

การสร้างมูลค่าเพิ่มให้กับวัสดุเหลือทิ้งสู่ผลิตภัณฑ์ ออกแบบตกแต่ง: ชุมชนต้นแบบเทศบาลเมืองเขารูปช้าง

Adding Value to Waste for Decoration Products: Prototype Communities in Khaoroochang Municipality, Songkhla Province Thailand

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บทคัดย่อ

บทความนี้มีวัตถุประสงค์เพื่อแก้ปัญหา กำจัดและจัดการวัสดุเหลือทิ้งให้เกิดมูลค่าในเชิงพาณิชย์ โดยใช้กระบวนการการออกแบบมาสร้างมูลค่าเพิ่ม วิธีดำเนินการวิจัยด้วยกระบวนการวิจัยเชิงปฏิบัติการแบบมีส่วนร่วมของภาคประชาชนในพื้นที่ ภาครัฐ และผู้มีส่วนเกี่ยวข้อง การลงสำรวจพื้นที่ศึกษาเทศบาลเมืองเขารูปช้าง การออกแบบและการสร้างต้นแบบผลิตภัณฑ์ ตลอดจนกระบวนการถ่ายทอดองค์ความรู้ให้กับชุมชน ผลการวิจัยพบว่า เทศบาลเขารูปช้างมีปัญหาขยะตกค้างมากถึง 40 ตัน/วัน ปริมาณขยะ 60% คือขยะอินทรีย์ รองลงมา 25% คือ ขยะพลาสติก ทั้งนี้ในงานวิจัยฉบับนี้ได้แก้ปัญหาขยะพลาสติกเหลือทิ้ง แปรรูปเป็นผลิตภัณฑ์ โดยนำแนวความคิด (1) การนำวัสดุเหลือทิ้งในชุมชน แปรรูปให้เกิดใช้ประโยชน์ โดยใช้รูปทรงอิสระและรูปทรงเรขาคณิต (2) การเลือกใช้วัสดุ สี และสัดส่วน ให้เหมาะสมกับการใช้สอย (3) การผลิต ไม่ยุ่งยาก ซับซ้อน สามารถผลิตและติดตั้งได้ง่าย สะดวก ปลอดภัย ข้อค้นพบประเด็นสำคัญในงานวิจัย คือ กระบวนการแปรรูปขยะพลาสติกเป็นผลิตภัณฑ์ตกแต่งสามารถแก้ปัญหาขยะจากวัสดุเหลือทิ้งในครัวเรือนในเทศบาลเมืองเขารูปช้างได้อย่างเป็นรูปธรรม โดยลดปริมาณขยะพลาสติกในครัวเรือนได้ถึง 48 ขวดต่อเดือน ทำให้ลดกำลังคนในการจัดเก็บ และลดผลกระทบต่อสิ่งแวดล้อมที่เกิดจากการบริโภคได้อย่างมีประสิทธิภาพมากขึ้น อีกทั้งชุมชนเองสามารถต่อยอดแนวความคิดการออกแบบ และสร้างผลิตภัณฑ์ที่มีความหลากหลายได้มากขึ้น แต่ยังคงขาดทักษะด้านเทคโนโลยี จึงไม่สามารถดำเนินการให้เกิดการสร้างมูลค่าเพิ่มได้อย่างสูงสุด จำเป็นที่จะต้องมีความรู้หน่วยงานภาครัฐ หรือเครือข่ายที่เกี่ยวข้องเข้ามามีส่วนร่วมในการพัฒนาและประชาสัมพันธ์ช่องทางการจัดจำหน่าย เพื่อสร้างมูลค่าในเชิงพาณิชย์ให้เป็นรูปธรรม

คำสำคัญ: วัสดุเหลือทิ้ง, การสร้างมูลค่าเพิ่ม, ผลิตภัณฑ์ตกแต่ง

Abstract

The objective of the research was to solve, eliminate, and deal with waste problems to have commercial value by design process for adding value. The research methodology was a participatory action research with people in the area, government offices, and related stakeholders, as well as a field trip in Kharoopchang Municipality, prototype design and creations, and knowledge transfer to the communities. The research results revealed that there were 40 tons/day of waste in Khaoroochang Municipality. 60% of the waste was organic waste, followed by 25% of plastic waste. The solution to this problem was to process plastic waste into products. The concepts were (1) to process community solid waste into useful free-formed and geometric-formed products, (2) to select suitable materials, colors, and ratios for utilization, (3) to easily produce and install products with safety. The main investigation in the research was that processing plastic waste into decoration products could concretely solve waste problems in households in Khaoroochang Municipality by reducing 48 plastic bottles per month. Workers for waste collection can thus be reduced and impacts on the environment caused by consumption can be decreased effectively. Finally, people in the communities can extend the design concepts and produce a variety of products, but they still need to know about skills of technology and public relations since they cannot add the most value to their products. Consequently, it is suggested that some government offices or related networks necessarily engage in this development and help them do the online distribution in order to add commercial value concretely.

Keywords: Waste, Adding Value, Decoration Products

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1. Introduction

We are currently facing a global waste crisis. In each year, more than 2.1 billion tons of municipal solid waste appears, but only 16% or 323 million tons of them have been recycled. According to the ranks of countries producing the most waste when compared to a ratio of population and appearing waste, it was found that the US which contains 4% of the world population makes 239 million tons or 12% of municipal solid waste per year. In the other word, one American makes 773 kilogram of the waste per year. It is similar to the waste in India where the number of citizens are as five times as Americans or 18% of the world population.

The waste problems are also happening in Thailand like other countries in the world. In 2018, there were 27.93 million tons of waste throughout the country, which was increased by 2.05% from 27.37 million tons of the 2017 waste. Due to the urbanization and the adjustment from agricultural society to industrial society as well as the promotion of Thailand's tourism, a number of tourists are increasing (Pollution Control Department, 2019). In addition, Thailand has been ranked as the world's fifth country releasing waste into the sea. Over half of eight million tons of waste releasing into the ocean are plastic.

Songkhla is located on the east coast of lower Southern Thailand. There were approximately 1,594 tons/day of waste which were divided into 1,058 tons/day of municipal solid waste and 536 tons/day of solid waste in subdistrict administrative organizations (Pollution Control Department, 2019).

the waste problems like the country and the world. That is, 40 tons/day of the waste in this this area is made, and the municipality cannot deal with the waste collection. The factors affecting their management are the routes of the waste collection in daytime, increasing waste, and an insufficient number and sizes of garbage trucks for increasing waste. Most of the waste is food leftovers, followed by plastic, glass, and tree leaves/ twigs.

As a result, the global waste crisis has even been spread to a community level. A solution to this crisis should be conducted. Unwanted waste should be eliminated or reduced. Moreover, waste can be commercially added to value by a method of Upcycling. This method is similar to recycle in terms of a concept to add value to waste by design and innovation to create new valuable products. In this research, design was used as a tool to add value to waste according to the economic principles of waste management and the value added to waste was analyzed. However, the management of waste problems needs participation from every sector and everyone. People in a community can participated in this process by getting started to reduce plastic waste from their households and community to other upper levels. Importantly, people can sustainably earn incomes for their families.

2. Literature Reviews

2.1 Concepts of waste and adding value

Waste management in a community is one of responsibilities of a local government organization (Pintamul, 2012). To succeed in waste management, cooperation from people and other related organizations is needed. Adding value to such waste also needs design which is a way to use experience, skills, and knowledge, including an ability to bring surrounding things to respond physical and mental needs. It is considered that design is as complex as technology. Design is an important step for waste reuse because a designed item should be practical as needs and should not be transformed to be a new form of waste. Therefore, a concept of Reuse, Reduce, and Recycle (3R) has been adapted to use resources worthily and the most beneficially in order to transform such waste into new products and make more money by reducing waste amount to solve environment problems. The concepts about adding value to products are as follows:

- 1) Adding value is mainly considered from consumers' needs and tastes by studying physical, emotional, and feeling factors.
- 2) Knowledge, basic understanding of products, good product contexts are necessary to consider products, and creative thinking and strategic thinking are important for creative and outstanding concepts.
- 3) Materials are considered and selected from their stories in order to add value to the products.
- 4) Production and processing procedures are considered to modify for adding more value (Poonlarp, Thipchartiyothin, 2553).

According to Koranut Suksawad (2019), a study of creating and adding value to community waste called 'bamboo-leaf-made paper' was conducted. The results from the field trip revealed that the Traditional Bamboo Handicraft Center and Saha Saeng Chai Community Enterprise in Prachin Buri produce Lam Pan mats (made from bamboo strips) and other products made by splitting bamboos into strips such as baskets, wicker and baskets. Bamboo tubes are mostly used to make products, but leaves are not. Therefore, bamboo leaves, unwanted waste, are brought to create and add value to be paper products and then process into other products. To produce the paper, clean, fresh and dry leaves

are selected. The other products produced from bamboo-leaf-made paper are wrapping paper, book covers, lamps, and food packages. Therefore, jobs and incomes are made for these enterprises, and their products become prototypes and selections for other interested OTOP groups.

2.2 Participation process

Orathai Kokphol (cited in Patcharee Siroros, 2003) concluded that public participation is a process which people or stakeholders have opportunities to express and exchange their information and opinions in order to find out alternatives and make decisions on suitable and mutually accepted projects. Therefore, every related sectors should participate in this process from the beginning to follow-up and evaluation in order to mutually understand and perceive project adjustment for every sector's benefits.

As you see, community participation is caused by needs and targets to take part in activities to reach every sector's goals - communities, local leaders, government offices, and other stakeholders.

2.3 Policies and development

Chaoroochang Municipality has determined a strategy to promote and develop jobs in their community, including resources and environment management. By Public Health and Environment Division, Chaoroochang Municipality, the Environmental Conservation Group was officially established to deal with environment based on the policy of waste reduction. In fact, for the municipality, over 15 million Baht for waste management are spent each year. The Environmental Conservation Group is aimed to be a channel for personnel to reduce waste, and especially consider about recycled waste for commercial value. In addition, it is to promote personnel, villages and communities to have consciousness for recycled waste value, environment conversation, and reduction of global warming, including promote waste segregation and waste reuse.

Moreover, Khaoroochang Municipality has focused on waste management. There have been some projects such as a 60-day project to "separate before throwing waste" to raise awareness of waste reduction in households, a project of "clean and livable Chaoroochang by reducing foam and plastic use for recycled waste reduction" according to the Songkhla policy, a project of sustainable environmental conservation in the community, and so on. Nowadays Khaoroochang Municipality has a policy to utilize waste as fertilizers or energy such as coals made from fruit peels in each season, waste products for construction, fashion products, and waste decoration.

As aforementioned policies and strategies, it was found that to achieve the management of local development planned, there are some factors: (1) people as essential resources to develop things, (2) capital which is important for operating activities, (3) machines or tools to process materials into products, (4) material supplies to facilitate working process, (5) decision-making as a necessary factor, and (6) communication to help connection and collaboration (Surapan Chantadansuwan, 2010).

3. Research objective

To add value to waste in Khaoroochang Municipality, Songkhla Province.

4. Methodology

This mix-method research was conducted by both qualitative and quantitative methods. The research was cooperated with Khaoroochang Municipality and Khaoroochang Communities in Songkhla Province. This research was collaborated with every sector, network, government office, and the community. The steps of the research are as follows.

4.1 Data collection and site and waste surveys were conducted in Khaoroochang Municipality by interview, observation, and group discussion with the local government and the community leader to find out types of waste and waste selection through the participation process of the communities and related organizations.

4.2 Inspection of the data from related documents and the field trip were conducted to analyze according to criteria of waste qualities in order to determine a concept of waste product development, including community participation.

4.3 The design and development processes of waste products were done. In terms of decorations, the communities took part in design by twice of group discussion in order to set up the design concept.

4.4 Prototypes were created and produced from community solid waste, namely plastic, care tires together with such local materials as clear and colored plastic bottles.



Figure 1 Solid waste in Khaoroochang Municipality

4.5 The knowledge of technology was transferred to 62 people of the communities - Ban Khao Kaew, Ban Bang Dan, and Ban Keha in Khaoroochang Municipality.

4.6 Adding economic value to the waste was analyzed. The concept of the research can be concluded as follows.

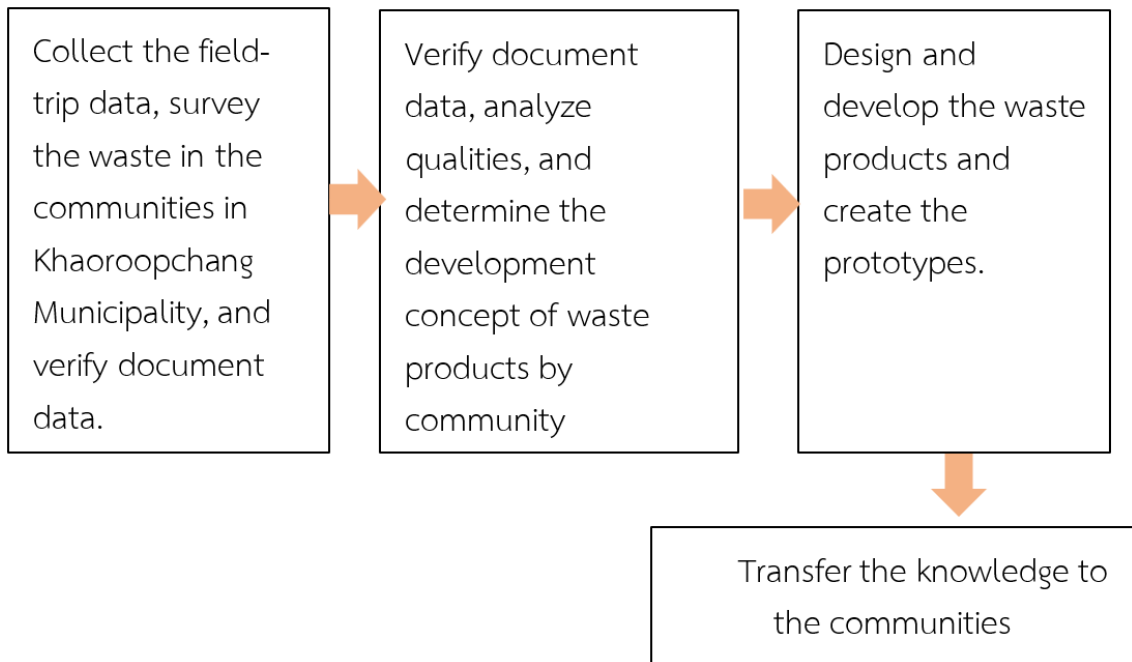


Figure 2: Research concept

5. Results

5.1 Site survey

According to the site survey, Khaoroochang Municipality is located in the center of Mueang Songkhla with 27.49 square kilometers or 17,181 rai. It is a semi - city and 5 kilometers away from Songkhla City Hall.

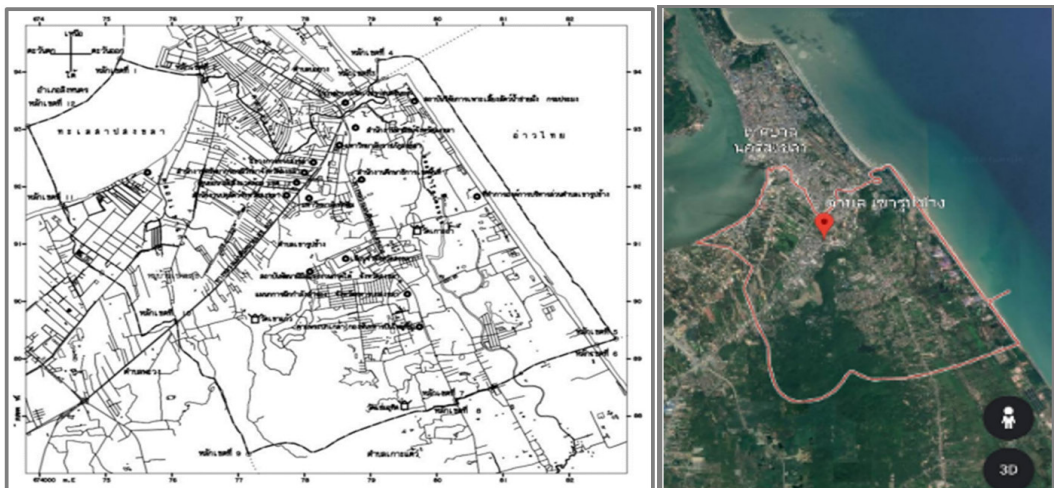


Figure 3: Khaoroochang Municipality area

5.2 The data of physical geography

According to the survey of waste quantity in Ko Taew Landfill, the Environment Conservation Group of Khaoroochang Municipality, Waste Banks in Moo 2 Khao Keaw, Moo 1 Bang Dan, Moo 3 Ban Thing Yai, and Moo 9 Ban Keha, car tire shops, and motorcycle garages, it was found that waste is managed to reuse by segregating plastic bottles, paper, and matal in the landfill.



Figure 4: Ko Taew Landfill

According to the survey of waste types and quantity at the waste station of Songkhla Municipality, it was found that there have been 40 tons/day of solid waste left in Chaoroochang Municipality, which are unmanageable to take care due to some factors - the routes of the waste collection in daytime, increasing waste, and an inadequate number and sizes of garbage trucks for increasing waste. Most of the solid waste is food leftovers, followed by plastic, glass, and tree leaves/twigs.

Table 1 Types and amount of solid waste

No.	Types of solid waste	Amount (%)
1	Organic waste	60
2	Plastic	25
3	Glass	5
4	Leaves/twigs	4
5	Paper	2
6	Foam/construction waste	2
7	Matal	1

5.3 Waste selection

According to the results of the field survey and the community participation for the waste selection, it was found that there were the environment conservation group of Khaoroochang Municipality, the Waste Banks of Ban Khao Kaew Moo.2, Ban Bang Dan Moo.3, Ban Thung Yai Moo. 9, and Ban Keha, a car garage for tire change, and a motorcycle garage attending to exchange opinions publicly. The criteria of the waste selection are as follows:

The first criteria was types of waste. The selected waste must be able to be reshaped easily without using advanced technology; therefore, people in the communities can create some products by themselves by considering physical appearance of waste, namely sizes, surface, and colors. The second criteria was possibility of product design. The design should not be complex and focused on what the communities could really make.

Therefore, according to the meeting among communities, researchers, and related organizations, it could be concluded that there were six types of the selected waste in the communities for the research: old care tires, motorcycle inner tubes, plastic bottles, paper, and banana tree fibers. In this research, only three types of the waste were identified that they could be reshaped without chemical process, which were ole car tires, plastic bottles, and banana tree fibers for value-added products. The qualities of each waste are presented in Table 2.

Table 2 Waste qualities

Types	Qualities	Reuse process
Car tires	They are flexible and tough. Their tensile strengths are high without other reinforcing agents, and their tear strengths are high even with high temperature.	- No chemical process - No physical transformation
Plastic bottles	Their physical appearance is clear, soft, flexible, and tough. They are well resistant to acid and base chemicals. Their very low water absorption ability can prevent water vapor transmission, low gas transmission, and low lipid transmission. They can also be sealed with heat and used with suitable temperature. Importantly, they are safe and suitable for food and medicine.	- No chemical process - Physical transformation
Banana tree fibers	These fibers can be utilized for weaving. They can be 100% to be weaved, or they can be mixed with natural fibers (cotton), which make them soft, but sometimes tough depending on mixture ratios.	- No chemical process - Physical transformation

Regarding Table 2, it revealed that the qualities of such types of waste can be physically transformed by decoration and molding without the chemical process. This is relevant to the Upcycle process which is focused on making natural resources the most valuable. That is, waste can be developed to be new quality products with high value. The most important is that these products are environmentally friendly in the process of design and production. The strength of the upcycle process is appearance design, and the main content is this upcycle process needs no energy, any other resources, or additional chemical process polluting environment (Jakkrit Siririn, 2019).

5.4 Community Participation in waste processing to decoration design

To design waste to become decoration products, participation between the research team and the communities - Bang Dan, Khao Kaew, Tha Sa-An, and Ke Ha - was needed. The group discussion was held to select four types of solid waste with different qualities, namely car tires, banana tree fibers, plastic bottles, and glass bottles. However, all four types of solid waste have a quality for the recycle process. They were sold in kilograms through middlemen. These types of waste were inexpensive or some types of plastic (colored) cannot be sold; therefore, the waste should be value-added as shown in Figure 5.



Figure 5: Participation process between the research team and the communities

To have related people exchange and express their opinions about waste processing, the waste management presenting in pictures, prototype models, and lectures of decoration products models, materials, and production process were together provided. The request gained from the field trip was “we want to design products, but we don’t have knowledge”, which is a weakness of designing skills.

By purposive sampling, the samples in the participation process included 62 people from the groups managing waste management and segregating waste: Ban Dan, Khao Kaew, Tha Sa - An, and Ke Ha communities. Therefore, the summary gained from the community participation in terms of new products was that plastic bottles, car tires, and banana tree fibers were brought to transformed into decoration products - lamps and furniture sets.



Figure 6: Participation activities

5.5 The draft of the prototypes

From the field trip on Monday, 10th August 2020 in Moo 1 Ban Bang Dan and Moo 2 Ban Khao Kaew, there were some opinions from the members of Khaoroochang Job Federation about designing products and proposing waste which can be value-added. The design concepts were (1) to process community solid waste into useful free-formed and geometric-formed products, (2) to select suitable materials, colors, and ratios for utilization, and (3) to easily produce and install products with safety (Figure 7).



Figure 7: Design concepts

5.6 Transfer of design process to communities

The training process of design and production was provided to the communities so that they can learn and practice, together with exchange a way to add value to waste. In this process, there were 25 members of Khaoroochang Job Federation and some interested people taking part in the important issue for this process was to have the people in the communities practice some necessary things for skill development due to shortage of production and creativity for the market.



Figure 8: Transfer Activities of design process

5.7 Decoration products from waste for utilization

The participation process was also involved to develop and create the prototypes from waste to see the clear models and functions of (1) lamps made from plastic bottles and (2) furniture sets made from car tires and banana tree fibers. In addition there were three considered concepts: a concept of having waste from communities processed in useful free-formed and geometric-formed products, a concept of selection of materials, colors and ratios for utilization which were suitable for utilization, and a concept of noncomplex and easy production and installation with safety as the following details.

5.7.1 Ball-shaped lamps were made from the bottom of clear plastic bottles of soft drinks by an easy cutting technique. The bottom of the clear plastic bottle was one inch high. Then 25 of the bottle bottoms or a number of them depending on the diameter of the sphere were assembled and spherically shaped such as a ball, and finally attached with wires as shown in Figure 9.



Figure 9: Waste processing of lamps made from plastic bottles

5.7.2 Leaf-shaped lamps were made from multi-colored plastic bottles which were easily cut in leaf shapes, and patterns of leaves were made by heat. Then each lamp was assembled by hot glue as a desired shape. 15 or more plastic bottles, depending on thickness of leaves, were used to make one lamp as shown in Figure 10.



Figure 10: Waste processing of leaf-shaped lamps made from colored plastic bottles

5.7.3 Flower-shaped lamps were made from the bottom of multi-colored plastic bottles which were easily cut in circle and square shapes, and then adjusted by heat to be flower petals. After that, all petals, made by 10 bottle bottoms, were attached to one plastic bottle by hot glue as shown in Figure 11.



Figure 11: Waste processing of lamps made from the bottom of colored plastic bottles

5.7.4 Furniture sets were made from car tires and banana tree fibers. Car tires were brought to process as furniture in a house. 1 centimeter of banana tree fibers were cut and dried in the sun. Each piece was flattened and baked with sulfur for one night before it was dried in the sun again, and it was finally weaved in any shape.



Figure 12: Waste process of furniture sets



Figure 13: Waste process of furniture sets

6. Analysis of adding economic value to the waste

A utilization to add value is explained about increasing value or prices of products in each step of production and design for waste products. According to Ernst & Woods (Ernst & Woods, 2011), product design is a way to design different characteristics of products from competitors and response to customer satisfaction.

To design waste to be decoration products in economic dimension of adding value to such waste, target customers were found and analyzed by using a questionnaire as an instrument to test a group of unpurposive customers. According to the questionnaire results, it was found that 76.61% of the customers were interested in buying new products processed from waste. Therefore, the value was added to such waste through the design process for new products in order to respond to customers' needs of getting the most benefits which were functional and emotional benefits. However, there was one limited commercial advantage - incapacity of increasing production to solve make-to-order problems, which was the first strategy of distribution.

An economic dimension of reducing household waste is considered the first process to deal with the cause of the problem. That is, plastic waste is hard to decay, and its circle is very different from other natural waste. Therefore, upcycling product design from waste to become decoration products is one method to concretely solve waste problems and reducing impacts of consumption on the environment effectively. Due to the COVID-19 pandemic and the government policy of working from home, household waste has been increased. It was found that three adults and one child in a house had double waste of instant food boxes and plastic bottles. Normally, people consumed no more than three 1.5-liter bottles of water a day (<https://news.thaipbs.or.th/>, retrieved in 2021). Therefore, product design of 16 plastic bottles per product was considered. If 48 plastic bottles can be processed for these three products per month in one household, workers for waste collection can be reduced and impacts on the environment caused by consumption can be decreased effectively.

7. Conclusion

From the results of the study in adding value to waste to become decoration products by participation of communities and government offices, it can be concluded as the following details.

1) The problems of household waste in Khaorooopchang Municipality can be concretely solved by reducing 48 plastic bottles each month.

2) The value was added to waste by upcycling product design from waste to become decoration products distributed online so that people can earn incomes from them.

3) A transfer process of knowledge to the communities made participants have skills of practice and enhance this concept to produce a wide variety of products.

8. Suggestions

It is suggested about the online distribution of the products that the people in the communities still lack skills of technology and public relations so that they cannot add the most value to their waste products. Therefore, some government offices or related networks should necessarily participate in this development and assistance for the online distribution.

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