

HOL Design with Natural Process of Khmer-Thai Ethnic Group in Cultural Ecology of Lower Mekong Basin

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Abstract: The research design was mixed methods of quantitative and qualitative approaches. The research design for qualitative research was In-Dept Interview with structural form with 70 peoples comprised 50 Thai, 20 Khmer and 5 experts and quantitative research was survey research with 500 peoples of Khmer-Thai ethnics group who involved in natural dyeing silk. The content from qualitative research was analyzed to construct the questionnaire for quantitative research. Factor analysis was used for determination the component factors. The objectives of this research were to study cultural ecology of herb related to Hol silk cloth handicraft and to analyze component factor of dyeing silk with Hol design with natural process of Khmer-Thai ethnics group. The finding illustrated that there were 58 items were constructed from content analysis of In-Depth Interview and there were 6 components comprising 1) Hol Design with Natural Dyeing to Support Environment and Cultural Ecology, 2) Secret Code of Buddhist and Royal Household Wisdoms Succeeded Transferring of Fasten Dyeing and Hol Cloth Weaving Process, 3) Local Science and Technology Cultivated at Child Age through Family Learning, 4) Sun Energy and Water Mixers with Natural Process Conserve Ecosystem, 5) Content of Environmental Knowledge for Value Change of Chemical Use, and 6) Local Plants and Herbs are Important Raw Material of Sufficient Life with Local Appropriate Technology

Key Words: HOL Design / Natural Process / Khmer- Thai Ethnic Group / Lower Mekong Basin / Cultural Ecology

1. Introduction

The Mekong is a river in Southeast Asia. It is the world's 12th-longest river and the 7th-longest in Asia. Its whole length is 4,909 kilometers and in China its length is 2,130 kilometers. It drains an area of 804,381 square kilometers, discharging 475 cubic kilometers of water annually (Liu, et al., 2009). This river runs through China's Yunnan province, Burma (Myanmar), Laos, Thailand, Cambodia and Vietnam. In 1995, Laos, Thailand, Cambodia and Vietnam established the Mekong River Commission to assist in the management and coordinated use of the Mekong's resources. In 1996 China and Burma (Myanmar) became "dialogue partners of the MRC and the six countries now work together within a cooperative framework (Wikipedia, 2012, and Kasetsiri, and Kumkoon, 2010). Mekong or Khong River has origin from Himalaya range at Tibetan Plateau (Mekong River Commission. 2005). It runs through Lao and it is named "Khong River". In Thai language, it is called "Mekong River". Important characteristics of Mekong River is high bank both sides

and flows with curve a long with hill shoulder. It flows from North to South though out the year. The water level in rainy season and drought season will extremely different amount. The speed of current depends on each season. Soil in Mekong River is sand soil. A long the river, there are a lot of islands with different sizes more than a hundred, therefore it is named as "Eastern Danube River" (Kasetsiri, and Kumkoon, 2010).

Mekong River is a main blood vessel that nurtures the population more than 60 millions; hence it is as food source and water source for agriculture, transportation, traveling, and other numerous activities. A long with almost 5,000 kilometers, it flows through different geography and contains a large number of branches before flow to the sea (Kasetsiri, and Kumkoon, 2010). Therefore, it causes the diversity and furnish of natural resources, fauna and flourish and induces the unity and diversity of ecosystem of each area (Boonyaratanapalin, 2002).

Cultural ecology is the study of human adaptations to social and physical environments. Human adaptation refers to both biological and cultural processes that enable a population to survive and reproduce within a given or changing environment (Joralemon, 2010). This may be carried out diachronically (examining entities that existed in different epochs), or synchronically (examining a present system and its components). The central argument is that the natural environment, in small scale or subsistence societies dependent in part upon it. It is a major contributor to social organization and other human institutions. Cultural ecology represents the "ways in which culture change is induced by adaptation to the environment." A key point is that any particular human adaptation is in part historically inherited and involves the technologies, economic, practices, and knowledge that allow people to live in an environment as needs of physical and mental aspects. This is an important fundament to explain human behavior. This concept is emphasized on the relationship between culture and environment that it affects to each other and it is difficult to separate from each other in each age. However, each design and characteristics, experiences, familiarities, way of life, tradition and culture might be transferred from generation to generations (Wikipedia, 2012, Wongwipak, 1989 & Thakairach, 2001). In conclusion, cultural ecology, it is an attempt to analyze about three factors involve 1) the relationship between environment and technology of production that defines the importance of cultural change, 2) the relationship between technology and human behavior, and 3) the results for explanation the origin and characteristics of culture of different ethnic groups.

Nonetheless, human closely relates to woven thing from birth to grave. The utilization of woven thing is used for covering our body to protect from external environment whether to protect heat from sunlight, insect bite and contact with foreign thing including covering the secret part of body from other seeing. Moreover, it has developed to the step of creation for beautiful design to express the art of inventor for weaving. From historical period, the dress is expressed to craft skill and creation of weaver but it is an evidence of cultural prosperity of ethnic group (Center of Academic Assistant of Community Development Area 11, 2003). Therefore, weaving is a culture that express to the use of benefit from natural resources of human. From the archaeological delving, indicated that weaving culture of human had since before historical age.

Cloth weaving is a culture of ethnic group woman in prior period in Mekong Sub-region that has transferred succeeding since past period through the socialization process via Maternal Linage and it is a basic need of human. Particularly, in ancient age, the technology is not developed; therefore every household needs to weaving cloth for household use. The dress indicates to identity of each ethnic group and indicates to valuable art that should be admired. Beside, weaving is a craft that man perceives as woman work and uses to just for couple selection. Therefore, every woman must be able to weave so she must be taught since she is young. Learning method is natural through looking, observing, and remembering through looking her grandmother, mother or relative until she familiar and absorb weaving knowledge without consciousness. When she grows up if she is taught and learnt from closed person, she will try and practice by herself for a long period, she would get skill with her own creation and competency therefore the cloth results with diversity and variety of beauty according to each ability (Kuptusation, 2002, Center of Academic Assistant of Community Development Area 11, 2003, and Sriboonnak, 2006).

Silk cloth was recognized that cloth had origin from China about 7,000 years ago. Afterward, it has spreads over the world including Mekong Sub-region. It has been well known and favorable at Cambodia, Northeastern of Thailand, and Burma (Myanmar) (Panichpan, 2004). Silk is a natural protein fiber, some forms of which can be woven into textiles. The protein fiber of silk is composed mainly of fibroin and produced by certain insect larvae to form cocoons. The best-known type of silk is obtained from the cocoons of the larvae of the mulberry silkworm *Bombyx mori* reared in captivity (sericulture). The shimmering appearance of silk is due to the triangular prism-like structure of the silk fiber, which allows silk cloth to refract incoming light at different angles, thus producing different colors (Panichpan, 2004, and Sutherland, et al, 2012). Silks are produced by several other insects, but generally only the silk of moth caterpillars has been used for textile manufacturing. There has been some research into other silks, which differ at the molecular level (Sutherland, et al, 2012, and Wikipedia, 2012). Many silks are mainly produced by the larvae of insects undergoing complete metamorphosis, but some adult insects such as web-spinners produce silk, and some insects such as raspy crickets produce silk throughout their lives (Walker, et al, 2012). Production process of silk cloth composed of complexity and

difficulty by starting with Mulberry tree cultivation, silk thread pulling, dyeing, and design construction. There is hiding with body of knowledge, therefore if one does not deeply study, one could not understand and extend these bodies of knowledge further to use its benefit and adapt to go along with their needs and uses according to period of life. It is well known that silk dyeing is the step that is needed the high handicraft ability and fineness because it is an integration of scientific knowledge occurred from local wisdom that accumulated from different generations and art ability to create a color and design to express for its beauty, charm, durability and serve the demand of use.

Currently, different ethnic groups are still transferring the art of weaving that is identity of their ethnic groups. This is learning process from generations to generations. Art of weaving needs a specially personal ability with creative thinking to invent the new design or to develop old design to be new design with influent and supportive factors of living area. Therefore, weaving is wisdom to use natural resources of various ethnic groups that accumulate, develop, and transfer from generations to generations for a long time.

Hol or Hor is a kind of silk cloth that is accepted as special identity of Khmer Ethnic Group, particularly, Khmer-Thai Ethnic Group in Surin Province. It is silk cloth that is more exceptional color and design than other designs of silk cloth. Hol is Khmer language with meaning of flowing of gold and money, integrity, famous, and prosperity of wearer. It was occurred from wisdom of imagination to sunlight contacts to running and waving water and reflects to cause rainbow color but some ethnic has imagination about Hol cloth design from a stripes of python snake such as a case of Hol woven group in village of Na Haew, Sawai Sub-district, Muang District, Surin Province. Moreover, some might call Hol as "Bambooleaf design". Considering as holistic picture of cloth design, it might like a forest with channel of valley and stream as well (Phanurat, and Sriboonnak, 1995, Sriboonnak, 2006, Sriboonnak, et al., 1997, and Center of Academic Assistant of Community Development Area 11, 2003). Therefore, the process of Hol silk cloth weaving needs body of knowledge, handicraft ability, skillfulness, neatness, and time consumed, especially, the silk dyeing process with herbs from nature of Khmer-Thai Ethnic Group since they bring natural resources that occurred from diversity and richness of local ecosystem to use. It is a step that depends body of knowledge and wisdom by using scientific method from observation through try and error and real practice from things that is hidden in way of life and community way to apply with body of knowledge and creative thinking in art to construct design and color of silk cloth that is an identity of this ethnic group. This is congruent to nature.

From above mentioned reasons, it is interesting to study the process of silk dyeing with herb as Hol design of Khmer-Thai Ethnic Group in order to understand the concept, body of knowledge, and silk dyeing technology with herbs that are natural resources existing in locality with friendly environment. Then gathering, this body of knowledge is in terms of documentary evidences that are able to use for referring and kept as heritage for next generations. Moreover, it should be studied about the connection among environmental factors in community, ecosystem, and weathers that effected to raw material selection for silk dyeing. Therefore, it should deeply study to conserve this body of knowledge to sustain by introducing scientific knowledge and appropriate technology to support and extend from existing wisdom to be an appropriate technology with environmentally friendly concept.

2. Research Objective

The objectives of this research were as followings:

- To study cultural ecology of herb related to Hol silk cloth handicraft.
- To analyze component factor of dyeing silk with Hol design natural process of Khmer-Thai ethnics group.

3. Methodology

3.1 Qualitative research was used for data collection from In-Depth Interview form with 70 peoples comprised 50 Thai, 20 Khmer and 5 experts. 50 Thai peoples were collected from communities of Surin Province in Northeastern region of Thailand who are involving dyeing silk with natural process of HOL design. 20 Khmer peoples were collected from communities of Siem Reap Province in Northwestern of Cambodia. 5 experts who have local wisdom and are accepted by community of dyeing silk with Hol design natural process, were collected from Khmer-Thai ethnics group communities.

3.2 Quantitative research was survey research with 505 peoples of Khmer- Thai ethnics group who involve in dyeing silk with Hol design natural process.

4. Results

4.1 In-Depth Interview

The results of In-Depth Interviews with peoples comprised 50 Thai, 20 Khmer and 5 experts with content analysis, the 58 items were constructed for survey research as presented in table 1.

Table 1 Content Analysis Results

Item Evaluation
1. Way of life of people who sericulture involves with Mulberry tree and silk worm all a day.
2. Using hand to press silk cocoon or shake silk tube is simple technology.
3. Even though the tree bark used for dyeing consumed time but it is useful more than using chemical color.
4. Herb gives color that is valuable for ecosystem because it gives color, active medical properties, and support for small tree and animal in terms of food and drug.
5. Technology of dried silk cocoon under the sunlight will assist silk thread to silk thread and dyeing.
6. Silk cocoon in period before to be silk worm has high nutritional value and is an important period draw the silk with high quality.
7. Transferring knowledge for sericulture is gradation process from baby to adult.
8. At present there is a development by dressing with cutting branch to shorter three so the leaf will bigger.
9. Silk thread has natural glue therefore; it needs to wash with alkaline water before dyeing with quality.
10. Kapok tree is general apparent in Khmer- Thai Ethnic Group communities, even through Kapok peel is used to make alkaline water for silk dyeing.
11. Alkaline water made with Kapok peel and Spiny amaranth help for better silk dyeing.
12. Alkaline water made (Kabong) is worth not only for silk dyeing and hair washing but it also make people realizes to important of plants and conserve community ecosystem.
13. Silk dyeing, silk thread must immerse in water first for better dyeing before boil it with and color water.
14. Sunlight is an important solar power in dyeing and bleaching process, the weaver pays respect to the Sun with Brahman ritual.
15. Hol silk design dyeing must fasten before dyeing with repeatedly process by using red, yellow and blue colors.
16. Hol patter natural dyeing, the yellow color is used Khae tree, red color used a insect named Laccifer lacca, and blue color is used indigo blue tree.
17. Hol patter natural dyeing process is not only hobby and business but it also a promotion of science and technology.
18. Hol patter weaving and silk worm feeder, it encourages for learning life cycle of silk worm and fly.
19. Silk weaver is housewife who looks after her child as main work but feeding silk worm and weaving supplementary work.
20. Silk thread will have good quality if silk worm feeder is delicate and pays attention to separate the male silk worm from female in the egg laying period.
21. Silk worm feeder must love silk worm like her child by selecting Mulberry leaves to be appropriate for its age. Moreover she must to cut in fine pieces and increases with quantity of leaf.
22. Silk worm likes a baby, feeder must take care it carefully and precaution to prevent it from other insects including smell to disturb it.
23. Feeding silk worm with love, it makes family members to realize the silk value and they will learn together about cultural ecology.
24. Khmer- Thai Ethnic Group give value for Hol patter silk dyeing process and silk cloth will be used for different auspicious ceremony.
25. Hol silk cloth related to various ceremonies from birth to grave and for next incarnation.
26. Silk excrement is worth for both soil furnish for plant and a food for cow and buffalo.
27. Culture of silk and Mulberry tree comes together with rice culture because silk, mulberry tree, cow, buffalo and rice are in cycle of food and the same ecosystem.
28. Hol silk cloth is an ancient design with valuable for education, economic, and social aspects.
29. Cloth wisdom of Royal Household is influence to weaver for carefully make delicate thread silk with fine and thin in order to fasten and dye with fine strip.
30. Hol design natural silk dyeing process gives all of spiritual worth, intelligence, and economy.
31. Hol design natural silk dyeing process is gradually transfer continuous from generations to generations from Khmer-Thai ethnic group.

32. Great grandmother teaches grandmother, grandmother teaches mother and mother teaches daughter. The daughter uses it as job to nurture her child, grandchild, and great grandchild.
33. Fastening, dyeing and silk worm feeding is able to train since 9 years old.
34. Hol silk cloth production is created a job dividing systemically.
35. Hol silk designer will deeply learn on natural color use, color mixing with fasten dyeing and ecology of herbs that give color dyeing and sit can be found in community at the edge of field or farm and community forest.
36. Silk twisting is a technology to create a new color on silk cloth.
37. Treat with silk worm and Mulberry tree with deep knowledge; it will get the high quality of silk thread and Hol silk cloth.
38. Dyeing of silk thread, if dyer has deepness about plant and insect a insect for color made, it will get better dyeing and better silk thread quality.
39. Dyeing process with insect named Laccifer lacca for better stain, it is related to some kinds of plants such as Mhued leaf and tamarind, therefore it is accounted as environmental conservation.
40. Crushing, grasping and soaking the silk thread in hot water mixed with acid from leaf with sour taste, it was learning skill about dyeing with natural chemical process.
41. Hol patter natural dyeing process, the whole color in pot is stained or not, it can notice from bubble color is fade until becomes clear. The weaver uses as indicator that learn from technological wisdom at molecular level.
42. Fastening and dyeing Hol with 2 times hot boiling and 2 times cool dyeing is an endeavor of dyer.
43. Dyeing with color from plant is a mean that weaver must learns from wisdom in chemical aspect according to Khmer-Thai ethnic group from their ancestor deeply.
44. Dyeing with hot and cool for better stain, it needs to use both technical wisdom and training experience seriously and long term.
45. Hol patter natural dyeing process, it helps practitioner knows about temperature, growth of bacteria, acid-base and making of dark and light color.
46. Banana, spinach, coconut, Cassia, Kapok and others are raw materials for Hol patter natural dyeing process and it is cultural ecology that weaver learn deeply.
47. Technology of alkaline water and dyeing water with acidic condition in Hol patter natural dyeing process, it is connection with cultural ecology of weaver.
48. The clear water is an important part for Hol patter natural dyeing process, Khmer-Thai ethnic group pays attention to and expresses grateful in various merit tradition.
49. Hol patter natural dyeing process is ever make in Cambodia and South I-san of Thailand
50. Every house in Khmer-Thai ethnic group has banana tree.
51. Weed nearby house such as spinach, and Heliotropium, these are eatable and use drug and involve to silk dyeing with natural chemical process.
52. Mango, coconut, jackfruit, and Kapok trees are cultivated in community and side yard garden, these are involving to natural dyeing process.
53. Sanuan, Sakae, and Jamjuree trees are used for feeding insect named Laccifer lacca to be red color in Hol patter natural dyeing process.
54. Mhued leaf, Purple Bauhinia, tamarind and Bauhinia malabarica roxb are perennial trees stand at edge of field or farm and community forest. These involve to patter natural dyeing process are decreased.
55. Hol cloth will be with stay with Surin people for everlasting.
56. Hol cloth dyeing with chemical substance looks better than Hol cloth dyeing with natural color.
57. Relationship among trees, people, religion and Hol cloth is unity for Khmer-Thai ethnic group life.
58. It should study, conserve, and succeed Hol cloth urgently for young generation of Surin Province, particularly, Hol design natural dyeing process of Khmer-Thai ethnic group origin.

4.1 Survey Research results

The questionnaire was used to collect data from 500 peoples of Khmer-Thai ethnics group who involved in natural dyeing silk. Then the factor analysis was employed for component determination. There were 6 components were constructed as presented in table 2, 3, 4, 5, 6 and 7 as followings.

Table 2 Component 1: Hol Design Natural Dyeing to Support Environment and Cultural Ecology

No.	Items	Factor Loading	NB
53	Sanuan, Sakae, and Jamjuree trees are used for feeding insect named Laccifer lacca to be red color in Hol patter natural dyeing process.	0.789	Raw material

43	Dyeing with color from plant is a mean that weaver must learns from wisdom in chemical aspect according to Khmer-Thai ethnic group from their ancestor deeply.	0.761	Process
54	Mhued leaf, Purple Bauhinia, tamarind and Bauhinia malabarica roxb are perennial trees stand at edge of field or farm and community forest. These involve to patter natural dyeing process are decreased.	0.757	Decrement of raw material source
35	Hol silk designer will deeply learn on natural color use, color mixing with fasten dyeing and ecology of herbs that give color dyeing and sit can be found in community at the edge of field or farm and community forest.	0.713	Learning process
15	Hol silk design dyeing must fasten before dyeing with repeatedly process by using red, yellow and blue colors.	0.678	Production process
58	It should study, conserve, and succeed Hol cloth urgently for young generation of Surin Province, particularly, Hol design natural dyeing process of Khmer-Thai ethnic group origin.	0.672	Study, conserve, and succeeding
9	Silk thread has natural glue therefore; it needs to wash with alkaline water before dyeing with quality.	0.661	Production process
16	. Hol patter natural dyeing, the yellow color is used Khae tree, red color used a insect named Laccifer lacca, and blue color is used indigo blue tree.	0.657	Source of raw material
17	Hol patter natural dyeing process is not only hobby and business but it also a promotion of science and technology.	0.654	Supplementary income
44	Dyeing with hot and cool for better stain, it needs to use both technical wisdom and training experience seriously and long term.	0.713	Body of knowledge
40	Crushing, grasping and soaking the silk thread in hot water mixed with acid from leaf with sour taste, it was learning skill about dyeing with natural chemical process.	0.652	Practical technique
49	Hol patter natural dyeing process is ever make in Cambodia and South I-san of Thailand	0.643	Same ethnic group
51	Weed nearby house such as spinach, and Heliotropium, these are eatable and use drug and involve to silk dyeing with natural chemical process.	0.626	Holistic concept
3	Even though the tree bark used for dyeing consumed time but it is useful more than using chemical color.	0.611	Local and globalization
25	25. Hol silk cloth related to various ceremonies from birth to grave and for next incarnation.	0.589	Raise for sustainability
41	Hol patter natural dyeing process, the whole color in pot is stained or not, it can notice from bubble color is fade until becomes clear. The weaver uses as indicator that learn from technological wisdom at molecular level.	0.548	Explain with scientific process
8	At present there is a development by dressing with cutting branch to shorter three so the leaf will bigger.	0.531	Promotion and development
26	Silk excrement is worth for both soil furnish for plant and a food for cow and buffalo.	0.505	Silk, buffalo, soil and environment
22	Silk worm likes a baby, feeder must take care it carefully and precaution to prevent it from other insects including smell to disturb it.	0.496	Maternal socialization
13	Silk dyeing, silk thread must immerse in water first for better dyeing before boil it with and color water.	0.493	Dyeing technique
39	Dyeing process with insect named Laccifer lacca for better stain, it is related to some kinds of plants such as Mhued leaf and tamarind, therefore it is accounted as environmental conservation.	0.307	Dyeing adjusted with wisdom

From table 2 Component 1: Hol Design Natural Dyeing to Support Environment and Cultural Ecology comprised 23 items, the highest factor loading was Sanuan, Sakae, and Jamjuree trees are used for feeding insect named Laccifer lacca to be red color in Hol patter natural dyeing process with 0.789, subsequences were Dyeing with color from plant is a mean that weaver must learns from wisdom in chemical aspect according to Khmer-Thai ethnic group from their ancestor deeply, and Mhued leaf, Purple Bauhinia, tamarind and Bauhinia malabarica roxb are perennial trees stand at edge of field or farm and community forest. These involve to patter natural dyeing process are decreased with 0.761 and 0.757 respectively.

Table 3 Component 2: Secret Code of Buddhist and Royal Household Wisdoms Succeed Transferring of Fasten Dyeing and Hol Cloth Weaving Process

No.	Items	Factor Loading	NB
29	Cloth wisdom of Royal Household is influence to weaver for carefully make delicate thread silk with fine and thin in order to fasten and dye with fine strip.	0.849	Promote and develop
28	Hol silk cloth is an ancient design with valuable for education, economic, and social aspects.	0.782	Study, economic, and social
31	Hol design natural silk dyeing process is gradually transfer continuous from generations to generations from Khmer-Thai ethnic group.	0.720	Local informal education
57	Relationship among trees, people, religion and Hol cloth is unity for Khmer-Thai ethnic group life.	0.712	Hol holistic
30	Hol design natural silk dyeing process gives all of spiritual worth, intelligence, and economy.	0.711	Ethnic socialization and Identity
37	Treat with silk worm and Mulberry tree with deep knowledge; it will get the high quality of silk thread and Hol silk cloth.	0.690	Socialization
27	Culture of silk and Mulberry tree comes together with rice culture because silk, mulberry tree, cow, buffalo and rice are in cycle of food and the same ecosystem	0.679	Food and Drink
55	Hol cloth will be with stay with Surin people for everlasting.	0.674	Identity as symbol
48	The clear water is an important part for Hol patter natural dyeing process, Khmer-Thai ethnic group pays attention to and expresses grateful in various merit tradition.	0.646	Pay attention to water as essential factor
24	Khmer- Thai Ethnic Group give value for Hol patter silk dyeing process and silk cloth will be used for different auspicious ceremony.	0.637	Good thing of Hol cloth is subjective
38	Dyeing of silk thread, if dyer has deepness about plant and insect a insect for color made, it will get better dyeing and better silk thread quality.	0.636	Source of raw material
32	Great grandmother teaches grandmother, grandmother teaches mother and mother teaches daughter. The daughter uses it as job to nurture her child, grandchild, and great grandchild.	0.616	Transferring maternal knowledge
34	Hol silk cloth production is created a job dividing systemically	0.603	Family and community management
45	Hol patter natural dyeing process, it helps practitioner knows about temperature, growth of bacteria, acid-base and making of dark and light color.	0.598	Scientific and technological process
46	4Banana, spinach, coconut, Cassia, Kapok and others are raw materials for Hol patter natural dyeing process and it is cultural ecology that weaver learn deeply.	0.591	Friendly environment living
21	Silk worm feeder must love silk worm like her child by selecting Mulberry leaves to be appropriate for its age. Moreover she must to cut in fine pieces and increases with quantity of leaf.	0.574	Love relationship between man and silk
50	Every house in Khmer-Thai ethnic group has banana tree.	0.548	Important raw material
20	Silk thread will have good quality if silk worm feeder is delicate and pays attention to separate the male silk worm from female in the egg laying period.	0.536	High technique of silk worm feeding
19	Silk weaver is housewife who looks after her child as main work but feeding silk worm and weaving supplementary work.	0.532	Role of male and female of ethnic group
42	Fastening and dyeing Hol with 2 times hot boiling and 2 times cool dyeing is an endeavor of dyer.	0.520	Love, mind, and attempt
10	Kapok tree is general apparent in Khmer- Thai Ethnic Group communities, even through Kapok peel is used to make alkaline water for silk dyeing.	0.506	Apply raw material for friendly environment
36	Silk twisting is a technology to create a new color on silk cloth.	0.491	Better quality
47	Technology of alkaline water and dyeing water with acidic condition in Hol patter natural dyeing process, it is connection with cultural ecology of weaver	0.475	Cultural ecology

From table 3 Component 2: Secret Code of Buddhist and Royal Household Wisdoms Succeed Transferring of Fasten Dyeing and Hol Cloth Weaving Process comprised 21 items, the highest factor loading was cloth wisdom of Royal Household is influence to weaver for carefully make delicate thread silk with fine and thin in order to fasten and dye with fine strip with 0.849. Subsequences were Hol silk cloth is an ancient design with valuable for education, economic, and

social aspects and Hol design natural silk dyeing process is gradually transfer continuous from generations to generations from Khmer-Thai ethnic group with 0.782 and 0.720 respectively.

Table 4 Component 3: Local Science and Technology Cultivated at Child Age through Family Learning

No.	Items	Factor Loading	NB
23	Feeding silk worm with love, it makes family members to realize the silk value and they will learn together about cultural ecology.	0.766	Learning together of family
18	Hol patter weaving and silk worm feeder, it encourages for learning life cycle of silk worm and fly.	0.677	Scientific and technological knowledge
33	Fastening, dyeing and silk worm feeding is able to train since 9 years old.	0.629	Cultivate learning process at child
14	Sunlight is an important solar power in dyeing and bleaching process, the weaver pays respect to the Sun with Brahman ritual.	0.578	Sunlight is a sources of energy for living things
7	Transferring knowledge for sericulture is gradation process from baby to adult.	0.573	Learning process transferring
6	Silk cocoon in period before to be silk worm has high nutritional value and is an important period draw the silk with high quality	0.553	Supportive for all process

From table 4 Component 3: Local Science and Technology Cultivated at Child Age through Family Learning comprised 6 items, the highest factor loading was feeding silk worm with love, it makes family members to realize the silk value and they will learn together about cultural ecology with 0.766. Subsequences were Hol patter weaving and silk worm feeder, it encourages for learning life cycle of silk worm and fly, and fastening, dyeing and silk worm feeding is able to train since 9 years old with 0.677 and 0.629 respectively.

Table 5 Component 4: Sun Energy and Water Mixer with Natural Process Conserve Ecosystem

No.	Items	Factor Loading	NB
11	Alkaline water made with Kapok peel and Spiny amaranth help for better silk dyeing.	0.607	Production Process
12	Alkaline water made (Kabong) is worth not only for silk dyeing and hair washing but it also make people realizes to important of plants and conserve community ecosystem.	0.566	Awareness toward environment
5	Technology of dried silk cocoon under the sunlight will assist silk thread to silk thread and dyeing.	0.440	Sun energy direct effect to production process

From table 5 Component 4: Sun Energy and Water Mixer with Natural Process Conserve Ecosystem comprised 3 items, the highest factor loading was alkaline water made with Kapok peel and Spiny amaranth help for better silk dyeing with 0.607. Subsequences were Alkaline water made (Kabong) is worth not only for silk dyeing and hair washing but it also make people realizes to important of plants and conserve community ecosystem, and technology of dried silk cocoon under the sunlight will assist silk thread to silk thread and dyeing with 0.566 and 0.440 respectively.

Table 6 Component 5: Content of Environmental Knowledge for Value Change of Chemical Use

No.	Items	Factor Loading	NB
56	Hol cloth dyeing with chemical substance looks better than Hol cloth dyeing with natural color.	0.735	Local and globalization

From table 6 Component 5: Content of Environmental Knowledge Change Value of Chemical Use had only 1 item, Hol cloth dyeing with chemical substance looks better than Hol cloth dyeing with natural color with 0.735.

Table 7 Component 6: Local Plants and Herbs are Important Raw Material of Sufficient Life with Local Appropriate Technology

No.	Items	Factor Loading	NB
2	Using hand to press silk cocoon or shake silk tube is simple technology.	0.728	Simple technology
1	Way of life of people who sericulture involves with Mulberry tree and silk worm all a day.	0.601	Way of life
4	Herb gives color that is valuable for ecosystem because it gives color, active medical properties, and support for small tree and animal in terms of food and drug.	0.582	Herbs of community
52	Mango, coconut, jackfruit, and Kapok trees are cultivated in community and side yard garden, these are involving to natural dyeing process.	0.526	Source of raw material in locality

From table 7 Component 6: Local Plants and Herbs are Important Raw Material of Sufficient Life with Local Appropriate Technology comprised 4 items, the highest factor loading was using hand to press silk cocoon or shake silk tube is simple technology with 0.728. Subsequences were way of life of people who sericulture involves with Mulberry tree and silk worm all a day, and herb gives color that is valuable for ecosystem because it gives color, active medical properties, and support for small tree and animal in terms of food and drug with 0.601 and 0.526 respectively.

5. Discussion

It might be concluded that above study reflected to past of Hol cloth production as holistic view of integration of science and art together with learning process and cultivating morality together with natural and environment conservation of locality both in community and community forest. Therefore, it requires collaboration among local community, governmental sector and private sector to conserve cultural ecological knowledge of HOL Design Dyeing Silk Natural Process of Khmer- Thai Ethnic Group to sustain for next generations to accomplish sustainable development. Moreover, it should use this Khmer-Thai ethnic group community as prototype for promotion and conservation of culture and environment for other community and ethnic group.

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