
SUSTAINABLE ARCHITECTURAL DESIGN IN A TRADITIONAL BALINESE HOUSING IN ACCORDANCE TO THE CONCEPT OF *TRI MANDALA*

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ABSTRACT

Global challenges such as natural resource depletions, irregular weather pattern, and pollutions were imminent. The Home Green Design proposed by other countries was not suitable to Bali Island because of the local social context. The Balinese House is regulated with the Tri Mandala and Sanga Mandala to achieve the harmonious relations between Macrocosms (Bhuana Agung) and Microcosms (Bhuana Alit) [or Tri Hita Karana]. The Sanga Mandala guides the spatial pattern both on the house and the settlement scale. The Tenganan traditional Village implemented Tri-Mandala which organized the house into the Utama (upper and sacred), Madya (middle and human), and Nista (lower and profane). The Tri Mandala concept is very adaptable to the environment, even in the middle of the economic-driven activities and fast home development. However, the Tri-Mandala really supported the sustainability in the functionality aspect, the social acceptance aspect as well as thermal comfort aspect. Therefore, the Tri Mandala concept could be implemented in the contemporary house design in Bali.

Keywords: *sustainable architectural design, cultural approach, appropriate green technology, socially-sustainable house*

ABSTRAK

Tantangan global seperti penipisan sumber daya alam, pola cuaca yang tidak teratur, dan polusi sudah semakin banyak terjadi. The Home Green Design yang diusulkan oleh negara-negara lain tidak cocok dengan Pulau Bali karena konteks sosial setempat. Rumah Bali diatur dengan Tri Mandala dan Sanga Mandala untuk men-capai hubungan yang harmonis antara makrokosmos (Bhuana Agung) dan mikrokosmos (Bhuana Alit) [atau Tri Hita Karana]. Sanga Mandala memandu pola spasial baik di rumah dan skala pemukiman. Desa tradisional Tenganan dilaksanakan Tri-Mandala yang diselenggarakan rumah ke Utama (atas dan suci),

Madya (te-nengah dan manusia), dan Nista (rendah dan tidak suci). Konsep Tri Mandala ini sa-ngat mudah beradaptasi dengan lingkungan, bahkan di tengah-tengah kegiatan yang didorong kebutuhan ekonomi dan pengembangan rumah cepat. Tri-Mandala benar-benar mendukung keberlanjutan dalam aspek fungsi, aspek penerimaan sosial serta aspek kenyamanan termal. Oleh karena itu, konsep Tri Mandala dapat diterapkan dalam desain rumah kontemporer di Bali.

Kata kunci: *desain arsitektur berkelanjutan, pendekatan budaya, teknologi tepat guna, rumah sosial berkelanjutan*

INTRODUCTION

Rapid technology advancement offered opportunities for observing architectural design trend abroad. The development affected the architecture design trend in Indonesia, causing abandonment of local cultural values by modern Indonesian design trend. Furthermore, the design trend was influenced by the environmental issues in a decade such as: limited natural resources, climate change and global warming, pollution, excessive energy consumption, etc. The abandonment of local cultural values and unsustainable development, a sustainable architecture principle was needed. The principle actually defined by Sustainable by Design concept that was prescribed by International Union of Architect (UIA) on Copenhagen Declaration in 7th December 2009 (http://www.uiaarchitectes.org/image/PDF/COP15/COP15_Declaration_EN.-pdf). UIA stated that Sustainable by Design (SbD) Strategy was needed to solve the climate change and reduce the impact of environmental changes to future generations. Furthermore, the SbD also highlighted the UNESCO's recommendation to facilitate cultural diversity preservation. This encouraged the writer to understand the sustainable design based on the local Balinese heritage. The purposes of the research are to find implementation of *Tri Mandala* in Tenganan homes, and relationship *Tri Mandala* to social and economical sustainability of the home zoning.

THEORY / RESEARCH METHODS

Balinese Traditional Architecture Concept

The Balinese principle of living is to live in harmony with nature, and it is facilitated by the Traditional Balinese architecture concept. The Balinese way of life is related traditions and cultural related to individuals and society. The Design and construction of traditional Balinese architecture was influenced by the philosophy of life, attitude to life, religion, beliefs and ancestral culture of Balinese (Meganada, I W, 1990).

Originally, the ancient Balinese perception to space is bounded by the earth beneath and the sky above (Raharja, I.G.M., Remawa, A.A.G.R., Cora, T.I.R., 2010). Later on, the traditional Balinese spatial concept was developed to sky-earth spatial orientation (Bali Mula period); mountain-sea (Bali Aga period), and sunrise-

sunset (Bali Arya - Majapahit period) (Gelebet, I.N., et.all., 1986). The development of spatial regulating system actually evolved in modern time, with *Sanga Mandala* and *Tri Mandala* (see Figure 1) (Lansing, J.S.,1983 and Budihardjo, E., 1985, quoted in Aranha, J., 1991).

Based on several traditional rules of Balinese Architecture (Lansing, J.S., 1983 and Budihardjo, E., 1985, quoted in Aranha, J., 1991, and Sulistyawati, et.all., 1985), the basic principle of Balinese Architecture came from:

1. *Tri Loka* is the spatial hierarchy consisting of:
 - a. Utama (the upper, sacred, Gods)
 - b. Madya (the middle, human)
 - c. Nista (the lower, profane, demons)
2. *Hasta Kosala Kosali* is the application of *Tri Loka* and *Tri Angga* in all planning and architectural design such as: measurement units, proportion, ceremony, orientation, sitting and spatial order in the Balinese villages and homes' design.
3. *Tri Mandala* is the application of *Tri Angga* in the vertical zoning.
4. *Sanga Mandala* is complex zoning applied all principles above (see Figure 2). The most important, sacred, or private part of a village or dwelling are located to Kaja (Mountain) as possible. The spaces that are used for day-to-day life are located in the center of the *Sanga Mandala*. The most impure or potentially profane areas are located in the direction of Kelod (Sea). The most important sacred is oriented toward sunrise while the most profane is oriented toward the sunset.

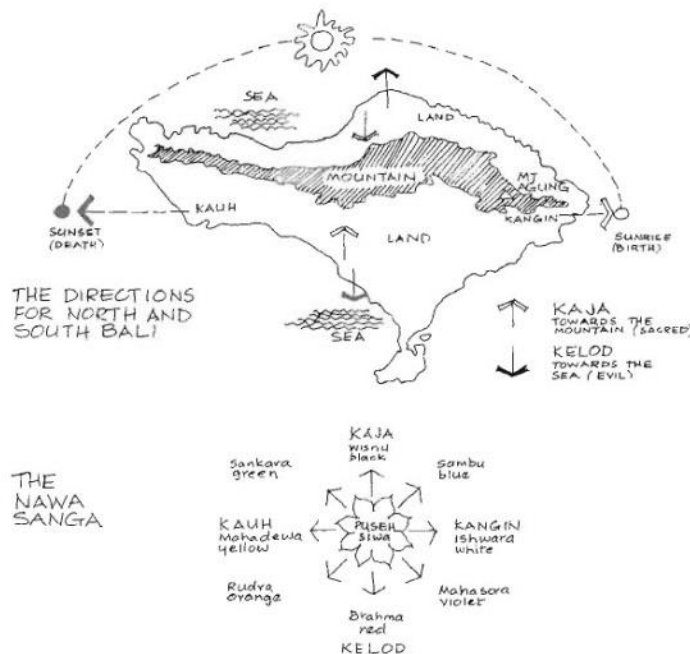


Figure 1. The Basic Concept of Balinese Traditional Houses

Source: Budihardjo, E., 1985, quoted in Aranha, J., 1991

Sanga Mandala of Balinese Traditional Home

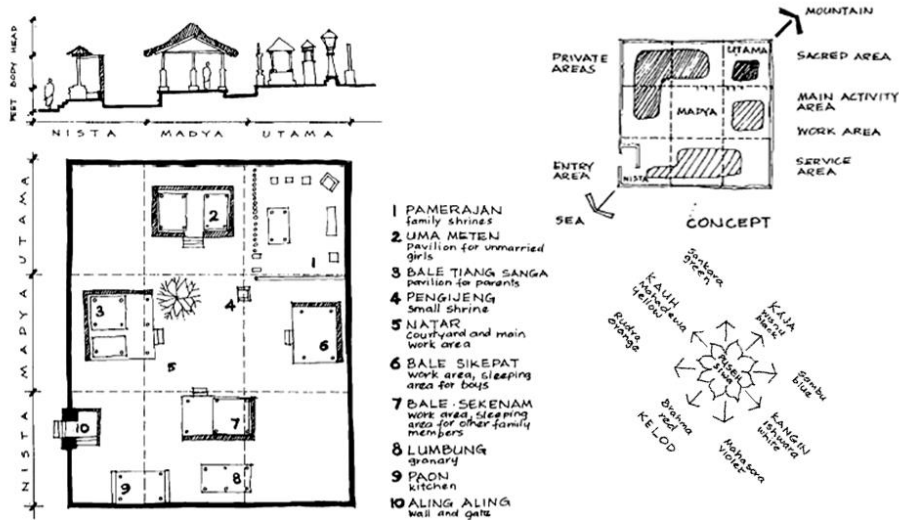


Figure 2. The *Sanga Mandala* (from *Tri Mandala*) in The Balinese Houses
 Source: Budihardjo, E., 1985, quoted in Aranha, J., 1991

The implementation of *Sanga Mandala* is related to the Sustainable Design Strategy with local flavor. Unfortunately, the implementation of *Sanga Mandala* faced difficulties recently, because of land using, the gradation of their way of life, etc. In the other hand, *Tri Mandala* which is simpler to apply had been used by Balinese in Tenganan for their housing. The *Tri Mandala* regulated the sacred activities in Utama (the upper, sacred, Gods) area, the activities of a social, economic and living in the Madya (the middle, human) area, and profane activities Nista (the lower, profane, demons) area. One example of the application of *Tri Mandala* is on the Tenganan Village and Housings.

Kumurur, V.A., Damayanti, S., (2009) described the Tenganan Village is one of the traditional village in Bali. The village could be categorized as the Bali Aga village was not influenced by Javanese Hindu kingdom. The village residential is located in a mountainous area, expanding longitudinal in the center of Bali Island. The physical form of Bali Aga traditional villages was characterized by the linear-shaped main road serving as a community-owned open space and the main axis of the village. The Tenganan village was still preserved and became a cultural attractions although was located quite remote in Karangasem regency (is about 60km by road from downtown Denpasar, Bali).

Furthermore, the Tenganan traditional housing was built based on the belief concept to God Indra. It was reflected upon the settlement structure concept of “self defense”. Four zones (lawangan) were found divided into North, East, West and South areas. The North area was designated for economy defense, while the South area was designated ancestor worship. Lastly, Western and Eastern areas were used for funeral activities. The traditional housing has 15.000 acres of wide land and di-

vided into three Banjar, Banjar Kauh (West), Central area and Banjar Kangin (South). Meanwhile, Banjar Pande (East), inhabited by people who have violated or the outsiders who were asked to stay for ceremonial purpose. The Tenganan traditional housing is contained by the *Penyengker* wall (enclosure wall) and two accesses (front and back gates). The housing is located regulated by the *Tri Mandala* and in relationship with 3 sacred buildings namely: Pura Desa, Pura Puseh, Pura Dalem. The Tenganan traditional village had 3 clusters of housing, namely: (1) the settled residents cluster, (2) plantation cluster, and (3) paddy field cluster (Kumurur, V.A., Damayanti, S., 2009).

The Sustainable by Design Strategy and Heinz Frick's Sustainable Design Strategy

Related to Sustainable by Design, International Union of Architect (UIA) prescribed some strategies that connected to the local cultures such as (http://www.uia-architectes.org/image/PDF/COP15/COP15_Declaration_EN.pdf):

1. Sustainable by Design recognised that all architecture and planning projects were part of a complex interactive system, linked to their wider natural surroundings, and reflect the heritage, culture, and social values of the daily life of the community.
2. Sustainable by Design endeavoured improving the quality of life, promoting equity both locally and globally, advancing economic well-being and providing opportunities for community engagement and empowerment.
3. Sustainable by Design endorsed UNESCO's statement that cultural diversity, as a source of exchange, innovation and creativity, was very important for humankind.

Frick, H., Suskiyatno, B., (1998) prescribed the Sustainable design as ecological design which balancing the natural cycle and consider the natural condition. Secondly, it would consider the health of the building residents. And lastly, it should use user-friendly materials. The ecological design principles recommended comprises:

1. Adapting design to local condition. Any design is important to be adapted to the local condition.
2. Saving the natural energy resources. The renewable energy resources should be utilized to minimize the use of non renewable energy resources.
3. Maintaining and improving the environmental system. The ecosystem should be understood and the energy usage needed to be preserved.
4. Self-supported concept. The residents should be able to produce their needs with utilizing the yard as a farm, pond, and livestock.

Therefore, the local design principles should be implemented with understanding of local cultures and relationship of microcosms and macrocosms to achieve more economic and social sustainability.

Research Methods

The research is conducted with literature study on Balinese traditional housing concept, especially for Tenganan traditional housing and Sustainable Design regarding to Frick, H., Sukiyatno, B. A site visit and analysis are conducted on the implementation of *Tri Mandala* concept in Tenganan traditional housing with qualitative method. The research also conducted with interviewing the dweller Tenganan villagers.

Finally, the sustainability of Tenganan traditional is measured whether they fulfill four sustainability factors such as Frick, H., Suskiyatno, B., (1998):

1. Considering the local condition.
2. Saving the natural energy resources.
3. Maintaining and improving the environment system.
4. Having the self-supported concept.

RESULTS AND DISCUSSION

Context of Pagringsingan Tenganan Traditional Village

Tenganan Pagringsingan village was located on the mountainous terrain (see Figure 3). It is a Bali Aga traditional village which is unique in the tradition, culture and beliefs. As the traditional village the Tenganan Pagringsingan has several characteristics, namely of layouts such as:

1. The settlement is regulated by *Tri Mandala* among the Kaja – Kelod (North – South) axis (see Figure 4). The traditional housing is connected by Awangan (Common plaza) that possess function of The village is divided into three Banjar, West Village (Banjar Kauh), Central Village (Banjar Tengah) and East Village (Banjar Kangin or Banjar Pande). The Banjar Pande is inhabited by villagers that violated the customs or outsiders for ceremonial purposes.

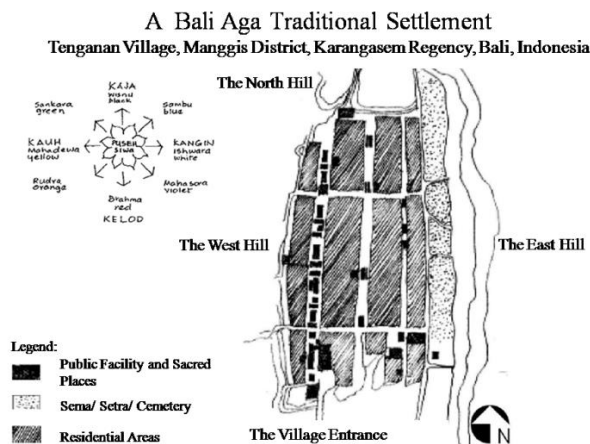


Figure 3. The Village Structure

Source: Kumurur, V.A., Damayanti, S., (2009) modified by Aryani (2013)

Tri Mandala in a Bali Aga Traditional Settlement
Tenganan Village, Manggis District, Karangasem Regency, Bali, Indonesia

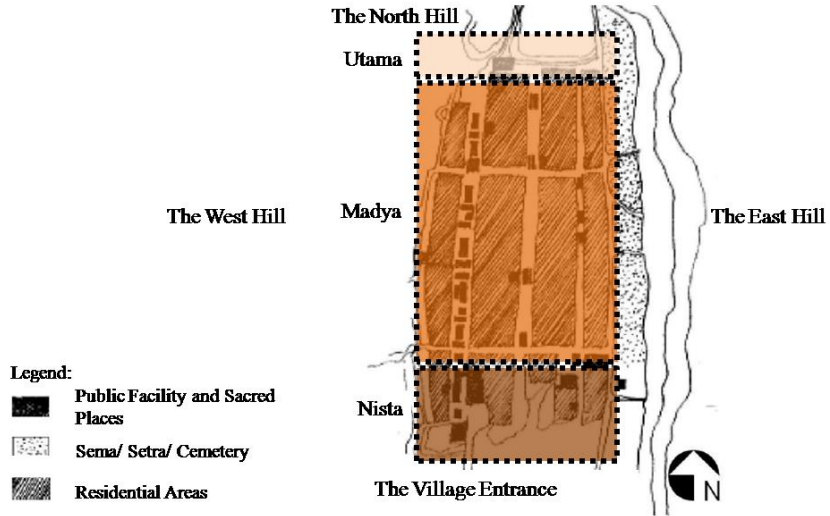


Figure 4. The Village Structure and *Tri Mandala* Rules
 Source: Kumurur, V.A., Damayanti, S., (2009) modified by Aryani (2013)

Bali Aga Traditional Home
Tenganan Pegringsingan Cultural Village
Tenganan Village, Manggis District, Karangasem Regency, Bali, Indonesia

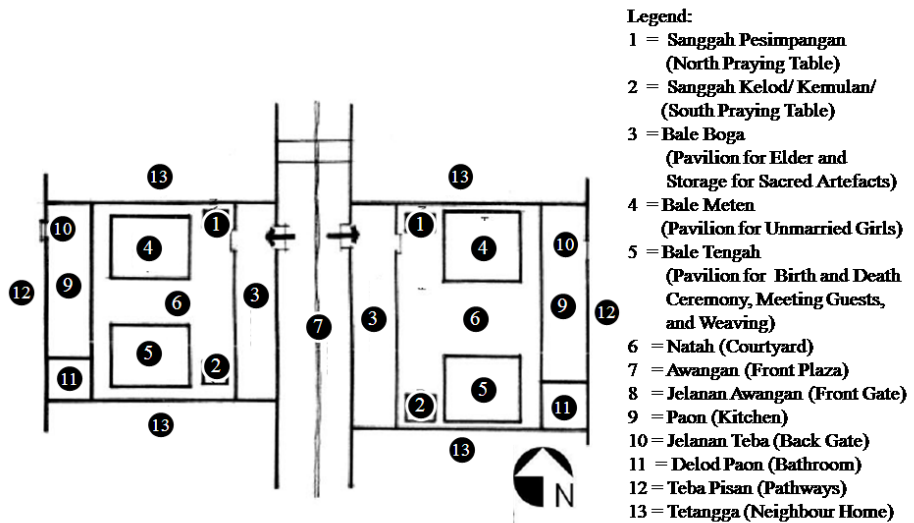


Figure 5. The Home Structure and *Tri Mandala* Rules
 Source: Kumurur, V.A., Damayanti, S., (2009) modified by Aryani (2013)

Tri Mandala in Bali Aga Traditional Home Tenganan Pegringsingan Cultural Village Tenganan Village, Manggis District, Karangasem Regency, Bali, Indonesia

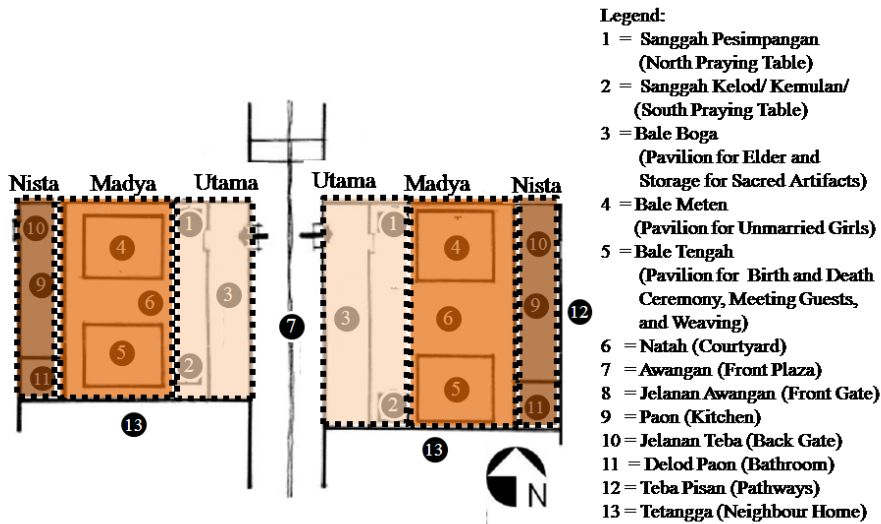


Figure 6. The Home Structure and *Tri Mandala* Rules

Source: Kumurur, V.A., Damayanti, S., (2009) modified by Aryani (2013)

2. The *Tri Mandala* zoned the house into Utama, Madya and Nista (see Figure 6). The Utama is designated for worshipping activities, sleeping for elderly and storage for Sacred Artifacts. Meanwhile, the Madya is designated for sleeping of the unmarried girls, birth ceremonies, death ceremonies, meeting guests, and weaving. Lastly, The Nista is designated for service such as cooking, toileting and pig farming.

The main entrance to the house (yard) called Jelanan Awangan (Front Gate) or Kori Ngeleb. It is a boundary of the internal part of the house and Awangan (common plaza). The elements of the house are categorized into two, namely mandatory elements and non-mandatory elements. Mandatory building include: Sanggah Pesimpangan (North Praying Table) and Sanggah Kelod/ Kemulan (South Praying Table).

The non-mandatory elements are Bale Boga, Bale Tengah, Pelipir (sitting place), Paon (kitchen), Bale Meten, Delod Paon (Bathroom) and Sanggah Kaja (Intersectional Praying Table). And the elements of the houses are (see Figure 5):

- a. Sanggah Pesimpangan (North Praying Table)
- b. Sanggah Kelod/ Kemulan (South Praying Table)
- c. Bale Boga (Pavilion for Elder and Storage for Sacred Artifacts)
- d. Bale Meten (Pavilion for Unmarried Girls)
- e. Bale Tengah (Pavilion for Birth and Death Ceremony, Meeting Guests, and Weaving)
- f. Natah (Courtyard)
- g. Awangan (Front Plaza)

- h. Jelanan Awangan (Front Gate)
- i. Paon (Kitchen)
- j. Jelanan Teba (Back Gate)
- k. Delod Paon (Bathroom)
- l. Teba Pisan (Pathways)
- m. Tetangga (Neighbour Home)

In every house, a barrier of 1meter wide gutter and 5meters backyard (Teba Pisan) was found. It further reduced the environmental impact form pig farming or bathroom to the neighboring housings.

3. The Tenganan traditional village apparently is organized with the simple *Tri Mandala* concept. The *Tri Mandala* rules of the traditional village and housing brought positive aspect. The *Tri Mandala* was actually easier to implemented, and the *Tri Mandala* concept required less area. The *Tri Mandala* also fulfilled the heritage, culture, and social values of the daily life of the community and preserved the cultural diversity of the Bali Aga people as recommended by UIA (http://www.uia-rchitectes.org/image/PDF/COP15/COP15_Declaration_EN.pdf).
4. The zoning arrangement in Tri-Mandala also reduced the natural energy resources with cross ventilation, as well as it would consider the health of the building residents and less energy usages. It also preserved the ecosystem because the village was not allowed to develop towards the mountain areas. *Tri Mandala* also allowed the residents should be able to produce livestock. It showed that the local knowledge or wisdom actually is already sustainable as prescribed by Frick, H., Suskiyatno, B. (1998).

Sustainability of *Tri Mandala* Application in Tenganan Housing

1. Every building in the Pekarangan (courtyards) was regulated based on the *Tri Mandala*. Each building was located at a certain distance, and it was completed with its own walls and roof. Thus, it provided space for air flow more freely between each unit in the building.
2. By the regulation of distance for every unit and has its own walls and roof, then direct sunlight will also be able to come into the house. Thus, the sunlight can illuminate every corner space maximally. This advantage could reduce the use of artificial lighting by electricity power.
3. The Tenganan traditional housing was located in a mountainous terrain and drained sufficiently. The positioning created positive impacts, such as better ventilation and drainage.
4. The natural materials for buildings also created the comfortable in the house. The roof's materials were the dried reed and wood construction (see Figure 7). Meanwhile the wooden and bamboo (gedhek) walls were found. They modify wood columns with wood reinforcement on the bottom of the columns. All materials (material) which were applied in every house (Pekarangan) are obtained from Tenganan traditional residential area. Local materials are very easy to obtain and easy to applied.

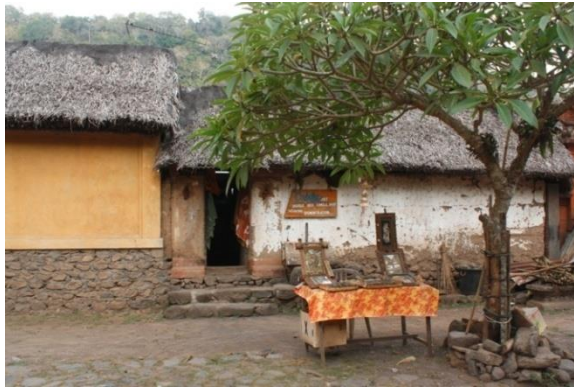


Figure 7. The Impact of Staggering Roof Form
Source: field survey, 2013

5. The Tenganan traditional houses were connected by dirt road and paving stone roads (see Figure 8 and 9). In the corner of the open space, a paving stone of different sizes was provided. The use of natural stone pavement is very environmentally friendly. Lastly, the rain water were absorbed into the ground. Meanwhile, the stone reduced slippage during the rainy season.



Figure 8. The Dirt Road and Paving in front of The Village Home
Source: field survey, 2013



Figure 9. The Dirt Road and Paving in front of The Village Home
Source: field survey, 2013

6. The dwellers of Tenganan used to work as a farmer. Therefore, the location of padi field/gardens are lower areas. The products produced by the Tenganan community, is one of the best products in Bali (see Figure 10). The dwellers always use natural manure to fertilize the plants. In addition, residents also have the space to raise (pork or chicken) which is located near the back of the house. In the end, the needs of residents can be met properly.
7. The harmonious relationship between human and nature, was also embodied in the cautious usage of building materials. For example, a person needs wood to repair the house, he must be listed by the Kelian Adat (traditional Administrator)

and he has to wait for his time to have the tree to cut or he has to use fallen tree or replant the trees as well to keep the environment in the balanced.



Figure 10. One of The Product of Tenganan Village
Source: field survey, 2013

CONCLUSIONS

The architecture design trend in Bali had abandoned of local cultural values. On the other hand, the *Tri Mandala* is the concept that is important to be maintained because of its social, environmental and economic sustainability. The Tenganan Traditional Housing was regulated by *Tri Mandala*. The concept has many positive impacts to implement to the housing as it is supported sustainable way of living. Unfortunately, the Tenganan Traditional Housing faced current challenges because of the tourism activities in the village. A new design strategy with *Tri Mandala* approach needs to be implemented to reduce the unsustainable impact.

ACKNOWLEDGMENTS

We would like to express our gratitude to Architecture Program Study of Petra Christian University

1. Agus Dwi Hariyanto, ST., M.Sc. Head of Architecture Program Study.
2. Ir. Joyce M. Laurens, M.Arch., Lecturer of Architecture Program Study.

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