COTTON DYEING WITH MEKONG BASIN SOIL FOR APPLICATION IN COSTUME DESIGN

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Abstract

The research entitled Cotton Dyeing With Mekong Basin Soil for Application in Costume Design aimed to 1) study the soil chemical properties, physical properties, ratio, dyeing duration, and durability of the colors on cotton dyed with Mekong Basin soil, 2) apply the cotton dyed with Mekong Basin soil in costume design. The research is a mixed method research consisting of experimental research and quantitative research. The data was collected through records of experiment results, surveys, interviews, and questionnaires. The data was analyzed using Pore Model and Adoption and Innovation theory. The research results show that the Mekong Basin soil has the highest aluminum value of 9811.000 mg and is categorized as sand, with the following composition: sand 39.40 percent, silt 47.05 percent, and clay 13.55 percent. When used for dyeing cotton, it was found that the different concentrated ratio and the dyeing duration does not affect the durability of color when washed, sweat resistance, and abrasion resistance. Overall, the test result shows a level of 2-3 or more, which is acceptable according to Thai Community Product Standard 18/2557. On applying the cotton dyed with the Mekong Basin soil for costume design, it was found that naturally dyed costumes are often found in medium-priced markets, including men's and women's costumes. The opinions of consumers are at the highest level, with an average of 4.52, with a standard deviation of 0.61. The research entitled Cotton Dyeing With Mekong Basin Soil for Application in Costume Design can be further developed for business using the ratio of natural dye with soil to processed products and export at the international level.

Keywords: Mekong Basin soil, color durability, costume, natural color

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1. Introduction

Mekong Basin soil is full of essential minerals created from minerals of living things, such as fallen leaves, rotten trees, insects, and micro-organisms, in combination with water and air. The differences in the soil vary according to the terrain and climate. Today, soils are used in various forms, such as in art, where the colors from the soil are used to create artwork, and in cosmetics. Soils are also used in dyeing different things or as mordants. Due to their essential mineral properties, human uses soil to dye cloths or make clothes softer. It is also a way to replace the colors from the trees cut down for their bark or from some types of fruits. If a lot of dyes are needed, these materials will slowly disappear or become rarer. Therefore, colors from the soil are one alternative that people choose.

Soil colors indicate their components, source materials, and soil creation process (Tipjariyaudom, 2003). Humans discovered colors from plants, animals, soil, minerals, and other natural things and used them for many benefits, such as dyeing. It had become known and accepted amongst the natural dye groups to use mud as a mordant or natural mordant. While the government and private sectors are all aware of the environmental problems and are trying to change the production process to create minimum impact and risks to both humans and the environment, the natural dye process is another process that is becoming popular, especially in the One Tambon One Product project related to basketry and textiles (Wanphonthong, 2005). Natural dyes are becoming more popular among consumers and tend to increase in market demand. The data analysis by Organic Exchange indicates that the development of organic textiles in 2009 had a value of 4.3 billion US dollars. Due to an increasing trend in organic textiles, Biotech Fair, the biggest exhibition for organic products, was held in Germany, and the Texworld Exhibition showcases environmentally friendly textiles worldwide (Chantachon, 2015). Not only is the world emphasizing products with natural colors, but it is also an opportunity to increase the quality of naturally dyed products to align with the Northeastern Development Plan. The northeastern region has an advantage in its location, the central region of the Mekong Sub-region that connects Laos, and Northern Vietnam, all the way to China, the global economy's center. The area also connects with the eastern special development area, which opens an opportunity for the area to continuously develop industries based on the development of the nation's megastructure by processing the natural hand-dyed textiles for export and generating income for the communities. This product processing can be done using textiles, for instance, costumes, ornaments, home decorations, souvenirs, and other products. The textile production groups across Thailand had already processed their textiles into various products (Wangyen, 2011). For example, the research by Wangyen et al. (2013) studied product development from loincloths using local wisdom, combined with the concept of fashion design, and created knowledge on the development of costumes made from loincloths to give back to the communities. The research result shows that the wisdom in weaving loincloths of the community groups has been passed down through generations by producing for household use, resulting in the patterns and colors from local materials. The techniques of cutting fabrics and placing patterns in different forms, combined with traditional wisdom, were used to create interesting patterns suitable for the fashion trend. The communities received the knowledge and can use the wisdom in weaving loincloth to combine with the concept of creative fashion design and create new styles of working clothes for women to support traditional careers and promote new careers to the community members.

From the importance mentioned earlier, it can be seen that social trends change rapidly, and the population is increasing. However, the culture and the wisdom remain the same. Humans must adjust their way of life to catch up with the current social trend to survive. Soil, a material that is easy to find in communities, and villagers' wisdom in weaving are the two things that can move forward together and might become a vital community identity through a unique processed product. In addition, this also helps promote the clever use of natural resources. Cotton dyed with the Mekong Basin soil for application to costume design aligns with the current fashion trend and addresses consumers' needs.

Research Objectives

1) to study the soil's chemical and physical properties, ratio, dyeing duration, and durability of the colors on the cotton dyed with Mekong Basin soil, Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province

2) to apply the cotton dyed with Mekong Basin soil Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province to costume design

2. Research Methodology

This research was a mixed method, consisting of qualitative and quantitative methods. The research methodology is as follows.

1. The study of the soil's chemical and physical properties, ratio, dye duration, and durability of the colors on the cotton dyed with Mekong Basin soil is qualitative research.

1.1 Soil's chemical properties

The soil was taken from the Mekong River bank in Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province, in May from a depth of less than 10 centimeters to study its chemical properties. One kilogram of soil was used to separate the chemical properties, consisting of aluminum (Al), manganese (Mn), and organic matter (OM), acquired by using Manual on Organic Fertilizer Analysis, APSRDO.; 4/2551, and Iron Oxide (Fe2O3) and Silica (SiO2) was acquired by using Calculate method.

1.2 Soil's physical properties

The soil's physical properties consisted of a study of the soil texture of the ground surface from Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province, at a depth of less than 10 centimeters. The sand, silt, and clay values were acquired using Mechanical Analysis; Pipette Method on one kilogram of soil sample.

1.3 Color extraction 1:1, 1.5:1, and 2:1, respectively. The soil was stirred until dissolved in the neutral pH water and sifted through a net to filter out rocks and sticks. The extracted soil colors were tested using a machine to find the pH value (pH Meter range 0.00-14.00).

1.4 Dyeing

Dyeing is divided into three methods: cold, hot, and mordant dyeing methods. The cold dyeing used the concentration ratio of 2:1:100, soil(kilogram):neutral pH water (liter):cotton fiber (gram). Cotton fiber was kneaded in the dye for 10 minutes to allow the dye to penetrate the fiber. The fiber was then left for 24, 48, 72 hours. The hot dyeing used the concentration ratio of 2:2:100, soil(kilogram):neutral pH water (liter):cotton fiber (gram). The cotton fiber was kneaded in the dye at a temperature of 40°C - 50°C for 10 minutes and boiled at 80°C for 30, 60, and minutes respectively. After boiling, the fiber is left for 30 minutes before being washed with clean water. Dyeing with mordant used the results from the hot dyeing with the ratio of 2 kilograms of soil per 2 liters of water and boiling the cotton at 70-80°C for 90 minutes before washing in mordant. The mordant consisted of lye from ash from burned dried banana stocks and leaves. The ashes were put in water until they precipitated. Iron rust water, obtained by soaking rusted iron in water for at least one day, was mixed with limewater, obtained by dissolving lime in water and waiting for it to precipitate, and alum was obtained by mixing alum with clean water.

1.5 Testing colors' durability

1.5.1 The colors' durability was tested using soap wash or soap with standard soda, Thai Industrial Standard Volume 3 - 2009. Cotton fibers were laid out in parallel, matching the length of the splicing cloth of (40 ± 2) millimeters x (100 ± 2) millimeters, with a sufficient amount of cotton to the splicing cloth used. Cotton fibers were spread evenly on the splicing cloth and sewn on all four sides with white non-luminescent thread. Next, the sample was put into the wash tube, and the soap solution was added with a liquid-to-material ratio of 50:1. The lid was then closed, and the fiber was washed at (40 ± 2) degrees Celsius for 30 minutes. After washing, the sample was removed from the tube, put in a four-liter beaker filled with distilled water at room temperature, and stirred lightly for one minute. The beaker was then put down to allow water to flow through the sample for one minute. The excess water was squeezed out by hand. The sample was then separated from the splicing cloth, only leaving one side that was sewn together to prevent the fibers from falling off. The last step was to dry the sample by laying them out on filtering paper to get rid of the excess water and dried at a temperature not more than 60°C (Thai Industrial Standards Institute, 2019).

1.5.2 Durability of colors in terms of sweat resistance was tested according to the Thai Industrial Standard 121 Book 4 – 2009. Two sets of samples were prepared using artificial sweat solution – alkali and artificial sweat solution – acid. The sample had an adequate weight compared to the splicing cloth. An adequate amount of fibers were prepared based on the total mass of the splicing fabric used. Place the sample between the multi-fiber cloth and the splicing cloth that cannot be dyed, with each piece (40 ± 2) millimeters x (100 ± 2) millimeters in size. The sample was evenly distributed, and all four sides were sewn with white non-fluorescent sewing thread. The sample was placed on a flat-bottomed plate. The artificial sweat solution-alkali was poured onto the sample with a liquid-to-material ratio of 50:1 and left at room temperature for 30 minutes. The sample was stirred occasionally to allow the solution to cover the whole sample. The excess solution was squeezed out using a glass rod. The test sample is weighed and should have 2 to 2.5 times its original weight. The test sample was placed between two acrylic resin plates and in a pre-heated test apparatus. After all the acrylic plates were placed, a pressure of 12.5 kPa was applied on the sample by placing a weight of about 5 kilograms on the acrylic resin plate in the apparatus. The screws were tightened to secure the stainless steel and remove the weight. The second sample underwent the same process by pouring artificial sweat solution - acid on a different set of equipment. The apparatus with the test piece was placed in an oven at (37 ± 2) °C for four hours, with the sample placed vertically. The sample was then taken out of the incubator. The sewing threads were removed, leaving only one side. The same was then hung to dry at a temperature not exceeding 60 degrees Celsius (Thai Industrial Standards Institute, 2009).

1.5.3 The test for color abrasion resistance (dry condition) was conducted according to the Thai Industrial Standard 121, Volume 5 - 2009. The cotton fibers were prepared by winding the threads parallel to each other along the length with a rectangular hard card paper to obtain a sample piece bigger than (50 x 140) millimeters in size. The samples were placed on the testing machine so that the long side of the sample was in the abrasion line and firmly tightened. Waterproof sandpaper was placed between the base of the testing machine and the samples to prevent them from slipping. A standard cotton rubbing cloth treated at a temperature of (20 ± 2) °C was applied to the rubbing head, and the weaving line was parallel to the rubbing head's movement. A full cycle of scrubs was performed at a rate of 1 cycle per second in a straight line over a length of (104 ± 3) millimeters on the dried samples with a pressure of (9 ± 0.2) newtons. Ten cycles were performed. Afterward, the standard cotton scrub was removed from the machine and placed in the standardization room to adjust the condition at (20 ± 2) °C (Thai Industrial Standards Institute, 2009).

2. The application of the cotton dyeing with Mekong Basin soil to costume design was quantitative research.

2.1 Reviews of literature and relevant research were conducted, along with the Method of Agreement analysis that would lead to the conclusion and the data analysis on the aspect of costume design, consisting of form, structure, shadow, colors, materials, and decorative technique. Other aspects include the characteristics of users, lifestyles, tastes, and costumes style of the target group.

2.2 The costume drafts were presented to the costume design experts to consider the agreement between the draft and design concept and the consumer groups. The result from the consideration and the suggestions were used to make adjustments and to create the model for ready-made fashion costumes.

2.3 115 questionnaires were administered online to the target group concerning the costume design from applying dyed cotton with Mekong Basin soil. The questionnaire can be divided into two following parts. The first part was the population data, and the second part was the questions related to the application of dyed cotton with Mekong Basin soil to costume design through a five-level scale questionnaire.

3. Research Result

1. to study the soil's chemical and physical properties, ratio, dye duration, and durability of the colors on the cotton dyed with Mekong Basin soil

1.1 Result from the study of chemical properties

From the study of the chemical properties of the Mekong Basin soil at Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province, the following amount of chemicals were found: aluminum content (Al) was at 9811mg/kg, iron oxide content (Fe2O3) was at 54675.53 mg/kg, manganese content (Mn) was at 422.4 mg/kg, silica content (SiO2) was at 2648.57 mg/kg, and organic matter content (OM) was at 2.62%.

1.2 Result from the study of physical properties

From the study of the chemical properties of the Mekong Basin soil at Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province, the following amount of particles were found: sand = 39.40%, silt = 47.05%, and clay = 13.55%. Therefore, the Mekong Basin soil at Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province was categorized as sand since the soil sample contained the overall particle of sand of more than 40% and the particle of clay of less than 20%.

1.3 Result from color extraction

From the color extraction by mixing soil with clean water with a neutral pH, it was found that there was only a slight difference in the soil color. The significant difference is the characteristics of the dye. When the dye is left for one hour, the soil will settle. In the ratio with less soil, the dye will be liquid with less sediment, and the dye will be highly concentrated with more sediment in the higher soil ratio. If the soil precipitation is high, the soil will adhere to the fibers needed to be dyed more. Therefore, the optimum ratio is 2 kilograms of soil: 1 liter of water: 100 grams of cotton fibers (in cold dyeinging method), and 2 kilograms of soil: 2 liters of water: 100 grams of cotton fiber (in hot dyeinging method).

1.4 Results of dyeing

From the cold dyeing, hot dyeing, and mordant dyeing, cold dyeing with a duration of 72 hours produce the darkest colors since the method has the longest duration. The cotton fibers reacted best with the soil colors within 72 hours of cold dyeing. Hot dyeing where cotton fiber was boiled at 80°C for the duration of 30, 60, and 90 minutes provide similar tones of colors. However, the duration that provided the darkest color was 90 minutes. In mordant dyeing, carried out after the initial dye by first dyeing the fiber with soil and afterward, with mordant, it was found that the mordant with the best reaction to the soil colors was limewater and alum, which caused the colors to be darker and clearer.

1.5 Results from the color durability test

In evaluating the quality of the durability of naturally dyed fibers, the values have to be higher than 2-3 in the grayscale (a 5-level scale), both on discoloration and staining according to the community product standard 18/2557, which was an acceptable characteristic that can be applied to weaving.

1.5.1 Color resistance to soap or soap and soda wash test

Table 1 Level of dyed cotton with Mekong Basin soil color resistance to soap wash

Dye Type	**Duration/ Mordant**	**Level of Color Resistance**						
		(Color change)	**Staining Level of Splicing Cloth**					
			Acetate	**Cotton**	**Polyamide**	**Polyester**	**Acrylic**	**Wool**
Cold dyeing	24 hrs.	3-4	5	4-5	5	5	5	5
	48 hrs.	3-4	5	5	5	5	5	5
	72 hrs.	3	4-5	4	4-5	4-5	5	5
Hot dyeing	30 minutes	3-4	4-5	4-5	5	5	5	5
	60 minutes	2-3	4	4	4	4-5	4	4-5
Mordant Dyeing	90 minutes	2-3	4-5	4-5	4-5	4-5	4-5	4-5
	Limewater	3-4	4-5	4-5	5	5	5	5
	Alum	4	4	3	4	4-5	4-5	4-5
	Iron Rust	3-4	4-5	4-5	5	4-5	5	5
	Alkaline Ashes	3	5	4-5	5	5	5	5

Table 1 shows that all methods of dyeing, cold dyeing, hot dyeing, and mordant dyeing, resulted in changes in the color level between 2-3 and up to level 4. The stain level of the spliced cloth was at level 4 to level 5. It could be said that the cotton fibers dyed with Mekong soil using all dyeing methods and all durations showed good resistance to soap and soap and soda wash according to the Community Product Standard 18/2557

1.5.2 Color resistance to sweat test

Table 2 Color resistance to artificial sweat, both acid and alkali, of cotton dyed with Mekong Basin soil.

Dye Type	**Duration/ Mordant**	**Level of Color Resistance**	
		(Color change)	**Staining Level of Splicing Cloth**

		Artificial Acid	**Artificial Alkali**	**Acetate**	**Cotton**	**Polya-mide**	**Polyester**	**Acrylic**	**Wool**
Cold dyeing	24 hrs.	4-5	4-5	5	5	5	5	5	5
	48 hrs.	4-5	5	5	4-5	4-5	4-5	4	5
	72 hrs.	4-5	4-5	5	4-5	4-5	4-5	4-5	4-5
Hot dyeing	30 minutes	4-5	4-5	4-5	3-5	4	4-5	4	4
	60 minutes	4-5	4-5	4-5	4	4	4	4-5	4
	90 minutes	4-5	4-5	5	3-4	4-5	4-5	4-5	4-5
Mordant dyeing	Limewater	4	4	3-4	2	3	3	3	2
	Alum	4-5	3-4	4	4	4	4	43	4
	Iron Rust	4-5	4-5	4-5	4	4-5	4-5	4-5	4
	Alkaline Ashes	4-5	5	5	5	5	5	5	5

Table 2 shows that all types of dyeing have color changes starting from levels 4 to 4-5. The stained level of the spliced cloth was from level 4 up to level 5. It could be concluded that the cotton dyed with Mekong Basin soil in every dyeing type and duration has good resistance to artificial sweat solution for both acid and alkali, according to the Community Product Standard 18/2557.

1.5.3 Color abrasion (dry) resistance test

Table 3 Levels of color resistance to abrasion (dry)

Dyeing Method	**Duration/ Mordants**	**Level of Color change**
Cold dyeing	24 hrs.	4-5
	48 hrs.	3-4

	72 hrs.	4
Hot dyeing	30 minutes	4
	60 minutes	3
	90 minutes	3-4
Mordant dyeing	Limewater	1-2
	Alum	2-3
	Iron Rust	4
	Alkaline Ashes	3-4

From Table 3, it was found that mordant dyeing with limewater provides the lowest abrasion resistance and, therefore, is unsuitable for weaving. However, other types of dyeing showed a color change level starting from 2-3 to 4-5, which could be concluded that the cotton dyed with Mekong Basin soil has a good color abrasion resistance according to the Community Product Standard 18/2557, except with limewater.

2. The application of cotton dyed with Mekong Basin soil in costume design

2.1 The online market study shows no products related to naturally dyed textiles on high-priced markets. This market type does not generally sell Haute Couture products or products from famous designers and only uses online spaces for advertisement and news notifications rather than selling products. These naturally dyed products are mostly found under the brands on applications such as Instagram, Facebook, and the brands' websites and are typically sold through Facebook Live and Instagram. Additionally, various channels exist for selling these products through different applications, such as Shoppee and LAZADA. However, these products' tailoring aspect is not as delicate as other products, prioritizing quantity over quality and using imitated hand-woven fabrics, such as printed fabric.

2.2 The analysis results of the fashion trend by WGSN Spring Summer 2023 (WGSN, 2023) and the Thai fashion trend from Thai Textile Trend Book Spring Summer 2023 (Department of Cultural Promotion, 2023) was adapted to be more suitable to the environment, society, culture, and consumers' need. In addition, the analysis result of the provinces in the Mekong Basin led to the interpretation that helped provide the design direction under the About of Season concept. These concept shows the different seasons of the Mekong River and nature's imperfection, consisting of ideas, colors, materials, silhouette, and decoration detail. The concrete and abstract unique characteristics were analyzed and helped in interpreting the national fashion trend, which can be concluded as follows.

Table 4 Concluded results in costume design from the application of cotton dyed with Mekong Basin soil

About of seasons		
Topic	**Key Design**	**Detail**

Ideas		Seasons occur in the Mekong River and provide concrete and abstract feelings, which can be divided into two main seasons, dry and flooded seasons, which were used as the design inspiration.
Color		The main colors used in the collection were distributed to every outfit, consisting of brown, the color obtained from Mekong Basin soil; fashion colors, obtained from the fashion trend analysis; inspirational colors, neutral colors, connecting basic colors and fashion colors to create unison.

Table 4 Concluded results in costume design from the application of cotton dyed with Mekong Basin soil (Next)

About of seasons		
Topic	**Key Design**	**Detail**
Textile & Material		The main materials used in the collection were cotton dyed with Mekong Basin soil mixed with linen, a contemporary material, according to the international fashion of emphasizing natural and environment-friendly fabric.
Style or Shapes		The fashion trend and concept analysis helped create a structure that focuses on the loose structure and can be worn with other outfits.

Details		Using threads with different colors and sizes to create dynamic and uneven texture. The silver silk signifies a glittering sandy beach, while the bigger cotton threads signify the flowing of water during the flooding season. Additional decorations consist of ruffles and tucking.

Image 1 Prototype of women's costume applied from dyed cotton with Mekong Basin soil

Image 2 Prototype of men's costume applied from dyed cotton with Mekong Basin soil

2.3 Consumers' opinions evaluation results on the style of costume from the application of dyed cotton from Mekong Basin soil through online questionnaires

Table 5 Consumers' opinion level on the style of costume from the application of dyed cotton from Mekong Basin soil

Questionnaire Items	**Consumers (n=115)**		
	$\overline{X}$	**S.D.**	**Opinion Level**
1. Suitable for different functions and wearing in everyday life	4.50	0.58	Totally Agree

2. Modern, with quality and exquisite tailoring, can be used on many occasions	4.57	0.58	Totally Agree

Table 5 Consumers' opinion level on the style of costume from the application of dyed cotton from Mekong Basin soil (Next)

Questionnaire Items	**Consumers (n=115)**		
	$\overline{X}$	**S.D.**	**Opinion Level**
3. Suitable price considering the products' quality and style	4.43	0.67	Agree
4. Communities can further develop the products into businesses	4.61	0.60	Totally Agree
5. Modernity combines with local culture	4.50	0.61	Totally Agree
Average	**4.52**	**0.61**	**Totally Agree**

Table 5 shows the overall opinions on the style of costumes from the application of dyed cotton with Mekong Basin soil was at the "totally agree" level with an average of 4.52 and a standard deviation of 0.61. Considering each item, it was found that consumers totally agree with the following items, Communities can further develop the products into businesses, Modern, with quality and exquisite tailoring, can be used on many occasions, Suitable for different functions and wearing in everyday life, and Modernity combines with local culture. Consumers agree with the item, Suitable price considering the products' quality and style.

4. Conclusion

1. Conclusion on the study of soil chemical properties, physical properties, ratio, dyeing duration, and durability of the dyed cotton from Mekong Basin soil in Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province

Finding the soil's chemical properties is the study of the soil's components and properties and the soil's chemical changing process. In this research article, the properties include aluminum, iron oxide, manganese, silica, and organic matter. It was found that the soil from the bank of the Mekong River in Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province has a high level of aluminum and iron oxide, chemicals considered natural dyes from minerals. For the soil's physical properties, it was found that the soil is classified as sand since the sample consists of 40% sand particles and less than 20% of clay particles. The soil was used as the dye on cotton fiber. According to the Pore Model theory, cotton fabric has pores similar to those in sponges, which allows colors to penetrate those pores like cellulose fiber (Bureau of Science and Technology Information, 2017), causing textiles to absorb colors better than other fabric. The durability test of the dye consisted of the color resistance to soap and soap and soda wash, the color resistance to sweat (artificial alkali), and abrasion resistance (dry) using the gray scale according to the Thai Industrial Standard 121 Volume 4-2522. The hot dyeing test shows the color change level from 1-5 or significant to no change. The cold dyeing test shows a color change level of 3-5, small change to no change, and dye using mordants has a color change level from 1-5, or significant to no change.

2. Conclusion on the application of dyed cotton with Mekong Basin soil in Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province, to costume design.

From the result of dyeing cotton Mekong Basin soil to costume design and the study result of online markets on naturally dyed textiles, it was found that no high-priced products were found on the online market due to their haute-couture nature and are typically made by high-end tailor which requires wearers come in for the fitting for the costume to fit perfectly. Thus, there might only be one costume in the whole world. There are many middle to higher-priced products on online markets. A majority of these products can be found under different applications such as Instagram, Facebook, and the brands' website. Most products in this category are ready-to-wear products produced in large quantities with good quality and decorative detail. Most of the products on the online market are cheap, mainly consisting of work attire, semi-formal

attire, and outfits for everyday life. These products are mainly found on Facebook Live broadcasts and Instagram. These products tailoring aspect is not as delicate as other products, prioritizing quantity over quality, with no emphasis on naturally dyed products, but sells imitated hand-woven fabrics, such as printed fabric, at lower prices and easier access. From the analysis of the fashion trend to the conclusion of the design direction of the silhouette, color groups, decorative detail, and materials, to men's and women's wear, and the distribution and consumers satisfaction evaluation, it was found that the agreement level is high with the average of 4.52 and standard deviation of 0.61. The result shows that the consumers accept the costume innovation that uses the Mekong Basin soil. The result aligns with the Adoption and Innovation theory of Toffler. A. (1980), cited in Kerdngern et al. (2021), defines innovation with three characteristics: 1) new creation, 2) implementation provides results, and 3) dissemination to society. Innovations led to dissemination, a process that passed on the thought process and helped it align with the product's characteristics and led to the implementation and resulted in high acceptance in the middle – high-priced market.

5. Discussion of Research Result

1. Discussion of the study of soil chemical properties, physical properties, ratio, dyeing duration, and durability of the dyed cotton from Mekong Basin soil in Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province

The test for the chemical and physical properties of the soil aligns with research by Yubol (2549), which stated that the soil in an area that a large quantity of organic matter will have a darker color, soil with lots of iron would appear red. Iron is an essential mineral for natural dye. The study of the physical properties of the Mekong Basin soil shows that the soil from Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province is new soil created by erosions and deposits of sediments and is considered as sand. These findings align with Nokkate et al. (2551), who explained that most sediments have characteristics of fine sand with particles of 0.21 millimeters, similar to the research by Sukudom (2015) explaining that the sediment at 0.7 centimeters deep mainly consists of sand. Thus, it can be concluded that the soil from the banks of the Mekong River is sediment mainly consisting of sand. After the cotton dyeing test through several methods, it was found that the best duration for the colors to stick to the fibers is 72 hours for cold dyeing. For hot dyeing, the best duration is 90 minutes with a water temperature of 80 degrees Celsius. As for dyeing with four different mordants: limewater, alkali ashes, iron rust water, and alum using aftermordant method, the mordant that best reacted to the soil color was limewater. The result conflicts with the research by Thipmanee (2561), who studied the chemical properties and the development of natural dye using Maya soil and stated that Toray was the best fabric for natural dye and the best mordant was ash water, which might be because the soil has different chemical properties and the fabric used was different. The test for color durability also provided different results. It could be noticed that the dyeing duration is an essential factor in color duration. Cold dyeing uses a dyeing duration of 24, 48, and 72 hours, which helps the colors stick to the fabric better than other dyeing methods. Hot dyeing uses a duration of 30, 60, and 90 minutes. Water temperature helped the colors stick to the fabric more but required more duration, leading to a higher color change level than cold dyeing. Dyeing with different mordants produces different results, which aligns with the research by Saratapun (2533), who explained that different mordants affect the colors and duration of the colors and the resistance to wash and light differently.

2. Discussion on the application of dyed cotton with Mekong Basin soil in Nawaeng Sub-district, Khemmarat District, Ubon Ratchathani Province, to costume design

In textile design by applying natural dye from the Mekong River, the study of the online market for naturally dyed products, and the analysis of the international fashion trend, the costume design mainly applied the About of Seasons concept by applying naturally dyed textiles from the Mekong Basin soil from Udonratchathani Province as the cultural capital to create and adapt the product to increase their values, create uniqueness and differences to the products, and address consumers' needs. This application aligns with Chollatep (2011), who stated that the economy consists of the industry based on the individual's creativity, skills, and expertise that has accumulated and passed down through generations. From the fashion trend analysis, the art design principle was aesthetics and the use of local materials. This analysis is in line with Hankla & Vongsingthong (2556), who use beautiful local scarves with unique patterns from the mixed cultures of community members whose ancestors migrated from the northeastern region to costume design that is currently popular since they can be worn in everyday life and can compete with the today's costume market. The consumer satisfaction evaluation shows the highest agreement level, showing that textile design by applying natural color from the Mekong Basin is acceptable to general consumers.

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