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Aero-hidroponic products for rural forest farming

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Abstract

Today's rural farmers depend on private land, chemical fertilizers and high-cost irrigation. Farmers are less productive, because the land is getting narrower and prohibited to exploit the village forest that has become the source of village life. To improve farm productivity, agricultural systems are needed in accordance with the village environment. Through ethnographic and ergocultural studies of village farmers' behavior and rural farming patterns, as well as phenomenological studies of lifestyle changes, and the effects of modern agriculture within the village, the actual and factual description of the village situation and condition requires relevant agricultural work needs. Research on the revitalization of Tatanen Huma Sunda through aero-hydroponic science, has demonstrated the ability of aeroponic-hydroponic-aquaponic farming systems to meet the expectations of village farmers. The product design of aeroponic products for productive vegetable farming systems in forested areas (agribusiness in agroforestry) and hydro-aquaponic products for productive vegetable farming over fish ponds and home yards, is expected to be developed for village agricultural areas in Indonesia.

Keywords: ergocultural, aerohidroponic. Environment, Product Design

1. Introduction

Rural development in West Java is growing rapidly in all areas. In addition to strengthening in rural infrastructure, it also includes the attitude of the village community mentality in understanding the situation and environmental conditions.

Desa Cibeureum Kecamatan Sukamantri Kabupaten Ciamis Propinsi Jawa Barat, is one example of a village that is growing very rapidly. In agriculture, on 9 November 2006 Desa Cibeureum was declared by the Minister of Agriculture of the Republic of Indonesia as an agropolitan area marked by the inauguration of P4S (Karangsari Agricultural and Rural Training Center) as a center of agribusiness development and agroforestry activities. In the field of culture, one of Kecamatan Sukamantri special art of "bebegig" has won a parade contest at the international carnival in Rio De Jainero City of Brazil. In the social field, Desa Cibeureum has LMDH (Lembaga Desa Desa Hutan), which is very concerned about forest preservation around the village environment.

Wilderness in the village environment is essentially threatened by the development of agribusiness which requires a very wide homogeneous farmland. Some areas of deforested forest into vegetable business farmlands have a devastating impact on communities where water sources in the forests are contaminated with pesticides, resulting in widespread health disruption to villagers. In addition, the village area is also haunted by the possibility of erosion, landslide and earthquake. All villagers strongly believe in the natural balance of nature, so that if the ecosystem structure is disturbed or changed, nature will seek to reconstitute itself. The nature of the balance of nature is very influential in the life of the community in the area of forest-villages, causing high levels of public awareness in preserving this forest.

Desa Cibeureum farmers are eager to increase agricultural productivity without resorting to deforestation. Farmers need large farms to increase their productivity, but land owned generally narrows due to changes in the amount of land due to inheritance. In the village area, farmers can only work on small gardens in the yard of houses, fish ponds and rice fields in a limited area. Limited land and farm productivity demand is a common problem experienced by every smallholder farmer in forest village area. The principle of contemporary agriculture that is rampant in urban areas in various developed countries, is what is called urban farming, which is the way of modern farming by utilizing a narrow land in the yard as a hydroponic farm land that is considered very practical and productive. But the hydroponics system pioneered by the lovers of plants in several cities in Indonesia, was less developed in the general public, and tend to live only in the environment of the community of hydroponic lovers.

The principles and work systems of hydroponics, aeroponics and aquaponics introduced by urban farmers activists in various social media to Indonesian society, are basically well known to rural people, but because they are not derived from their cultural roots, village farmers are not enthusiastic about welcoming the new system. Attempts to introduce the concept of hydroponic, aeroponic and aquaponic farming in rural communities, are carried out with local cultural and policy approaches that are preserved. The principle of maintaining the ecosystem balance of forest villagers has a strong relevance to customary rules in the context of *mulasara buana* as well as the mandate of the Sundanese ancestors in preserving the natural environment.

2. Methodology

The research method used to understand the cultural roots of forest villagers is using ethnographic and phenomenological approaches. The study focuses on the philosophical and psychological aspects of their identity, so they have certain roles, functions and tasks that can be revealed, in terms of the environment in which they live. Based on geographical conditions, forest villagers residing in mountainous areas, derived from the pahuma community. Environmentally friendly people and nature lovers. The pahuma community is likely to accept the hydroponic, aquaponic, aeroponic and vertikultur farming systems that are environmentally friendly and in harmony with ecosystem situations and conditions in forests and mountains.

In analyzing the qualitative descriptive data, the effort of understanding through observation and the deepening of insight, through the process of ethnographic research methodology developed by Spradley (1985). In order to obtain comprehensive data which is a unified whole and integrated, used the method of description because the problem under study related to the concept of human behavior and human life of urban culture in the area of Bandung City. Data collection using observation techniques (field work observation) and ethnographic interviews using data collection guidelines. The ethnographic method of Spradley, as shown in the following scheme:

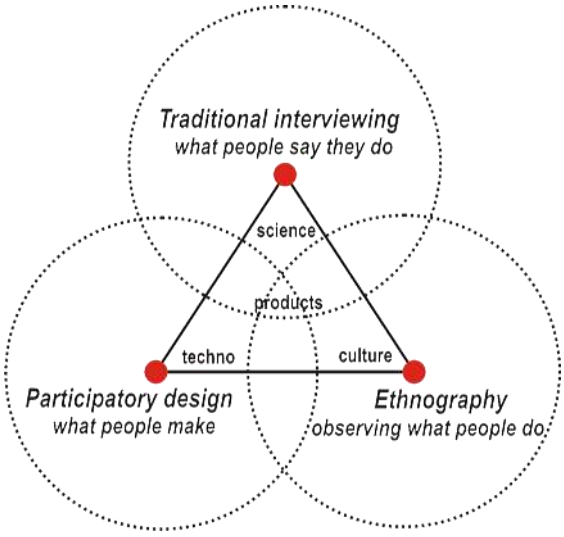

Fig. 1: The concept of ethnographic studies in the cultural sector that involves the application of science and technology (adaption of Spradley 1985)

Implementation of ethnography in the world of Product Design, is about observing the behavior of human work (observing what people do) as an influential socio-cultural point of view in design decisions. Another point of view involved in product formation is the paradigm of technology application in the form of participatory design in the form of competence in creating and producing (what people make) which is integrated with the element of science based on local wisdom, which can be absorbed through direct interview (traditional interviewing) about the fundamental capabilities possessed by a particular cultural society (what people say they do).

3. Discussion

In understanding the identity of forest village communities, a fundamental understanding of aspects relevant to the principles of natural conservation is required. This common life principle can be used to consider the hydroponic-aeroponic-aquaponic farming system as a solution to their problems.

The structure of Indonesian society according to Wertheim (1954) generally consisted of the cultivators in the inland and upland areas, the wetland farmers who settled in the watersheds, lakes and swamps, and seafaring societies (fishermen) living in the coastal areas.

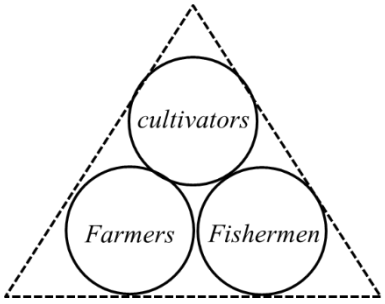

Fig. 2: The structure of Indonesian society according to Werheim (1954)

The division of the structure of Indonesian society from Werheim above shows that the societies of various ethnic groups in Indonesia, consisting of groups divided by the type of livelihood determined by the environmental conditions of the environment. Each tribe in Indonesia has the ability to adapt to its environment and gain knowledge on how to survive in its environment. These situations and conditions allow for competition or interaction between communities that make a society dominant so that it can be more developed when compared with other communities in the same tribe. This is what makes the dominant characteristic of various tribes in Indonesia.

Edi S Ekajati (2005) indicates that the Sundanese community consists of three major groups, the **pahuma** community who live in fields in the highlands and volcanic areas, **panyawah** communities living in the lowlands where there are sources of water, springs, streams, lakes and swamps, as well as **pamayang** people who live on the coast and estuaries.

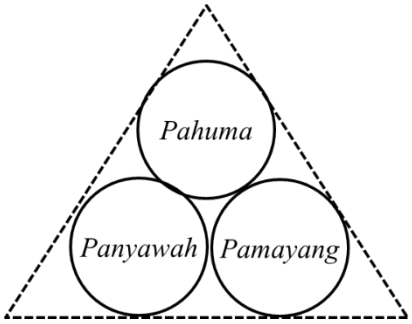

Fig. 3: Structure of Sundanese society
(source: Edi S.Ekajati 2005. Elaboration of the author)

The pahuma community lives in a highland mountainous area with a nomadic lifestyle. They are exploring in the interior of the jungle as a hunter or dipker and farming tubers and vegetables. Panyawah communities settle permanently in a fertile area that has a source of water for rice cultivation, palawija, vegetables, maintaining fish ponds and livestock. Pamayang communities living in fertile areas that have a source of water for cultivating

crops, fruits, and farms. This pamayang community has the ability to build boats and find marine fish in coastal areas. The image of the Sundanese cosmology below demonstrates the concept of trigatra in the structure of Sundanese society. Gatra pahuma (cultivators) living in the highlands or volcanic areas is a region that has a high degree as a sacred people, because it allows for a harmonious relationship between humans and the forces of nature. Pahuma serves as a guardian of nature.

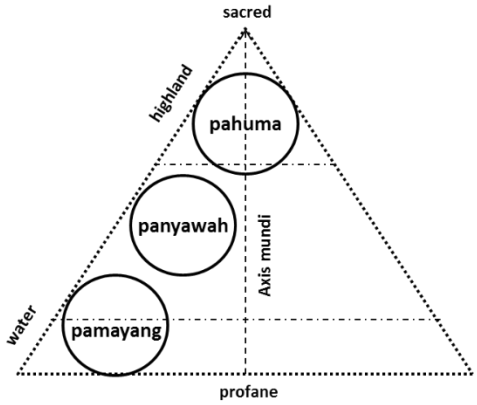

Fig 4: Overview of Sundanese Cosmology
(source: author elaboration)

The life of pahuma that has the task of preserving nature is in a sacred area called *the mandala* (sacred area). Due to its dynamic nature, pahuma is not in a permanent place. Pahuma is always moving and moving. The process of movement is often called *jarambah* or penetrated the forest up to the interior of the forest. Thus, pahuma has a lot of knowledge and unique related to the nature of the environment. Much knowledge of natural phenomena and natural guidance derived from the experience of pahuma in exploring or *ngumbara ngalalana*.

They have the ability to understand natural markers, footprints, natural forest phenomena and animal behavior in forest areas, so they can return to the village according to the rules set by their parents. They are obliged to return to the village before the sun sets. They understand very well that at night many wild animals search for prey. There is a rule that night is for animals to feed, whereas people have to rest to recover, reflect on what happens during the day, and talk to parents about things they can not yet understand.

The pahuma life in harmony with nature has placed them in a position that is highly respected by other Sundanese (panyawah and pamayang). Pahuma is considered as a sacred society, because it lives in the mandala area at the top of a hill or mountain. The towering volcanoes, a natural milestone sacred by all levels of Sundanese society, as well as by reformers who carry the message of Islam. The mountain is physically called *Giri*, whereas philosophically the *Gunung* is defined as *Guru nu Agung* (Great Teacher). Pahuma is often called *jalma gunung* or *tiyang gunung* by other people. The place of pahuma settled in calling the padukuhan.

The life of a sustainable pahuma community today is very important to be understood and appreciated, because they are able to live independently, able to harmonize with the natural environment, and never cause damage to ecosystems that impact natural disasters. Principle of life by following *pikukuh* (obedience) to *karuhun* (ancestors) for the noble task of *mulasara buana* (maintaining the universe). Pahuma society has customary rules or pukukuh karuhun which is interpreted as *patikrama*, that is *pati* (soul) and *krama* (tatakrama, procedure), which become customary law that animates all life of pahuma human being. *Tatanen Huma Sunda* (traditional procedure for Sundanese) is believed to be a source of answers to some of the difficult problems faced by villagers in forest areas, requiring farming without forest destruction or tree felling in protected and productive forest areas. Unfortunately, *Tatanen Huma Sunda* is not found in written reference form.

In cultivating fields or huma, pahuma must follow the guidance of nature. The forests that can be planted are *leuweung baladaheun* (not forest), not *leuweung larangan* (forbidden forests) or *leuweung keramat* (sacred forests). Do not disassemble the land, cut down trees and burn forest. they may only burn thorns and shrubs withered to be natural fertilizers.

Simple lifestyles, honest, patient and hard-working, are included in the *amanat buyut* and *tatakrama huma*, including: *gunung teu meunang dilebur* (mountain should not be destroyed), *lebak teu meunang diruksak* (valley should not be destroyed), *lojor teu meunang dipotong* (length should not be cut), *pondok teu meunang disambung*

(short can not be connected), *kudu ngadek sacekna* (must be printed precisely), *napas saplasna* (slash as liberally). In addition, the customary provisions in the ancient community are customary restrictions which are the guidelines and worldviews that must be run correctly. some of the surprising customary restrictions are: prohibited from altering waterways such as fish ponds or drainage, forbidden to change the shape of the land such as making a well or leveling the ground, prohibited from entering the forests to cut down trees, prohibited from using chemical technology, prohibited from planting a plantation cultivation, forbidden to keep four-legged animals such as goats and water buffalo, prohibited from arbitrary farming, forbidden to dress casually.

The forest villagers receive *the Amanat Buyut Sunda* gift of cultural roots. So as to understand why the forest should be preserved, why the water source should be maintained, why not exploit the land excessively. The offer to develop a new agricultural way that does not need to hoe the soil, do not use chemical fertilizers, does not employ livestock, does not pose a risk to the environment, is by applying a hydroponic system in the garden, aquaponic over the pond, and aeroponic in the forest.

In the beginning, the activity of cultivating plants without soil was written on Sylvia Sylvarum's book by Francis Bacon in 1627. The technique of cultivating plants using water became a very popular research. In 1699 John Woodward published a water-culture experiment with sprearmint. Jhon Woodward discovered that plants in impure sources of water actually grow better than plants that use pure water. The research of German botanist Julius Von Sach and Wilhelm Knop, in 1859 - 1865 who developed a technique of cultivation of plants without soil media, has concluded the importance of the fulfillment of mineral nutritional needs for plants, Research today is called a solution culture, regarded as a hydroponic type without media planting inert, which is a planting medium that does not contain nutrients. In 1929 William Frederick Gerickle of the University of California promoted openly about the solution culture used to produce agricultural crops. The researcher claims that hydroponics will revolutionize food crop agriculture. In 1940 Hoagland and Amon researchers from the University of California rearranged Gerickle's formula and published a book entitled Complete Guide to Soiless Gardening, which became known as hydroponics (in Greek hydro meaning water and ponos meaning power).

James S Douglas (1975) compiled a book entitled 'Hydroponics', which succeeded in transforming some vacant land in urban areas in the City of London into a fertile hydroponic farm. Some of the agricultural land that is infertile, has been successfully developed into productive hydroponic farming land in England. Bambi Turner (2012) released an online article entitled 'How Hydroponics Works', which inspires farmers in urban areas to develop hydroponic cropping systems in various ways. The concept of widespread hydroponic cultivation agriculture is static solution culture and wick system. In Indonesia static solution culture is better known as floating technique or floating raft technique, while wick sytem is known as the axis system, both of which are the simplest of all hydroponic types. Richard Stoner's (1983) study entitled aeroponic farming system, which is a hanging roots farming system, which is a system of plant roots periodically dampened with very fine nutrient solution grains. This method does not require soil media or puddles, but requires plant species that grow with a hanging roots in the air or extensive spatial growth on a regular basis. The roots of the plant moistened with a fine mist of nutrient solution can grow plants perfectly and healthy. The aeration system (wetting the roots with nutrient solution) is a major advantage of aeroponics. Researcher Anna Heiney of NASA in 2004 released an article titled 'Farming For The Future' which promotes the aeroponic system for the concept of life in the future. Some experimental plantations in outer space have proven the possibility of potential cultivation of plants in various fields or open spaces. In this concept, agriculture includes all types of planting activities that are not dependent on the existence of fertile agricultural land.

Pinus Lingga (2009) popularized hydroponics in Indonesia by publishing a manual to carry out hydroponic farming activities under the title 'Hydroponics: Farming without soil'. His experience in hydroponic farming activities inspires hydroponic farmers to try different ways to create a variety of media and hydroponic cultivation facilities, including with the use of a variety of used goods. Kunto Herwibowo and N.S Budiana (2014) developed a vegetable hydroponics system without using greenhouses for enthusiasts and crop entrepreneurs. Reno Suryani (2015) developed a hydroponics system for urban agriculture. Urban situation and conditions with narrow and expensive land, can be developed into productive hydroponic farming land.

Efforts to popularize the maintenance of plants by aerohidroponik, developing in various books, mass media and social media. The application of this system to the peasant community has never been done by other researchers, although there are many problems in rural areas related to the reduced farming facilities.

The concept of hydroponic-aquaponic applications on vacant land and fish ponds, with bamboo materials preferred by farmers rather than using pvc pipes, as well as very simple aeroponic designs with bamboo materials as tree-support constructions, more people choose, Examples of tested products:

Fig.4: Bamboo Hydroponic (source: author)

Fig.5. Bamboo Aeroponic (source: author)

4. Conclusion

Through the study of sustainable Patikrama Tatanen Huma Sunda in the area of padukuhan or Sundanese traditional countryside, obtained the picture of the importance of human understanding of the situation and the natural conditions of the environment. Just as the pahuma is obliged to mulasara buana or maintain the natural surroundings, the farmers in the forest village area have the same obligation to keep the forest ecosystem from damage and excessive exploitation.

The vision of the *mulasara buana* and the mission of *ngertakeun bumi lamba* that is firmly held by kabuyutan society, can be understood as the basis for preserving the forest, both in the category of forested forest, protected forest and prohibited forest. Utilization of forest land and fish pond as a productive vegetable garden can use the principle of huma, which is doing the process of plant maintenance without changing the structure of the environment. Not doing tree felling, excavation and ground shaking and other work that makes the earth's condition change. This principle has in common with the hydroponic principle that utilizes nutritious water flow without soil media.

Utilization of fish pond into vegetable garden can use the principle of aquaponics, where happened mutualisma process between plants and fish, through nutrient circulation from pond to medium planting vegetables which is above pond, and from plant to pond. The working principle is different from that of aquaponics in urban farming that must use electrical energy to move the water pump, in the acuponic design of this fish pond, obtained a more economical and practical way, that is utilizing the flow of water into the pool as an infinite supply of nutrients to vegetables that are above fish pond.

The principle of aeroponic work related to the supply of nutrients through the haze of nutrients absorbed by hanging plant roots can be applied to the design of aeroponic products that use the tree as a constructive part of the planting media product. In the forest every morning and evening comes a mist (fog) that provides nutritional supplements on plants that are above ground level. This principle is used to build vegetable gardens among large trees in forest areas.

The trial of the implementation of the aquaponic-hydroponic-aeroponic working principle in a landless farming system on limited landholdings shows symptoms that give rise to new enthusiasm for smallholder farmers without large farmland.

5. Acknowledgements

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