



Subak endurance in facing external development in South Bali, Indonesia



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Abstract

The traditional Balinese irrigation system is managed by the traditional institution called subak. UNESCO has established subak as world cultural heritage that must be protected. The facts on the field showed the existence of subak is increasing threatened along with its external environment development. This research aims at analyzing the spatial patterns of subak Tri Hita Karana (THK) endurance and external symptoms that threaten it. The research was conducted in 69 existing subak in Badung Regency, South Bali Province. The data about THK endurance were collected from subak leaders using interview technique, field observations, and document collecting. They were analyzed using quantitative descriptive technique and spatial analysis using geographical information system (GIS). The results showed that THK endurance in the subak system fell under three categories: high (29 subak), medium (28 subak) and low (12 subak). Spatially, each category forms a cluster pattern following the principle of distance decay, related to the dynamic development of its external environment. The external development that threatens THK endurance, i.e.: change in the region's spatial planning from the government, development in the non-agricultural economic sector, (3) population development and built-up areas, and development of road infrastructure.

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1. Introduction

On June 29, 2012, UNESCO assembly in Russia established *Subak* as world cultural heritage. The UN committee judged that *subak*, born from Balinese culture that is based on *Tri Hita Karana* (THK) philosophy has extraordinary authentic and universal values, one of which is a strong social cohesive value (Windia and Wayan Alit Artha Wiguna, 2013). The results of studies by some scholars have also proved that *subak* that has universal life values that are transferable to other regions (Ahimsa-Putra, 1999; Susanto, 1999; Windia, 2002 and Sutawan, 2008). This indicates that *subak* is a local genius of Balinese community that serves a model of a harmonious community life for humanity.

Hence, the people and the government have an obligation to make more serious efforts to protect the cultural heritage of world communities throughout the ages. The importance of protecting *subak* existence is also caused by its real contribution in realizing a sustainable development. Researchers reveal that *subak* is a very sophisticated, effective, and efficient organization in managing irrigation water, supporting food stability, supporting the culture, uniting the social life and preserving the environment (Lansing, 1987; Ostrom, 1992; Ambler, 1992; Susanto, 1999, 2000; Sutawan, 2005; Lorenzen, 2010; MacRae and I, W, A. Arthawiguna, 2011; Lansing and Therese A. De vet, 2012).

Basically, the various advantages of *subak* come from THK philosophy that becomes the guidance and goal in *subak* life. Balinese Hindus have a philosophy and belief that human happiness or prosperity can only be realized by creating a harmony and balance between the three components THK (Suastra, 2017). THK teachings in *subak* emphasize the importance of a harmonious life and togetherness to achieve the welfare of its members. THK teachings order people to keep a harmonious relationship in three components: (1) *parhyangan* (the relationship between human beings and God). (2) *pawongan* (relationship among human beings and their fellow human beings), and (3) *palemahan* (the relationship between human beings and nature).

Subak has existed for a millennium (Purwita, 1993), however, now it is facing increasingly more complex problems. The empirical conditions in the field show that the THK endurance of the *subak*, particularly in Badung regency is increasingly under a threat, along with the era of economic development. The most serious threat is felt in *palemahan* and *pawongan* components. The serious problem in *palemahan* is the rapid land conversion from rice field to nonagricultural use and the scarcity of water irrigation supply (Sriartha, 2011, 2014). Bali Province Central Bureau of Statistics (2007) recorded that during the 1997-2007 period, the conversion of rice field land in Bali was 5.601 ha, which means that the rate of rice field land conversion was 560,1 ha each year. The serious problems in *pawongan* are in the form of the degradation of collective life tradition, the decrease of the number of *subak* members/farmers, no interest shown by young generation in becoming farmers, weakening of *subak* institution, low income earned from agriculture and business orientation held by the *subak* members/farmers. These problems cause *subak* marginalization. Sutawan (2005) and Windia (2008) stated that almost all *subak* in Bali are undergoing marginalization that the end of the sustainability. Lansing, a foreign researcher (Lansing, 2013) studied *subak* from 1974 and also saw that *subak* was on the verge of destruction despite its success in its service of keeping the sustainability of agricultural environment for more than 1000 years. Thus, it is under a threat because of its popularity.

Subak destruction will cause a vastly negative impact. The international world will lose the most sophisticated irrigation system in the world. Indonesia will lose a unique cultural heritage and the national food endurance will be under a threat. *Subak* destruction will cause a social-cultural, economic and environmental destruction in Bali. Hence, it is important that a study is conducted on the spatial pattern of *subak* THK endurance as a determinant of *subak* sustainability. The result of this study can be used as a spatial policy in planning, regulating, and controlling the provision of space, both for supporting agriculture (*subak*) sustainability and for the nonagricultural sector as to synergize developments among different sectors.

Subak has been present about 1000 years or one millennium since its formation in 1071 (Purwita, 1993). The formation of *subak* seemed to be related to the geographical factor of Bali region that is hilly and has sources of water (rivers) that are far below the surface of the hills, thus encouraged the farmers at that time to form a group to get water which was then called *subak*. In its consecutive development, *subak* underwent a sociocultural transformation with the local people, thus it grew into a system or irrigation water managing organization and a complex institution that was based on *Tri Hita Karana* philosophy (Windia, 2008).

Tri Hita Karana philosophy used as a guide in *subak* life is a way of life of Balinese that comes from Hinduism. *Tri* means three. *Hita* means welfare/happiness, and *karana* means to cause. Thus, literally, *Tri Hita Karana* means three components that cause welfare/happiness. The three components are *parhyangan* (harmony in human relationship with God), *pawongan* (harmony in human relationship with fellow humans), and *palemahan* (harmony in human relationship with nature) (Sriartha and Sri Rum Giyarsih, 2015). The three components are reciprocally related and normatively form a perfect balance/ harmony as shown in Figure 1.

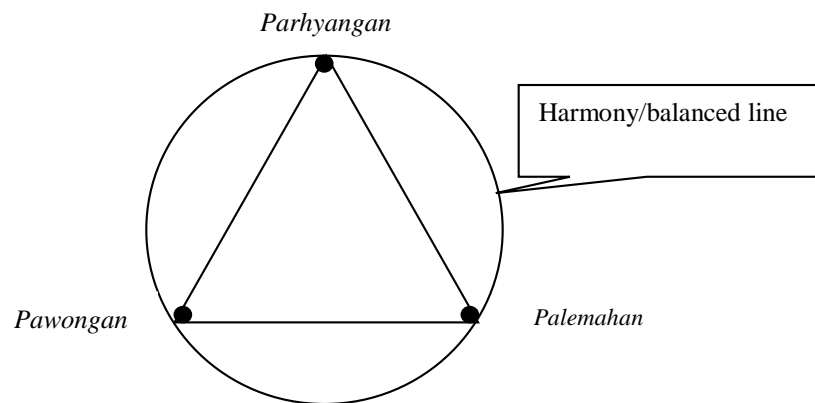


Figure 1. Reciprocal Relationship among THK Components
Source: Windia (2002, 2006, 2011).

The round circle in Figure 1 represents a perfect or harmonious life, meaning that in the perfect process of reciprocal relationship the three components are in an intact condition, both in terms of quantity and quality. The narrower and the less rounded the circle the lowest the value of its balance. The disturbance of one of the components will cause the disturbance of the balance, for example, the decrease of land and irrigation water in the *palemahan* component (natural environment) will decrease the production and finance of the subak and will increase the potentiality of social conflict (the disturbance of *pawongan* component). Furthermore, the *parhyangan* component will also be disturbed, line the decrease in ritual activities and the less care of the holy place (*subak* temple).

The three components of THK have been applied in reality by the farmers in *subak* life. The application of *parhyangan* is in principle related to the culture that is reflected by (1) the presence of way of life that land and water are God's creations that are very valuable for life and human beings are obliged to respect them. The conceptual framework about the importance of *awig-awig* (a written rule in use which a *subak* has), the principle of harmony, collectiveness, and fairness in irrigation water distribution, (2) the presence of religious ritual activity, and (3) the presence of *subak* temples.

The *subak* religious activities that are numerous, in addition, to serving as the manifestations of the expression of gratitude to God for all of his gifts, also has social functions (as reinforcement/ unifier of collective life and conflict preventer), and ecological functions (as pest control and plant disease control, and ecological system preserver) (Lansing, 1987; Sudaratmaja and Widiyazid Soetama 2003; Sutawan 2008).

The implementation of *pawongan* component in *subak* emphasizes collective activities conducted through communication and social interaction. The collective activities in *subak* consist of organization, meeting, the application of rights and responsibilities, the application of sactions, mutual work to make *subak* programs succeed, and *subak* internal and external conflict resolutions. In addition to social activities, there is also social facilities/ infrastructure such as a *bale subak*/office, *subak* road, and *subak* properties. The social activities in *subak* are regulated through *awig-awig* (written law) and *pararem* (unwritten agreement) that bind all of the *subak* members.

The implementation of *palemahan* component in *subak* is reflected by the presence of irrigation network, irrigation water regulation based on the principle of proportionality and the principle of collectiveness through water borrowing and lending principle, production techniques through agreement formats and planting schedule, rice field cultivation based on ecological and spiritual approach.

Subak THK endurance becomes the key to the sustainability of *subak*. The concept of endurance has the same meaning as resilience. According to Liu *et al.*, (2012), Endurance or resilience describes the water resource system capacity to maintain its essential functions and capacity to prevent stresses or disturbances which were initially unpredictable. While Cumming (2011) defines resilience as the system capability to maintain its identity in facing disturbances caused by external and internal changes. In Cumming's (2011) definition there is the tenacity or firmness and ability of the system to maintain its functions from various disturbances.

The increase in the threat to THK endurance seems to be closely related to the phenomena of development of the external environment. According to Arif (2003), the external environment that can threaten the irrigation system sustainability consists of the dynamics of the physical, social, economic and cultural, financial, ecological

environments and the government authority policies. Bataskoti, *et. al.*, (2010) that studied local irrigation systems in Nepal and Thailand, found that market economic development (agricultural commercialization) and the government policies have an effect on local irrigation performance, in the form of decrease in farmer collective life, reduction of capital invested in agriculture, and the shift of farmers to other sectors with a higher income. Susanto (1999, 2000) and Alit Artha *et al.*, (2006) conclude that the increasingly rapid tourism development becomes a serious threat to subak sustainability in Bali, especially in the subak area close to a tourism center with a heterogeneous population and a numerous social economic facility.

Referring to the concept of endurance above, a conceptual framework can be formulated, like the one in Figure 2. THK endurance in this study stresses *subak* capability in maintaining and applying THK components wholly and equally. A *subak* with high endurance is a *subak* that is capable of maintaining itself and applying the THK components wholly and harmoniously/equally and the reverse. For THK endurance to be measurable, then each of the THK component that is philosophical in nature is described into five operational fields, namely cultural (analogical to *parhyangan* component), social and economic (analogical to *pawongan* component), technical/technological and nature-physical (analogical to *palemahan* component) as shown in Figure 2.

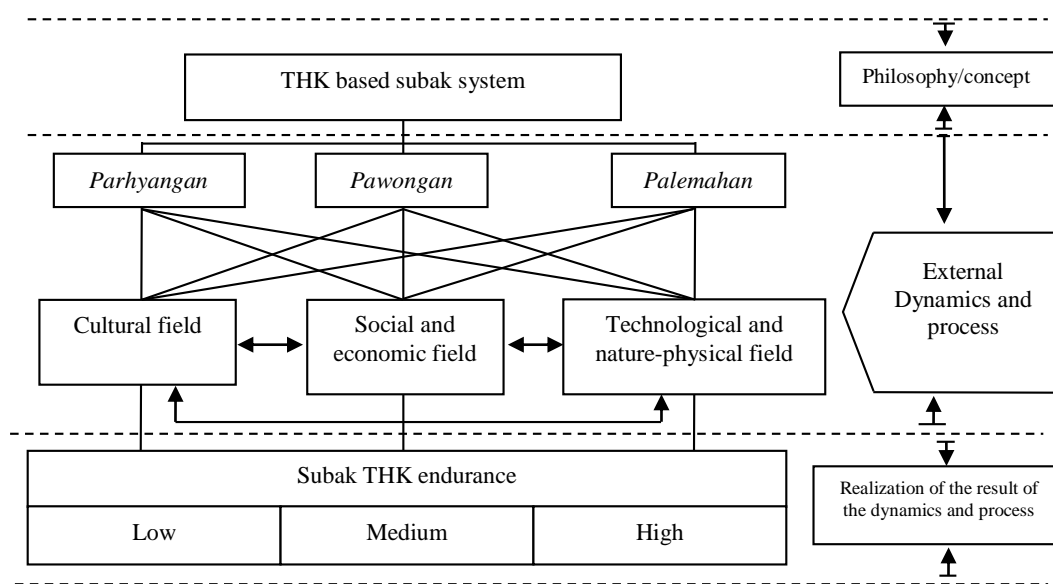


Figure 2. A Study on Subak THK endurance

2. Materials and Methods

This study was conducted in *subak* in Badung Regency, South Bali by selecting three districts, namely Kuta, North Kuta, and Mengwi. The areas were selected based on the considerations: (1) they form central regions of rice fields and function as “rice barns of Bali”, (2) They are the most rapidly developed areas in Bali, and (3) they are parts of *Sarbagita* (= Denpasar, Badung, Gianyar, Tabanan) metropolitan region as stipulated in Presidential Regulation No 45, 2011.

The *subak* THK endurance variable is broken into 5 sub-variables, namely cultural, social, economic, technical and nature-physical. Each sub-variable is broken into three indicators. The cultural indicators include the member’s belief that land and water are God’s creation, ritual activities, and *subak* temple functions. The social indicators include the existence and functions of organizational facilities, solidarity, and cooperation, the ability to solve violation and conflict problems. The economic indicators include the ability to develop a joint economic endeavor, *subak* financial ability, and the ability to access the market. The technical indicators include the condition and functions of irrigation networks, techniques for water allocation and distribution and agricultural management, the natural physical indicators include consistency in *subak* rice field area, damage of land and water, irrigation water sufficiency. Each indicator is described in the form of questions that are asked to *subak* leaders. The variables of the external development

phenomena investigated consists of the variables of spatial pattern, economic structure, road infrastructure, the size of the built-up area, density and population growth.

The data consisted of primary data and secondary data. The primary data were in the form of *subak* THK endurance that were collected from *subak* leaders by group interview technique, (2) The secondary data were in the form of the phenomena of the external development collected from Central Bureau of Statistics, Badung Agency for Regional Development Planning, Badung Office of High Way Construction and Irrigation and other related institutions that were collected by document recording supplemented by field checking.

The analysis of the spatial pattern of *subak* THK endurance was done by studying the characteristics of the spatial distribution of THK endurance levels. *The first step*, the answer to the question of the grains of the THK endurance were presented in scores that ranged from 1 (lowest level) to 4 (highest level). Then the level of THK endurance levels was grouped into three based on their average scores: high endurance level (the average score > 3), medium (the average scores range from 2 to 3) and low (the average score < 2). *The second step*, dividing the region into three zones (short zone, transitional zone, long zone) based on the average distance from the *subak* area to the tourism center. *The third step*, presenting data of THK endurance level into tables, graphs, and maps using geographical information system (SIG). *The last step*, doing the analysis qualitatively on the map by observing the tendency in the pattern of each zone, whether the pattern is a cluster or a random (dispersed) pattern, then the inter-zone comparison was studied relating them to theories or earlier studies, and to the dynamics of the elements of resources in the area, so that an accurate and systematic explanation was obtained.

The analysis of the external development phenomena was done by using the quantitative descriptive technique. The data collected were classified and displayed in tables and figures and then interpreted narratively and analyzed using an interpretative-comparative technique so that a comprehensive and accurate explanation of matters related to the research questions could be given.

3. Results and Discussions

3.1 *Subak* THK Endurance Spatial Patterns

To see the distribution of *subak* THK endurance spatial patterns, the *subaks* in the area under study were grouped into three zones based on the geographical distance of the *subak* area to Kuta as a tourism center. The results note that the longest distance was 27.8 km and the shortest 1 km. Based on the data criteria of the distance of each zone were made, namely short zone (< 10 km), transitional zone (10 – 18 km), and long zone (>19 km). The results of *subak* THK endurance are shown in Table 1.

Table 1
Distribution of the number of Subaks according to THK endurance leveling three zones

Subak THK Endurance	Zone						Total	
	Short distance		Transitional		Long distance		Total	%
	Total	%	Total	%	Total	%		
1. High	1	4.5	9	33.3	19	95.0	29	42.0
2. Medium	9	40.9	18	66.7	1	5.0	28	40.6
3. Low	12	54.5	-	-	-	-	12	17.4
Total	22	100	27	100	20	100	69	100

Source: Result of Analysis by the Researcher, 2014

The data of on the results of THK endurance in Table 1 shows that there are 29 *subaks* (42.0%) that have high THK endurance level, 28 (40.6%) medium THK endurance level, and 12 (17.4%) low THK endurance level. In the table can also see that the majority of *subaks* in close distance zone have low THK endurance level, in the transitional zone, medium *subak* THK levels form a majority, and in the long zone, high *subak* THK endurance levels dominate. Spatially, the *subak* THK endurance levels distribution form a cluster. The closer it is to the short zone, the more likely it is to have a low THK endurance level. On the contrary, the closer it is to the long-distance zone, the more likely it is to have a high THK endurance level. This fact shows that Kuta tourism resort as the center of secondary and tertiary (services) sectors have a great effect on *subak* endurance, in which the intensity of the effect depends on the distance

factor based on distance decay principle. [Susanto \(1999\)](#) and [MacRae and I.W.A. Arthawiguna \(2011\)](#) state that *subak* in principle is a culturally, socially, economically and ecologically homogeneous wet land irrigation community that is based on Balinese Hindu culture. Hence, if the region changes into a heterogeneous one, then *subak* will begin to be disturbed and its THK endurance will be threatened.

Viewed from the average scores of the five aspects of *subak* THK endurance, it is seen that cultural endurance ranks the highest (3,1 or 77,50%), followed by social (3,0 or 75,0%), technical (2,8 or 70,0%), nature-physical (2,5 or 62,50%), and the lowest being economic (2,1 or 52,50%) endurance. The highest rank of cultural endurance aspect and the lowest rank of economic endurance prove that socio-religious attribute is inherent in *subak* and *subak* does not have progressive characters as individualism, materialism, economic determinism, and pragmatism.

The findings above show that the weakening of *subak* THK endurance starts from which is physical-material in nature that is *pawongan* component and *palemahan* component. *Pawongan* component as manifested in the weakening of economic ability. The economic problem as indicated by the weak capability to develop a mutual economic enterprise, the increase in the operation and maintenance cost of the subak facilities and the low income earned from farming. *Palemahan* component manifested in an increase in *subak* land conversion, irrigation water scarcity, and pollution. The weak economy becomes the source of problems in other aspects shown by (1) the weakness in *awig-awig* (rule in use) implementation, (2) the less participation of the members in collective activities, (3) increase in competition over water use with other parties, and (5) the rate of land conversion from rice field to non-farming use that is uncontrollable ([Sriartha, 2015](#)).

The cultural component shows a preserved condition. Thus, this finding confirms the sociocultural change theory introduced by [Harris \(1999\)](#) and [Sanderson \(2000\)](#), that states that change always starts to form the infrastructure/material subsystem leading toward the social structure and ideological superstructure. The finding also confirms Koentjaraningrat's theory of cultural change (1985) in ([Geriya, 2008](#)), that states that in cultural change a change law applies, that is, the more abstract is the structure and the cultural element, the slower and more complex the change will be. Thus, a change in supra-structure such as value system/ideology always slower than a change in infrastructures such as physical cultural systems such as physical system or artifact/ material. Change in religious elements as the ideological element is also slower than that in tool element or means of livelihood. The finding slightly different from [Kaplan and Manners' opinions \(2000\)](#) that state that every socio-cultural subsystem in the community can be the origin of a change, meaning that change can start from any subsystem, while in this study it was found that change in *subak* system as sociocultural, economic, and technical-ecological system turns out to start from change in physical-material change.

Viewed from the balance among THK endurance aspects (Figure 3), there are variations in the three zones. In short distance zone, the balance of *subak* THK aspects is very bad, followed by a transitional zone, and the best balance is reached in the long zone. The facts in this study prove that the external development in the form of tourism and urban orientation can disturb the balance among the THK components in *subak* system. Balance is the key principle to realize the goal of *subak* system, that is the welfare/happiness of its members. Hence, if the balance among the THK components is disturbed by development in tourism and cities then it will be difficult to attain *subak* goal and this can threaten *subak* endurance.

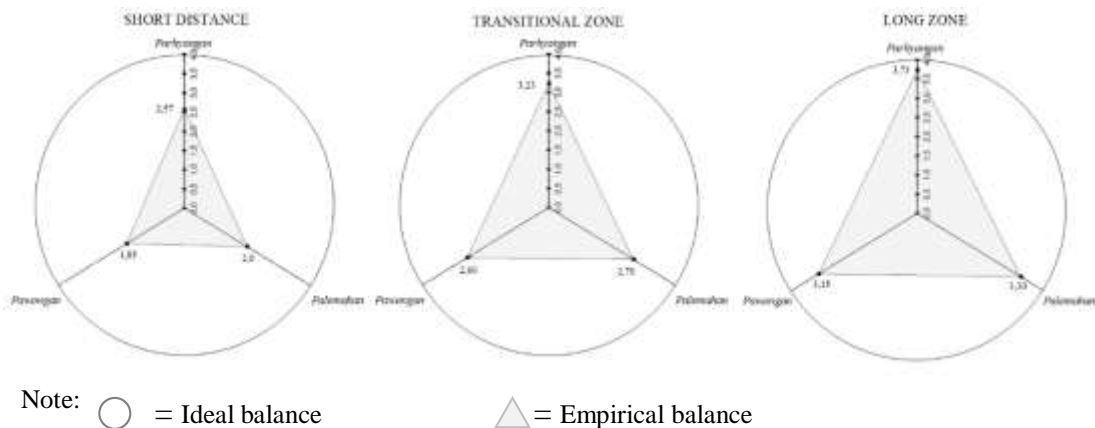


Figure 3. Balance among Subak THK endurance aspects in each zone

3.2 External Phenomena that Threaten Subak THK Endurance

The results of this study note five phenomena or symptoms that largely threaten *subak* THK endurance. The five phenomena are economic structure transformation, population development, road infrastructure development, built-up area development, and regional spatial pattern planning change. All of the phenomena are interrelated to each other in influencing *subak* existence.

In the areas of study extraordinary economic structure transformation occurs from the primary (agriculture) sector to secondary (industry) and tertiary (service) sector. The result of Badung Regency Gross Regional Domestic Product (GDP) in five periods (1970, 1990, 2000, 2010, and 2015) shows a sharp decrease in the contribution of the agricultural sector from 58.64% in 1970 to 6.79% in 2014. On the contrary, in the same periods, the contribution of the tertiary sector increases dramatically from 40.60% to 79.81% (Figure 4). Viewed from the balance in the absorption of manpower in five decades (1971, 1980, 1995, 2010, and 2014), the contribution of the primary sector also continued to decrease, however, the decrease was not as sharply as the decrease in the Regency Gross Regional Domestic Product. In 1971, the primary sector absorbed 67.50% manpower and it became 21.23% in 2014, while in the same periods the manpower absorption in the tertiary sector increased from 26.50% to 59.33%. (Nehen, 1994; BPS Provinsi Bali, 2000; 2010; 2014).

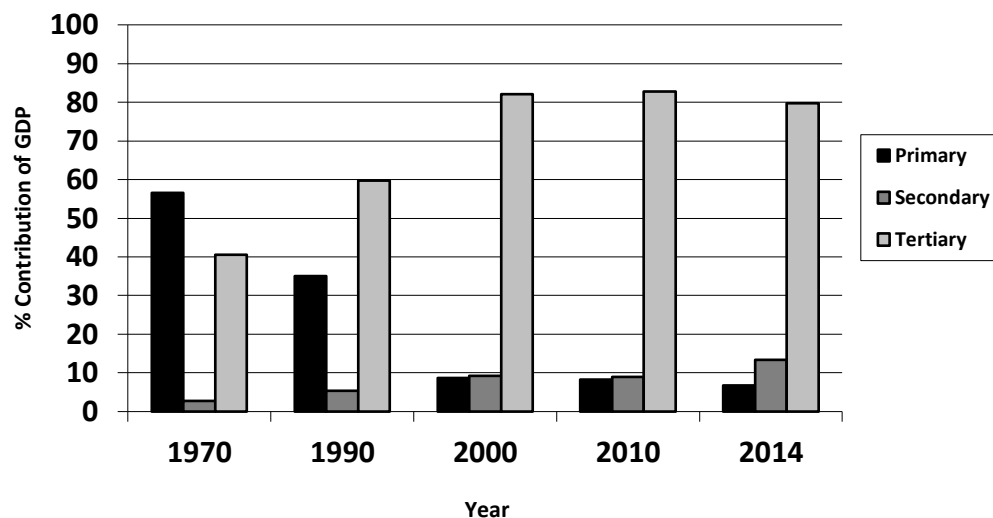


Figure 4. Contributions of Primary, Secondary and Tertiary Sectors to Badung Regency Gross Domestic Product

Rapid economic structure transformation in South Bali, especially Badung Regency is also followed by an increase in population rate, economic social infrastructure, such road, and built-up area. From 9 regencies/cities in Bali, Badung Regency undergoes the highest population growth. Bali Central Bureau of Statistics records the population growth rate in Badung Regency in the 2000-2010 period reached 4.63%. This figure is almost twice as high as Indonesia population growth (2.5%) each year, and three times as high as Bali population growth rate (1.49%) each year (Bali Post, 2013). The results of study record the density rate of the population in *subak* areas with low THK endurance level, that is 24 heads/ha (2,400/ km²) with the growth of 6.18% each year. While in the *subak* with high THK endurance the density rate is 9 heads/ ha (900/ km²) and the population growth is 1.73% each year. The factors that cause high population growth and density rate in *subak* areas with low THK endurance are high job opportunity and high wage outside the agricultural sector as the consequence of the rapid development of tourism. This encourages migration from neighboring areas and from outside Bali. The former migrations also become a stimulus for the people outside Bali (particularly friends and relatives) to come to Bali. As the consequence, the structure of the community becomes heterogeneous and an increase of the tension to the region's carrying capacity, particularly the carrying capacity of agriculture, including *subak*.

This study revealed that the presence of road infrastructures become the trigger of THK *subak* change. The research facts note that road density in *Subak Seminyak* (low THK endurance) is 292.5 m/ha, while that of *Subak Tungkub Dalem* (high THK endurance) is only 25.7 m/ha. This can be understood since road network plays a role as a triggering

factor of the increase of accessibility of a location. High region accessibility will motivate people from outside the area to live and open various economic activities in the area, so that land use, economic structure, and demography that are dominantly agricultural changes into heterogeneous (increase in the number of people who are non-farmers, increase in population density and social economic facilities). This heterogeneity then causes competition in using land and water that are managed by the *subak* together with other stakeholders, disturbances in irrigation channels, decrease in *subak* cultural activities and collective life. This phenomenon will end up with a decrease in *subak* THK endurance. Muta'ali (2013) states that transportation is one of the major factors that motivate the development of a region, forming the regional structure and determining the spatial orientation in the regional development and its connectivity,

The development of the built-up area (other than road infrastructure) in the area of study varies according to geographical location and *subak* THK endurance. On the whole (in 69 *subak* that were studied), in the 2002-2009 period, there was an addition of built-up area by 1,325.16 ha or by 14.72%. If we see it from *subak* THK endurance, it is noted that in high *subak* THK endurance regions (29 *subak*) there was an addition of built-up area by 111.55 ha or 4.74%, in medium *subak* THK endurance regions (28 *subak*), 460.73 ha or 16.08% and in low *subak* THK endurance regions (12 *subaks*) 736.64 ha or 21.27%. Based on these data it can be concluded that the development of the built-up area is an external phenomenon that can stimulate *subak* THK degradation.

The new regulation that regulates Badung regency regional spatial pattern was stipulated in Presidential Regulation No 45, 2011 pertaining to *Sarbagita* Metropolitan Region Spatial Planning. As it comes into effect there will be a decrease in rice field area by 2,166.37 ha or 33.30% compared with the rice field area in 2009 which was 6,506.28 ha. The high decrease rate will occur in the southern part, in short distance zone which is close to Kuta tourism center (1,027.23 ha), followed by the central part (medium zone) by 719.48 ha, and the lowest decrease rate will occur in the northern part (long distance zone) by 419.66 ha. This means that the area of rice field land maintained in the region's spatial pattern plan is 4,339.91 ha. The spatial distribution of the rice field which has vanished with the coming of the regulation into effect can be seen in Figure 5. The large extent of rice field land that has vanished as the consequence of the region's spatial pattern plan can be interpreted as a government policy which does not side with the interest of the agricultural sector which is actually the main potential of Bali region. The area of rice field land which is preserved is 4,339,91 ha., which is not free from conversion into nonagricultural use. This is caused by the fact that the formal regulation on land use conversion decided by the local government is not effective.

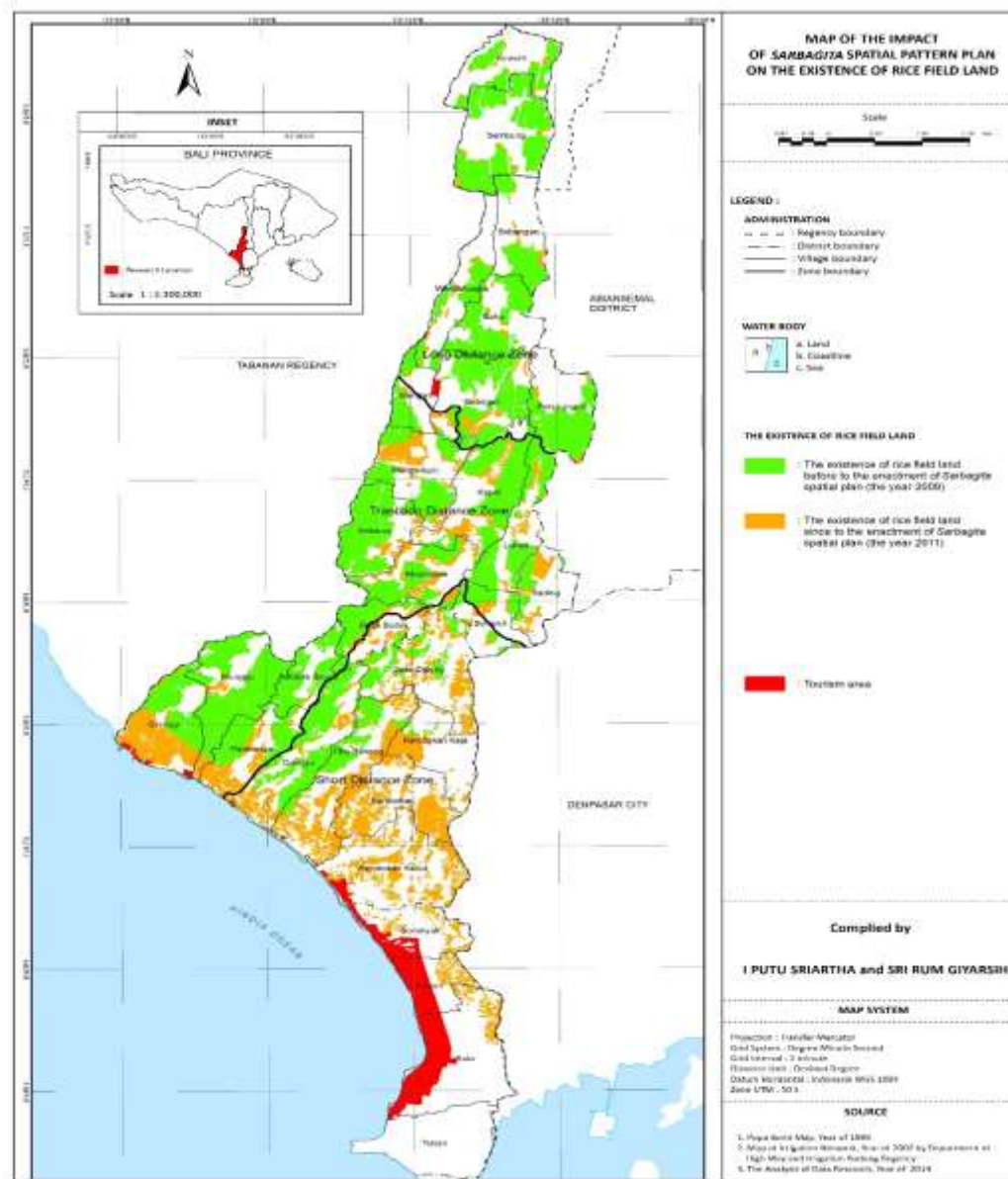


Figure 5. The Impact of Sarbagita Spatial Pattern Plan On Tge Existence Of Rice Field Land

Sriartha and Windia (2015) and Sriartha and Putu Ananda Citra (2016) state that the main weakness of the formal regulation is that they are top-down, ego-sectoral, inconsistent, not firm, and unfair in their implementation in the field, and do not involve socioreligious norm and the local people who are directly involved in rice field management, such as subak. The socioreligious norms that the subak hold such as *awig-awig* proves to be effective enough as the instrument for controlling rice field land use. Compared to the formal regulation decided by the government, *awig-awig* subak is superior in: (1) that it is made based on a joint decision by the subak members, (2) that it contains social and religious sanctions that are feared by the members, and (3) the implementation is direct (rule in use), meaning that when there is a member who breaks the regulation, he is given a sanction through a subak meeting. This bring with it an implication of the need for the government to formulate an integrated model of policy in rice field land conversation with the tradition, norms, and local/informal regulations that apply and still adhered by the community such as the ones that are effective in subak, and do not only rely on formal regulations which in reality are not effective.

4. Conclusion

Subak THK endurance spatial patterns in the areas of the study form clusters following distance decay principle from Kuta tourism center. The rapid development of tourism triggers the regional development with the symptoms which are represented in the forms of (1) increasing role of secondary and tertiary sectors followed by decreasing role of primary (agricultural) sector, (2) demographic development and heterogeneity, (3) increasing number of road infrastructures and social economic facilities, (4) increasing built-up areas and (5) change in spatial planning toward the one that emphasizes metropolitan/urban character. To maintain *subak* sustainability and saving Bali development for the future, then (1) the government ought to immediately establish eternal agricultural/*subak* spatial zonation together with its consistent, firm and fair application; (2) the government ought to reorient the development priorities toward the agricultural sector through capacity building programs, particularly farmers (*subak* members) economic empowerment that supports tourism sector; (3) *Subak* leaders and *subak* members should regulate parties who will exploit resources (particularly rice fields and water) for non-agricultural purposes in *awig-awig* and give them strong, firm and fair sanctions.

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Statement of authorship

The author(s) have a responsibility for the conception and design of the study. The author(s) have approved the final article.

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