology by subsistence craftsmen was their limited understanding of the technology; economic and social factors had lesser impacts. The statement of respondents during the interview had illustrated the inhibiting power of those three factors. Fig. 5 shows the extent to which the three inhabitants which affecting the process of adoption of new technology by subsistence craftsmen at each stage.

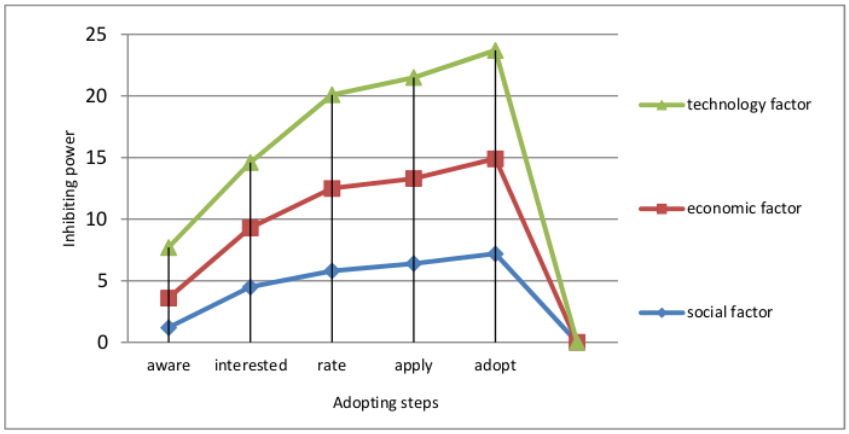

Fig. 5 The inhibiting power of three-factor affecting the adoption process of cocodust technology

The technology of cocodust production is indeed a challenge for the development of product diversification that can increase the income of respondents. Cocodust itself has several characteristics that determine the smooth adoption in both categories of respondents. Characteristics of innovation that determine the power of approval with subsistence respondents and innovators are not only referring to those proposed by [37] and [38]. However, other characteristics also determine and act as a facilitator.

The leading dominant characteristic motivating innovators to apply cocodust production technology is from relative advantage and trialability. Awareness of the usefulness of cocodust innovation encourages the interest and willingness of innovators to try to produce limited quantities of cocodust immediately. Other driving characteristics are observability and compatibility. The existence of cocodust is suitable for the needs of innovators who want to utilize some fine-shaped cococraft waste for economical product materials. Cocodust is also feasible for solving waste problems that accumulate and potentially pollute the environment around workshops. The stages of cocodust production are easily understood and observed so that innovators believed to process it without constraints. Explanation from a respondent, Jn (53 years) stated that:

> *"Cocodust production technology has many benefits. I was interested in producing cocodust, not just because of economic factors. However, I am more motivated because of environmental factors. Cococraft waste can be reduced because it is the cocodust raw material."*

Complexity characteristics are considered natural by innovators because they are deemed to be insurmountable. Unlike the other subsistence respondents who were reluctant to adopt cocodust innovation because they were worried about the complex process. From the beginning, the subsistence respondents were anxious about the complexity and difficulty of adopting cocodust innovation. While subsistence respondents are aware that cocodust innovation has functional and economic benefits for them. However, they do not dare to try. Subsistence respondents are too passionate about making cococraft products, so they are not sure of the suitability of the cocodust with their work experience. In Fig. 6, the details of the relationships between the main characteristic and the power of adoption by two categories of respondents.

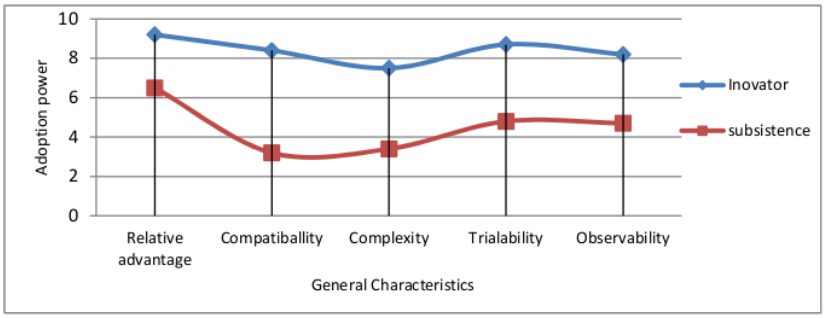

Fig. 6 Power of adoption with the main characteristics of cocodust innovation

The willingness of innovators to produce cocodust has a vital function in that it can reduce the effect of cococraft waste as an environmental pollutant. The technology used in cocodust production is environmentally friendly. Innovators also know the potential economic value of cocodust products as sources of additional income. These two characteristics provide innovators with a sense of belonging. The novelty and accessibility aspects are also significant drivers of innovation through cocodust production. As a new product, cocodust has social benefits for these innovators and wider benefits for humankind. Innovators sometimes also gave cocodust to farmers for free to use as a seedling and planting media. This socially motivated action will promote the use of cocodust to a much wider audience. Innovators considered production costs to be low and thus not an obstacle to adoption. Fig. 7 shows the relationships between characteristics of the facilitators of the new technology and the adoption of new technology by innovators and subsistence craftsmen.

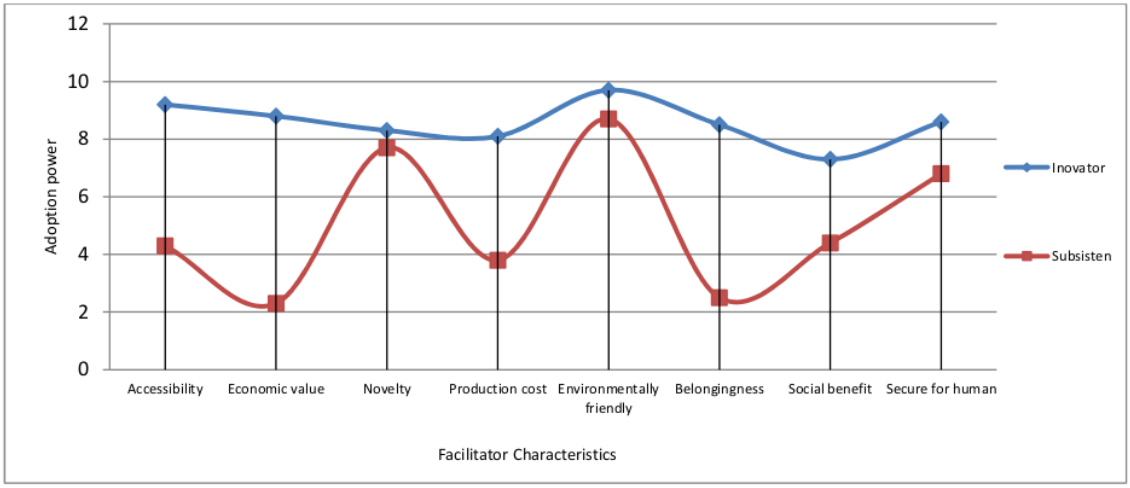

Fig. 7 The adoption potency with the characteristics of the facilitator of cocodust innovation

Subsistence respondents realized that cocodust production technology was environmentally friendly and had novelty value, but they were unwilling or unable to pay the production costs. Their limited production capital resulted in an aversion to the allocation of funds for cocodust production. They expressed doubts regarding insecurity about the social benefits of cocodust innovation. These doubts were difficult to suppress because the economic value of innovation had not been proven to subsistence craftsmen in real terms.

The problem of a lag time in technology adoption among on-farm farmers and off-farm craftsmen with subsistence characteristics has also been reported in an agrarian area in Tunisia [39]. Several factors, such as their agricultural education, farm size, and livestock, could lead to additional income for off-farm craftsmen, which aided their smooth adoption of innovative technology. Other factors facilitating technology adoption are an adequate supply of capital, intense counseling, ability spirit entrepreneurial, and the availability of production inputs [40]–[42]. Among subsistence craftsmen, the main characteristic of cocodust itself were not the only factors influencing technology adoption; the characteristics of facilitators were also important factors.

A flexible and conducive management mechanism is required to improve technology adoption among subsistence

craftsmen. The technological transfer of cocodust production to subsistence respondents cannot occur incidentally. The management approach requires a network of cooperation with innovators. Such a collaborative network would raise the awareness of subsistence craftsmen concerning the functional and economic benefits of cocodust production. The quality of finished wood products depends on the quality of processing [[43]. Product quality is also important to be targeted in processing cocodust from cococraft waste. Product quality also determines price and market. The demand for various wood and waste, especially in the domestic market, has increased, notably despite its limited [44].

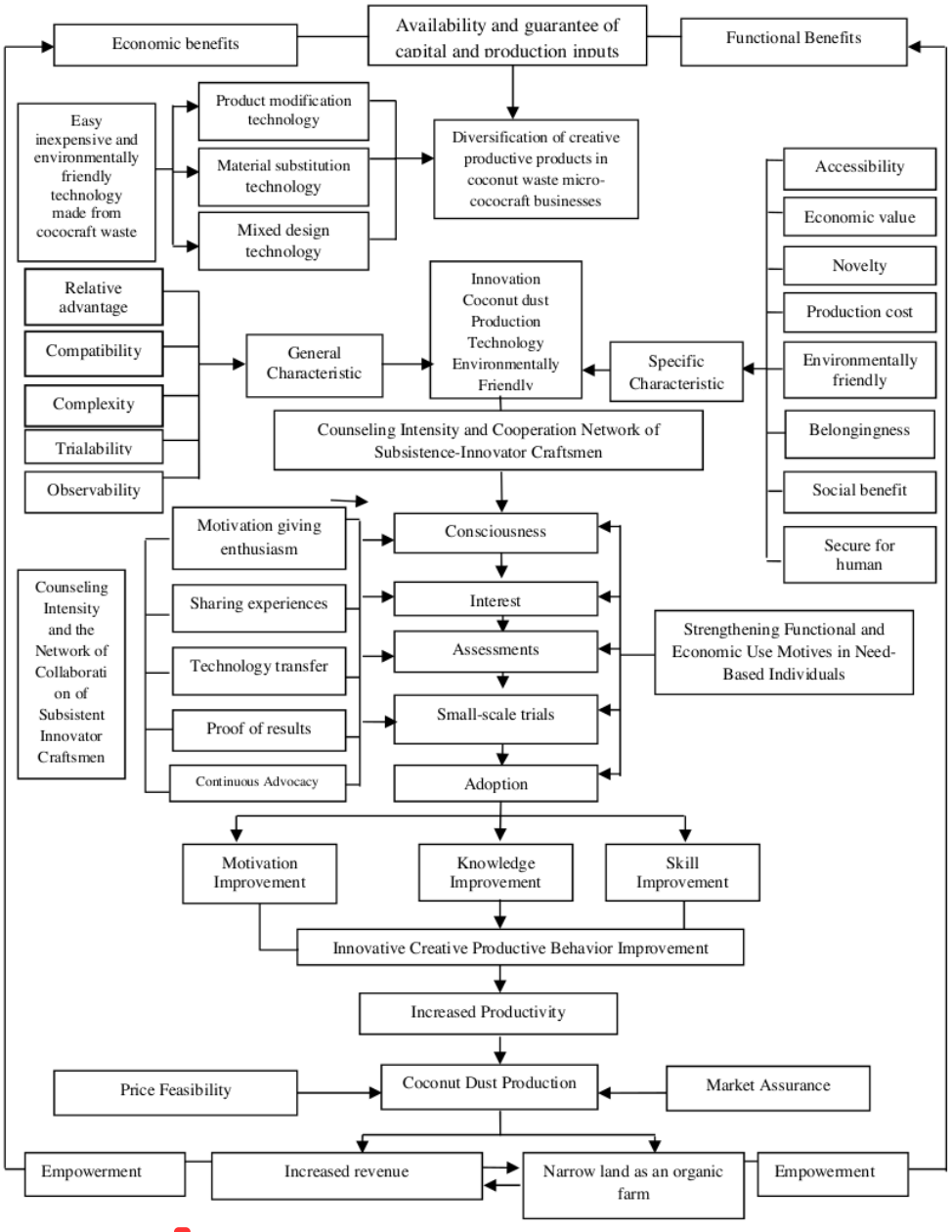

Fig. 8 Empowerment of subsistence farmers through the adoption of cocodust production technology

Another element that needs to be considered regarding the management of technology adoption by subsistence craftsman is the availability of production capital and raw materials, together with production inputs that are easy and cheap to obtain. The intensity of counseling and collaboration are also essential elements that should not be ignored by subsistence craftsmen. Fig. 8 shows the design of the empowerment scheme for the adoption of cocodust technology that would enable product diversification and allow subsistence craftsmen to create innovative products.

IV. Conclusion

The adoption of innovative cocodust production technology utilizing cococraft waste has the potential to empower subsistence craftsmen. Their reluctance to adopt this technology is not due solely to their subsistence characteristics. The dominant inhibitory factors are technological, economic, and social. Some facilitator characteristics also prevent subsistence craftsmen from adopting innovative cocodust production technology. Some of the key characteristics that prevent adoption include compatibility, complexity, observability, and trialability. Other facilitator characteristics that must be considered are the economic value, sense of belonging, production costs, accessibility, and social benefits.

The research output in the form of management design on the adoption of environmentally friendly cocodust production technology is a solution to the problem of reluctance behavior that has been experienced by subsistence craftsmen. Design management is constructed from several essential elements that are complementary and binding. The basic elements are focused on the clarity of functional and economic benefits. Another basic element of the design is the availability of capital and production facilities that are held collectively to save production costs. The supporting element which became the core of management adoption design lies in the behavior at each stage of adoption. Sympathetic management of primary and facilitator characteristics are part of the supporting element in the adoption of management design. Behavior adoption is improved by managing counseling activities, networks of collaboration, sharing experiences, and continuous advocacy. Continuous productivity has some functions to reduce cococraft waste. Market security and price level are some of the supporting elements for increasing income that supports empowerment. Management of potential cocodust production by technology adoption could also be a solution to the problem of scarcity in agricultural land. The cocodust products are produced effectively as a seedling and planting media in the organic farms, which is developed on a narrow land.

While the adoption management scheme is a fundamental and theoretical attribute, therefore, direct application to subsistence craftsmen requires studies combined with action research using some experimental methods. A solid network of collaboration and collectivity ties is needed to strengthen the awareness and willingness of subsistence craftsmen to change. The real proof of the functional and economic benefits of the cocodust innovation is needed to increase their desire to adopt cocodust production technology.

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