Study of urban spatial utilization on socio-cultural and environment based on sustainability index (study in Denpasar city)

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Abstract. The rapid development of tourism and population growth in Denpasar City stimulated the dynamic changes in the spatial utilization. This study aims to analyse the impact of spatial utilization on sociocultural and environment and formulate the sustainable spatial utilization that accommodate both social and environmental aspects. This research uses methods of spatial analysis and sustainability index. The results showed that during the period of 2011 to 2015 there was an increase of settlement and tourism land uses, meanwhile at the same period the paddy field decreased. The impact of spatial utilization on sociocultural leads to unsustainable, that showed by the decreasing of the sociocultural index from 1.038 in 2011 to 1.036 in 2015. The low of sociocultural index was stated by the increasing poverty, the obedience of traditional rules of purity radius of Temple and the height limit of the building. The impact of spatial utilization on environmental leads to unsustainable, with the environmental index of 1.065 in 2011 decreased to 1.056 in 2015. The decline of environmental index is due to reduced green open space and paddy field. The strategy formulation of sustainable spatial utilization is done by integrating traditional rules into spatial planning, plan the vertical building, strengthening implementation of traditional rules, implementation of perennial paddy field, and the establishment of traditional task control unit of spatial control.

Keywords: spatial utilization, sustainability index, sociocultural index, environmental index, Denpasar city

1. Introduction

The implementation of spatial planning based on Law Number 26 The year 2007 on Spatial Planning, is an activity consisting of spatial planning, spatial utilization, and control of spatial utilization. The purpose of the implementation of spatial planning is the realization of a safe, comfortable, productive, and sustainable living space. Current conditions are still not by the purpose, as experienced Denpasar City.

Denpasar City is the capital of Bali Province. Spatial planning of Denpasar City based on traditional culture of Bali named *Tri Hita Karana*. *Tri Hita Karana* is the life philosophy of Balinese society which consists of three elements: prosperity, happiness, and peace [1]. The three elements are the harmony a human relationship with God (*Parhyangan*), human with human (*Pawongan*), and human with the environment (*Palemahan*). Denpasar City uses the local wisdom *Tri Hita Karana* in the implementation of spatial planning to improve the economy, while maintaining the culture and environment.

Denpasar city is the smallest city area in Bali Province, but has the largest population. The population of Denpasar continues to increase from 788,589 inhabitants in 2010 to 846,200 inhabitants in 2013 [2]. The high growth of population was influenced by the rapid development of tourism, the main sector that pulled huge immigration from other regions (especially from the East Java) for finding job. [3]. The Tourism sector significantly contributed to the Gross Regional Domestic Product of Denpasar. The gross regional domestic product reached 29.39 trillion rupiah in 2013 [4]. But the success in the economic field has not been able to solve the problem of poverty in Denpasar City. The number of poor people in 2010 was 17,500 inhabitants, slightly declined until 2012, but increased again to 17,600 inhabitants in 2013 [5].

The rapid development of tourism, the increasing population, and the limited land resources cause problems in the spatial utilization in Denpasar City. The area of paddy fields which 2,632 ha in 2010 decreased to 2,506 ha in 2013 [6]. The decreasing of paddy fields has caused the decreasing of green open space in Denpasar City and impacted to the cultural aspect. The influence on culture because most of the Hindu ritual stuff comes from agricultural products. And since the huge demand of land use for the settlement and tourism activities, the spatial utilization ignore the philosophy of *Tri Hita Karana* [7]. The *Palemahan* (environmental) aspect has switched to concrete, the *Pawongan* (human) aspect has begun to decline, and the *Parhyangan* aspect (religion) has degraded. The land use changes also occurred in mangrove forests, around 169.41 ha of mangrove forests dissepeared during the period 2007 to 2008 [8]. The Badung watershed also changed to a settlement area with a change of 46.45 ha per year during the period 1992 to 2008 [9]. Thus, the water carrying capacity of Denpasar City has been exceeded, with a deficit of 462 litre per second in 2010 [10].

Based on the previous description, the spatial utilization should be able to make the aspects of sociocultural and environmental become sustainable. Fact, the sociocultural and environmental aspects both did not sustain. The objectives of this research are: (1) to analyse the impact of spatial utilization on sociocultural aspects, (2) to analyse the impact of spatial utilization on the environmental aspect, and (3) to formulate the spatial utilization strategy of sustainable Denpasar City.

2. Method

2.1. Approach and Location Research
This research uses the quantitative approach with mixed method (quantitative and qualitative). The quantitative methods are (1) the spatial analysis using GIS model and (2) the sustainability analysis using the sustainability index, which compound of sociocultural index and environmental index. The qualitative method uses in depth interview to the key informans to explore the cultural aspects.

The research location is in Denpasar City, Bali Province, Indonesia. Denpasar is located at a height of 0-75 mdpl. While the total area of 127.78 km² or 2.27% of the total area of Bali Province.

2.2. Population and Variables
Research population are divided into three, such as followings:

a) Traditional village chief: are the leader of the current period and the former leader of a previous period which occupies thirty-five traditional villages. The number of population are seventy. Determination of sample using stratified sampling and purposive sampling, with a criterion, that is traditional village chief and former traditional village chief whose villages have a larger population of migrants than local, and vice versa. The number of samples are twenty-eight people.

b) Expert team consists of two expert in spatial planning and expert in cultural aspect. The population of spatial planning expert are an academic who specializes in spatial planning in universities in Denpasar City, Udayana University. The population of cultural expert are an academic who specializes in the field of culture that exist in two universities based on the Hindu in Denpasar City. Determination of the sample using the snowball sampling technique and the determination of the informants until it reached the saturation point.

c) Head of Denpasar Government Agencies. This population includes the leader of each agency of the Regional Planning and Development Agency, the Spatial Planning and Housing, the Environment Agency, the Licensing Agency, and the Civil Service Police Unit in Denpasar City. The number of population are five people.

The variables of this research are spatial utilization (land use), sociocultural (human development index (HDI), poverty, purity radius of Temple *Kahyangan Tiga*, cultural heritage areas and building height limit), environment (green open space and land conversion of paddy fields). Data collection is done by geographic information system (GIS), agency documents, in-depth interviews, and observation.

2.3. Analysis Techniques

Analysis of land use data is analyzed using spatial analysis, with doing mapping the land use of Denpasar City in 2011 until 2015 which then will be compared with spatial planning (RTRW) Denpasar City. Socio-cultural and environmental data are analyzed using trend analysis, looking at developments during 2011 to 2015 and will be compared against predetermined targets. The socio-cultural index and environment index will be calculated by the formula [11]:

$$Index(k) = Weight \times \Sigma\left(\frac{X(i)Achievement}{X(i)T\arg et}\right) \qquad (1)$$

With the Index (k) = Index value (k) (k = socio-cultural and environment), Weight = 1/N (k), N(k) = number of indicators in index k (socio-cultural and environment), X(i) Achievement = achievement value for the index indicator of index k the i (i = 1,2,3 .. and so on), X(i) target = target value for the index indicator of index k the i (i = 1,2,3 .. and so on).

Conditions are considered to lead to sustainability if the index value of socio-cultural and environment continue to increase. The value of poverty will be reversed that is one hundred percent less the percentage of the poor. The purity radius of Temple *Kahyangan Tiga* and the height limits of the building are not included in the calculation of the socio-cultural index. The formulation of spatial utilization strategy of sustainable Denpasar City uses comparative descriptive analysis by combining the results of research on the impact of spatial utilization on socio-cultural and environmental aspects.

3. Results and Discussion

3.1. Spatial Utilization

The spatial pattern in the Spatial Plan document of Denpasar City (RTRW) 2011-2031 were dominated by land use for settlement, tourism (a combination of trade and services as well as the effective area of tourism), and paddy fields. The settlement has the largest plan area of 5,904.690 ha or 46.211 percent of the Denpasar City. Tourism has a plan of 2,437.180 ha or 19.074 percent of the Denpasar City. Paddy fields has an area of 1,563.520 ha or 12.236 percent of the Denpasar City.
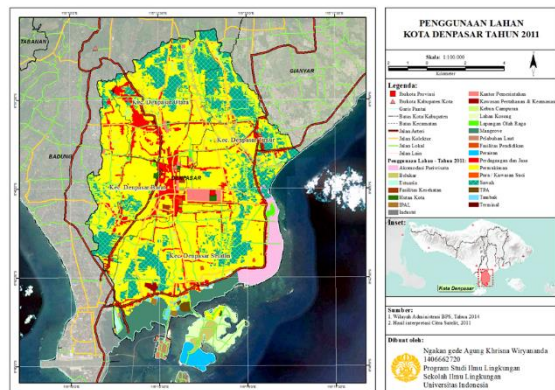
Figure 1. Land Use of Denpasar City in 2011
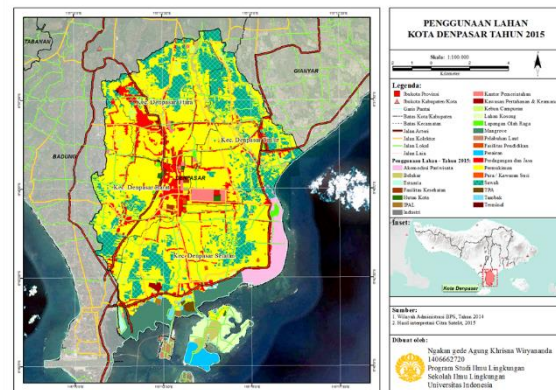
Figure 2. Land Use of Denpasar City in 2015

In the period 2011 to 2015, land use was dominated by the settlements, tourism, and paddy fields. The total area of settlement was 6,601.440 ha in 2011 and increased to 6,641.116 ha in 2015. The total area of settlements has grown by 39.7 ha over five years. The total area of tourism was 1,688.804 ha in 2011 and increased to 1,694.713 ha in 2015, and it was about of the Denpasar City. The land use of tourism increased by 5.908 ha for five years.The total area of paddy fields was 2,123.110 ha in 2011 but decreased to 2,103.566 hectares in 2015. The area of paddy fields was reduced to 19.5 ha for five years. The share of the settlements, tourism, and paddy field to the total area of Denpasar City in 2015 were 52.8 percent, 13.5 percent, and 16.7 percent respectively. The land use of settlement, tourism, and paddy fields for five years were not by the Spatial Plan of the Denpasar City 2011-2031. Land use during the period of 2011 to 2015 shows an increasing for settlement and tourism functions, but decreasing for the function of paddy fields. Furthermore, the city of Denpasar does not have documents of detailed spatial plan (RDTR) and zoning yet. Both rules are still in the process of drafting. Spatial utilization violations also show an increasing trend of 715 violations in 2011 to 1,273 violations by 2015 [12] [13] [14] [15] [16].

3.2. Impact of Spatial Utilization on Socio-Cultural Aspects
Trends of human development index (HDI) in Denpasar City during the period of 2011-2015 continue to increase [17] and have exceeded the set target [18]. This is because the spatial utilization that occurs related to health and education facilities have never experienced land conversion. In addition, Denpasar City has prepared five spreading points for infrastructure facilities that have an impact on the increase in HDI. This result is consistent with the theory that spatial utilization can enhance human development through physical and non-physical access [19]. The poor in Denpasar City during 2011-2015 tends to increase [20] and has not been on target set [21]. This is caused by loss of assets (paddy fields) owned by the community causing loss of income. This result is consistent with the theory that increased poverty is caused by the loss of assets (paddy fields) [22].

Based on Denpasar Spatial Plan, the purity radius of Temple *Kahyangan Tiga*, called *apenyengker,* is 50 m from the temple with high rise building and 25 m with non-high rise buildings. The rule of purity raidus of temple has not been fully implemented yet, because of the land around the temple are private properties. The ignorances of that traditional spatial rule were spreading with the dense of the building there and closer to the Temple. Different perceptions of *apenyengker* based on Denpasar spatial plan and traditional rules (*awig-awig*). *Apenyengker* according to *awig-awig* is minimal distance between wall of Temple and buildings is around 3-5 m. This result is consistent with the theory that there were two different perceptions related to the purity radius of Temple [23]. Cultural heritage areas were still appropriate in number of 15 regions. This is because the area already has legal status and the community itself does not dare to change the function because the area in the form of Temple. This result is by with the theory that the preservation of cultural heritage areas is done by establishing legal status [24]. During the year 2011-2015 there were eight buildings [12] [13] [14] [15] [16] which were not by the rules of

the height limit of buildings in the Denpasar spatial plan was 15 m. The existence of restrictions on the height of the building, the area of the fixed, and increasing the population then the spatial utilization that occurs leads to the horizontal. This result is in accordance with the theory that the height limit of the building causes the utilization to lead to the horizontal [25]. However, if you eliminate these rules then the Denpasar City will lose its characteristic and can cause various disorders.

Table 1. Sociocultural Index of Denpasar City Year 2011-2015

Description	Year					Conclusion
	2011	**2012**	**2013**	**2014**	**2015**	
HDI						
Achievements	79.770	80.450	81.320	81.650	82.240	The performance
Target	71.620	71.830	72.530	72.940	73.360	indication is improving
Achievements /Target	1.114	1.120	1.121	1.119	1.121	
Poverty						
Achievements	98.212	98.468	97.920	97.777	97.622	The performance
Target	98.058	98.311	98.552	98.784	99.006	indication of 2011-2012
Achievements /Target	1.002	1.002	0.994	0.990	0.986	remains, the year 2013-2015 deteriorated
Cultural Heritage Areas						
Achievements	15	15	15	15	15	Performance indication
Target	15	15	15	15	15	fixed
Achievements /Target	1	1	1	1	1	
Socio-Cultural Index	1.038	1.041	1.038	1.036	1.036	Leads to unsustainable

In general, the impact of spatial utilization on socio-cultural aspect leads to unsustainable. It can be seen from the socio-cultural index value in 2011 that was 1.038 increased to 1.041 in 2012. However, it tends to decrease during the year 2013 to 2015 which were 1.038 to 1.036. This is due to HDI and cultural heritage areas were improving, but poverty tends to worsen. Furthermore, the purity radius of *Kahyangan Tiga* Temple and the height of the building was not in accordance with the RTRW Denpasar.

3.3. Impact of Spatial Utilization on Environmental Aspects
Based on the satellite image interpretation from 2011-2015, the green open space of Denpasar has continued to decline during 2011-2015 and has not reached the target [26]. The decline in green open space tends to be replaced by increased land use for settlement and tourism functions. This is consistent with the theory that urban development tends to minimize green open space by overturning into a settlement, commercial, and industrial functions [27]. The decrease in green open space was caused by the community having land in the green line, but the community needs the land to be used as a settlement. The community requested the exchange of land to the Government of Denpasar, but it can not be undertaken by the Government of Denpasar.

Based on the results of satellite image interpretation from 2011-2015, the trend of paddy fields of 2011-2015 continues to decline and were still above target [26]. Land conversion was caused by five main factors, namely economic, institutional, social, population increase, and the rapid of tourism and development. Economic factors were unbalanced business and yield, unproductive land, and rising land prices. The institutional factor were the supervisory function that were not yet optimal and *Bendesa* (the traditional village head) were not involved in the sale and purchase of land. Social factors were caused by the image of the farmers still under other professions, many have changed professions, the lifestyle of the community and to meet the needs, including for religious ceremonies. Factors of population increase both from birth and migration. The rapid of tourism and development factor caused by the transition from agrarian to industry, especially the tourism industry. The results were consistent with the

theory that paddy fields conversion occurs due to factors of economic, social, institutional, population, and development [28] [29].

In general, the impact of spatial utilization on environmental aspects leads to unsustainable. It can be seen from the environmental index value of the year 2011 that was 1.065 continues to decline to 1.056 in 2015. This is due to the continued decline of green open space and paddy fields.

Table 2. Environmental Index of Denpasar City Year 2011-2015

Description	Year					Conclusion
	2011	2012	2013	2014	2015	
Green Open Space						
Achievements	27.003	26.969	26.935	26.922	26.829	The performance
Target	36.000	36.000	36.000	36.000	36.000	indications is deteriorate
Achievements /Target	0.750	0.749	0.748	0.748	0.745	
Land Conversion of Paddy Fields						
Achievements	16.882	16.843	16.809	16.785	16.727	The performance
Target	12.236	12.236	12.236	12.236	12.236	indications is deteriorate
Achievements /Target	1.380	1.376	1.374	1.372	1.367	
Environmental Index	1.065	1.063	1.061	1.060	1.056	Leads to unsustainable

3.4. The Strategy of Sustainable Urban Spatial Utilization

The impact of spatial utilization on socio-cultural and environmental aspects leads to unsustainable. The socio-cultural index values tend to decrease during 2011-2015. Problems that occur namely poverty tends to worsen, the purity radius of *Kahyangan Tiga* Temple and the height limit of the building was notin accordance with the Denpasar spatial plan. In addition, the area of green open space and paddy fields continues to decline. Spatial utilization that occurred not according to plan and not orderly in controlling. Spatial utilization has not been able to harmonize spaces for socio-cultural and environmental functions. This is in accordance with the theory that sustainable spatial utilization means utilizing in harmony for spatial as a socio-cultural and environmental function [30]. In addition, the spatial utilization can be appropriate and orderly in its plan and control can achieve community welfare and environmental protection [31]. Spatial utilization can not be separated from planning and control. Therefore, the strategy formulation of sustainable spatial utilization also incorporates elements of planning and control.
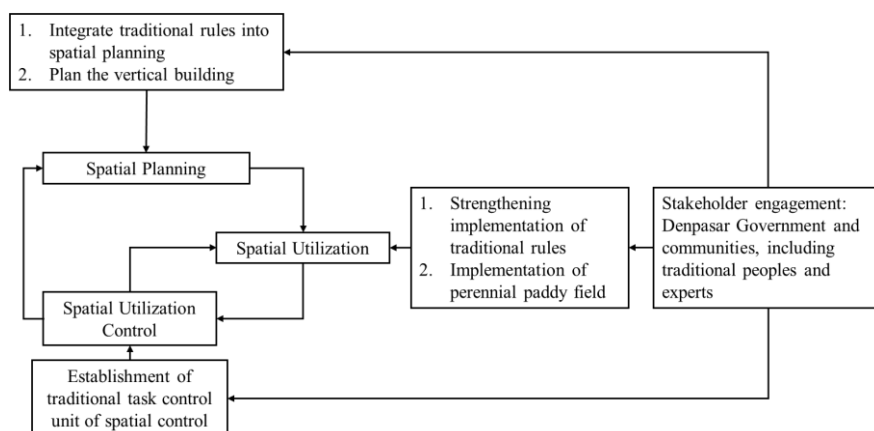

Figure 3. The Strategy Formulation of Sustainable Spatial Utilization

Spatial planning should integrate the traditional rules including the purity of temple rule and height limit of building rule. The integration of traditional spatial rules into spatial planning aims to avoid

conflict between traditional rules and formal rules. Planning of vertical buildings should take into account the high limit code of the building, determine the zone, function, priority scale, development period, and technology development.

The spatial utilization should strengthen the implementation of the traditional rules and the implementation of perennial paddy field. The strengthening implementation traditional rules is done by requiring the buyer of land to join in traditional village (*Pakraman*), *Bendesa* is involved if anyone wants to sell the land by conducting discussions and cooperating with Village Credit Institutions if anyone wants to sell the land. The implementation of paddy field is done in the form of eco-tourism, compensation regulation, the making of Local Regulation concerning the protection of sustainable agriculture land, and Denpasar Government in cooperation with farmers (profit sharing system or other model).

Spatial utilization control should be done by establishing a traditional task control unit of spatial control. This task unit will conduct a routine patrol to control the spatial utilization in the village area. The task unit can also provide sanctions in the form of reprimands that will coordinate with the relevant agencies. The task unit should be given training or education in advance with regard to spatial utilization.

4. Conclusions and Recommendations
The conclusions of this research are:

a) The impact of spatial utilization on socio-cultural aspect leads to an unsustainable condition. The socio-cultural index value that was 1.038 in 2011 decreased to 1.036 in 2015. This is because of two major factors. First, the poverty tends to worsen. Second, the traditional spatial rules of the purity radius of *Kahyangan Tiga* Temple and the height limit of the building were not in being integrated into the Denpasar spatial plan and caused the abandonment those rules in practices.

b) The impact of spatial utilization on environmental aspect also leads to an unsustainable condition. The environmental index value in 2011 that was 1.065 decreased to 1.056 in 2015. This is caused by the decreasing of green open space and paddy fields.

c) The strategy formulation of sustainable spatial utilization in Denpasar City should be done by integrating traditional spatial rules into the spatial plan, vertical building plan, and by strengthening implementation of traditional rules, implementation of perennial paddy field, and establishment traditional task control unit of spatial control.

The recommendations of this research are:

a) The Government of Denpasar is advised to have a policy of incorporating the traditional spatial rules into the formal spatial plan and vertical building plan. The Government should also cooperate with farmers, and make regional regulations related to protect of sustainable agricultural land.

b) Traditional Villages (*Pakraman*) are advised to establish a traditional task control unit of spatial plan and utilization, and work with Village Credit Institution to protect the land.

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