Tropical houses with economics activities consideration in Wonosobo

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Abstract. Kampung Sruni is an urban settlement located in the Dieng plateau region, Wonosobo Regency, Central Java. Along with population growth, new house buildings have been being constructed. Unfortunately, these new houses are being built with a lack quality of planning: the availability of green space, natural air circulation, natural lighting, and material. Improving the conditions of houses with urban acupuncture pattern seems to be the most respectful way. Three site locations are chosen—according to the different contexts of topography and surrounding neighborhood. On these sites, houses are designed specifically to each site context. However, these houses have same design logic. The tropicality is emphasized by arrangement of space elements—wall, openings, and materials—to obtain fresh air circulation and natural lighting penetration along the day. Another important idea is to put large enough space to generate family’s economy: to be freely used for shop, workshop, gallery, even guest house.

1. Introduction

Wonosobo is a district located in the highland region of Dieng, Central Java. Being at an altitude between 250 - 2,500 meters above average sea level makes the air temperature in this region tend to be cool—with a range between 14.3 - 26.5 °C—and relatively high air humidity—which is 66 - 88%. The area of Wonosobo Regency is surrounded by two active volcanoes, namely Mount Sindoro and Mount Sumbing. These two active volcanoes provide geological conditions that are rich in minerals due to volcanic processes [1]. This cool micro climate and fertile soil make agriculture as the main activity of the community. Rice, tea, coffee, tobacco, and various other horticultural vegetables are the types of plants cultivated by farmers. In addition to farming, people also specifically plant Dieng papaya known as Carica papaya (Carica pubescens) for compotes [2]. This compotes become a typical Wonosobo dish and a souvenir for tourists visiting this area.

In addition to agriculture, the Wonosobo society—both living in rural areas and in the city center—is known as an art community. In one year, various festival activities are held. The festivals that have been developed at this time firstly began with traditional ceremonies. Dreadlocks ceremony and
Nyadran Gianti ceremony are two examples of ceremony that have become community’s tradition held in villages in the Dieng plateau. These ceremonies are carried out as a form of gratitude to nature for the blessings of agriculture and for safeguarding the people from disaster. In the series of ceremonies, people usually insert traditional dance and music performances. This ceremonies attracting the interest of outside community and made this ceremonial activity as a tourist attraction for Wonosobo Regency. Along with the high interest of tourists, then variety of more modern festivals are introduced by utilizing the exoticism of the Dieng plateau, including Festival Jazz di Atas Awan, Sendratari Dieng, Lantern Festival, and Festival Caping. These activities later become the economic driving force of the society from the tourism sector [3].

Unlike in rural areas, economic activity in the downtown area of Wonosobo Regency is supposed to be better because of the central government, commerce, and offices. This kind of economic activity surely creates a relatively faster turnover and growth compared to rural areas. The ease of obtaining jobs and livelihoods that are better than in the villages makes people slowly move from village to city. The need for a house to live is inevitable. Communities with middle to lower economic conditions generally choose a general settlement environment as a place to live [4]. The buildings of new house are being established according to the needs of every family that came. Thus, the morphology of urban space is becoming increasingly denser due to the changing of green spaces that are now covered by man-made spaces. The urban space densification phenomenon that occurred in the downtown area of Wonosobo Regency is seen in Kampung Sruni.

2. Method

The purpose of this paper is to explain the way of exploring different kinds of site situations and proposing new model of houses—that can be replicated—as a solution to the specific site problems occurred in Kampung Sruni. In short, the paper is written as an abstraction and catalogue of solutions following situations. In addition to being sensitive to the context of tropicality, the house models are prepared for space needs, which not only accommodates the availability of basic space, but can also be used to generate the family economy. Before conducting the survey, Kampung Sruni was divided into several area groups. The division of area groups is based on house blocks that are close together and on

Figure 1. Settlement situation in Kampung Sruni facing south-east that is surrounded by natural environment.

Kampung Sruni is a settlement in the downtown area of Wonosobo Regency. The proximity of the area to the regional government and the economical district makes the location of this settlement strategic. New house buildings continue to be established on vacant land. The need for space fastly demands immediate development without careful planning and design. Space requirements consist of basic space needs, such as living room, family room, bedroom, bathroom, and kitchen. The function of house buildings as residential spaces is often found to be overlapping with economic functions that are combined into the house, such as a shop, workshop, or gallery. Many space requirements and limited land area then ignore the provision of green areas on the site, so that wider floor area is easily obtained. The distance between the surrounding houses is getting narrower. Natural lighting and fresh air are only obtained through the front openings because there are no opening in other sides of the house. As a result, the artificial lightings stay on during the daylight and the interior space feel slightly damp.
the relatively same topographic situation. This grouping aims to make it easier to search areas and find specific problems in each block. The survey was then conducted to observe the condition of the houses that have been built in the blocks. For each house, the observed aspects are the availability of green open space, building façade orientation, openings elements—windows and doors—and home interiors. At the same time, observations of the surrounding environment are carried out by taking into account the topographic level, the distance between the house and the road in the front, the relationship with the buildings of the surrounding houses, and the availability of vacant land that has the potential to be sold by the owner to build houses on it.

In addition to the physical aspects of space, observations of social aspects were also carried out. Communities were interviewed to explore social aspects included several inhabitants, chairmen of the neighborhood association, and several community figures. The social aspects were explored to obtain informations about how many family members live in one house, what daily activities of each family member are, what activities occur in the house, and as far as whether there is a problem with the electricity bill. Questions about activities were not only limited to activities that have occurred so far, but also whether homeowners plan to renovate their homes and what they expected with these improvements. Meanwhile, the question of electricity bills arises because through observations globally, some houses actually turned on lights during the day. Beside questions that were specific to each family, more general social questions are also important indicators, including what activities the whole community activities in general in the morning and evening and what kind of social activities between communities occur.

Checking for more global environmental conditions in Wonosobo Regency is also important. The micro climate of Kampung Sruni is actually affected by the macro climate of Wonosobo district [5]. Macro environmental conditions including climate, air temperature, air humidity, speed, and wind direction. These datas were accessed easily because of its open sourced nature. Information about this macro environment helps observers determine the real problems and consider potentials provided by nature in Wonosobo District. Thus, the problems and potentials obtained are aligned between the micro physical context on the site and macro at the regional scale, as well as the social and economic context of the community. All physical, social and economic data are then elaborated to determine what home design solutions are in line with existing problems and potential.

| Scoope of space hierarchy | Physical situation Aspects: Physical space and climate | Social situation Aspects: Community, human comfort and activities |
|---------------------------|--------------------------------------------------------|---------------------------------------------------------------|
| Global: Wonosobo district | Open source data                                       | Interview                                                    |
| Macro: Kampung Sruni      | Field observation                                      | Interview                                                    |
| Micro: Each block         | Field observation                                      | Interview                                                    |

3. Result

According to the Decree of the Minister of Settlement and Regional Infrastructure no. 403/KPTS/M/2002 concerning General Guidelines of Standard House, the space requirement per person in a residential house is 9 m$^2$ capita, while the global space density in Wonosobo Regency has now reached 3.85 m$^2$ capita [6]. This number indicates that Wonosobo Regency has experienced significant population growth. Population growth not only comes from the local society, but also by migrants—especially those who come to the downtown to find a job. Population growth is in line with the need for living space. The limited amount of land in the city and the high need for land to build houses then made the society transform the previously empty green spaces into man-made spaces. The need for living spaces increases the value of land and makes landowners willing to sell their land to migrants, especially around the central area of local government. On empty land, newcomers set up new houses. This has slowly changed the spatial morphology of Wonosobo Regency to become denser.
Kampung Sruni is a long-established settlement. It name came from the name of the flower, seruni flowers (*Chrysanthemum sp*). In the past times, these flowers were planted by the inhabitants in their home yards. However, along with the increasingly displaced green space on people’s houses, these flowers had been no longer planted. This made the settlement’s identity can no longer be seen at this time. The densification of space in Kampung Sruni is also indicated by the existence of traditional wooden houses that represents the characteristics of the kampung—although the kampung now is currently dominated by house buildings using more modern materials, such as red bricks and light brick. From the findings of several traditional houses that still exist, it can be seen that the formation between one house and another is close together and has a certain distance, at least one person can pass. However, this distance can no longer be found in houses that recently built. The newly house buildings have been constructed attached to the surrounded neighbors—on the right, left and back sides.

Accessibility in Kampung Sruni consists of several characters: roads that can be traversed by cars, roads that can be traversed by motorbikes, and paths. The road that can be traversed by a car is located on the north side of the settlement and its accessibility is connected to the main road. Roads that can only be traversed by motorcycles generally have a width of 1-2 meters. This narrow road segment is one of the characteristics of urban settlements. Following these road sections, the topography that is sufficiently downward to the south of the kampung is very pronounced. The road is in the form of a ramp, while some of the sections, the road width are shared with pedestrian stairs. Unfortunately, these roads with a steep slope is not equipped with safety in the form of hand rail. This is interesting because even though the accessibility as a means of transportation is quite difficult, the construction of new houses still continues. The building materials are transported using a truck that is carved at the end of the nearest car road. Then, the cart or other smaller vehicle transports the material gradually to the site. Likewise with other purposes, such as the transfer of other goods or transportation of household waste.

Accessibility in Kampung Sruni continues until it ends on the southeast area of the kampung. At this last point there is a footpath on a very steep slope. This area is a fairly high cliff, around 10-15 meters high. The path connects settlements with rice fields and rivers at the bottom of the cliff. Several springs were found flowing along the border between this settlement and the river. In the past, there were paths on both banks of the river. These roads were an attraction for tourists who come to Kampung Sruni to walk along the river. In fact, off-road racing activities had ever been held along this path. However, the existence of these two roads has disappeared due to eroded river flow. Nevertheless, the mound of land around the river can still be traversed even to pass the people to commute, although it is certainly not safe enough.

The people of Kampung Sruni mostly work as employees, merchants, and few of them are farmers and artists. The proximity to the center of Wonosobo Regency government and the availability of various facilities and infrastructure make Kampung Sruni as one of the strategic settlements. There are merchants who sell their merchandise by going around, while others open shops in the front of their houses. A small number of people working as farmers cultivate rice fields or plantations located on the south side of the settlement. Meanwhile, some artists in this village are painters, dancers, and traditional musicians. The artists open studios in this village and teach traditional dance and music to the inhabitants regularly every week. Interestingly, the studio in Kampung Sruni has become the most frequently contacted studio to showcase dance and music arts at various events. Art training activities are carried out by all communities on a part-time basis—usually the routine exercises are conducted at weekend night. The inhabitants also use this art training activity to socialize.

In average, house in Kampung Sruni is inhabited by a family. However, some larger houses can be inhabited by several families. Father is the foundation of the family economy. On a part-time basis, some fathers also work as artists and take shelter under community studios in this village. Additional income obtained by being a performer at art events, both as a dancer and traditional musician. Most of the mothers are housewives, while others work in the office or open a stall in front of their house. In addition, it is known that some housewives work in home industries that make carica. The children have additional activities by participating in community art studios. These children become dancers who are
also not less often appearing to perform traditional dance. The economic conditions of families in Kampung Sruni are generally middle to lower class.

Most of the houses in Kampung Sruni consist of 2-3 bedrooms. The facade of the building generally faces the street. While some of them have houses with different orientations, such as a house located on the edge of a cliff that makes use of the view towards the cliff so as to make an opening to this side. However, there are also many houses that do not valorize the view towards the cliff to make openings. Houses that are classified as modern (using red brick or light brick material) are built attached. In contrast to this, traditional houses with wooden materials have a distance between buildings, about 1 meter. Due to the quite steep difference in contour elevation, some houses were not directly faced with other houses in front of them, but faced with retaining walls on which houses were built.

Most houses do not have green space inside the site. Houses that still have green space are generally traditional wooden houses. Some modern houses that have a fairly wide footprint also still have a green front yard. All houses in Kampung Sruni have enough openings in the front façade of the house. However, some houses that located directly opposite the retaining wall in front of them—generally these houses face westward—do not get enough sunlight penetration because the façade is facing west so that during the day the artificial lighting are always turned on. The spaces in the house also feels humid because the air temperature is cool but the air circulation is not good so the air is trapped in the house.

4. Discussion

Based on the analysis of physical space on the pattern of building houses, settlements in Kampung Sruni has three site contexts. This grouping based on topography, relationships with surrounded buildings, and accessibility to sunlight and wind. The first site is the site with the same topographic level with the surrounded building. Access to natural lighting and air circulation is only freely obtained from the front side of the site, while the back, right and left sides have been blocked by house buildings. The second site is a site with a topographic level that is higher than the site of the house behind it. Access to sunlight can easily pass through this site from the front and back. The view towards the back is potentially good because it creates a downward skyline. Whereas, the third site is a site located on the edge of the cliff in this kampung. The right and left sides of the site are building houses, while the back side of the site is a cliff. The lower side of the cliff is rice fields, forests and rivers. Thus, the accessibility to sunlight and wind is unimpeded.

Figure 2. The settlement of Kampung Sruni with the yellow blocks are the three sites which is proposed to be built with new house designs. From left to right: the first, second, and third site context.
Improving the condition of the houses in the Kampung Sruni settlement is not possible to execute massively. In addition to its limited accessibility, massive improvements are also not effective and efficient for the results that will be obtained. The urban acupuncture strategy seems to be the most respectful way to do. In providing solution, it is important that not merely offering physical solution. The physical solution may become a fruitful result after the deep understanding problems, people, and place has been done [7].

A model house on each site context is planned and designed by looking for a vacant land or houses—with a bad-stage of its structure and potentially to be replaced with new building. Every site that has the potential to be established with a new house is documented. It is important to take into account the quantitative aspects of the site [8]. On the first site, there is an empty land measuring 7.5 x 5.2 meters; on the second site there is a site measuring 6.6 x 9.8 meters above which is a wooden house with a rotted building structure; and on the third site there is a 5 meter x 15 meter site with a terraced house with dark and stuffy interior conditions due to insufficient openings.

Table 2. Site context documentation.

| Site context | Site context 1 (RT 05) | Site context 2 (RT 07) | Site context 3 (RT 13) |
|--------------|------------------------|------------------------|------------------------|
| **Orientation** | East - west | East - west | North - south |
| **Site dimensions** (m²) | 7,5 x 5,2 | 6,6 x 9,8 | 5 x 15 |
| **Topography level difference in site** | ± 0 meter (relatively flat) | ± 0 meter (relatively flat) | ± 1.5 meters to the rear |
| **Site boundaries and topographic levels difference** | | | |
| Front | Road: 0 m | Road: 0 m | Badminton field: 0 m |
| Wall: 3 m | | | |
| Right | House: 0 m | House: 0 m | House: 0 m |
| Left | House: 0 m | House: 0 m | House: 0 m |
Each model house is specifically designed according to the size of the site. This adjustment is done to realize a realistic home model with existing site dimensions. The three model houses have the same design logic. The new house planning and design consist of tropicality aspects and space requirements. The tropicality aspect is translated as a response to the natural ventilation and lighting potentials on each site [9]. Green spaces on each site are designed on the front yard and backyard. In addition to providing rainwater catchment areas, the design of green spaces is intended as openings and void in the building. Space elements—windows, doors, and vents—are laid out on the front and back. The clean air in the village makes it possible to make more and wider openings. The window uses louvre types, while some areas of the walls use openwork bricks. The use of luvre window and openwork bricks are aimed to flow the air naturally. Openings on both sides are also a response to the east-west-facing site; so that the interior of the house will obtain the natural lighting along morning to evening.

Spatial planning consists of basic space requirements and adaptive space that can be used for economic activities. The space for economic activities is aimed to stimulate the family’s economic from other sector that can be operated from the home [10]. The basic rooms include two bedrooms, one bathroom, and one kitchen room. Adaptive space is a combination of living room and family room functions with space for economic functions. With the unification of these three functions, more space can be obtained. As a result of site availability that is not wide enough to accommodate large amounts of space, the space zone division strategy is carried out by making a two-story building. The ground floor is used for groups of spaces that are more often used and more public spaces, namely bathrooms, kitchens, and adaptive spaces. The walls of the first floor façade can be adjusted to economic activities function that will be carried out by each family, such as shops, galleries, or workshops. Meanwhile, the second floor is used for more private space, namely two bedrooms. Stairs are made straight one line and placed against the wall so that the room on the first floor is spacious.

4.1. House on the First Site Context
In the model house of first site context, adaptive space can be used for economic activities such as shops, galleries, or workshops. The kitchen and bathroom are located adjacent to one side of the ground floor, while on the opposite side there is a staircase leading to the first floor. The kitchen and bathroom have direct access to the outside air; so there is no need for an artificial air exhauster. The green area is in the form of a front yard—one meter width and length following the long side of the site—and an opening—60 centimetres width—on the back that connects to the first floor. The ground floor front façade uses a louvre type door. On the first floor there are two bedrooms attached to the back wall. The building roof is in the form of a roof that falls towards the front, giving a large opening for natural lighting and ventilation from the back side. The east side on back side of the building is good to provide a morning light to homeowners to start morning activities. Meanwhile, on the west side—in front of the bedroom—is a corridor with an overhang structure that has enough space to be used as another function.
4.2. House on Second Site Context
In the model on second site context, it is still slightly the same as the context of the first site, the adaptive space located on the ground floor can be used for store or gallery functions. At first glance, the first and second site context's model house are almost the same. The difference lies in the green space which is not only in the front and back yard, but also in the back of the first floor. In the context of this site, the building has a very broad view towards the back side—facing east. The land's topographic difference is quite high, about 3 meters, with the site of the building below allowing opening on the back side of the new house to be larger than the model house on the first site. Material of the back and front side walls of the first floor using openwork bricks. Meanwhile, on the ground floor, a glass window can be applied to the wall facing backwards.

4.3. House on Third Site Context
In the model house on the third site context, the availability of land is wider than the previous two sites. Another advantage of this model is that the view towards the back site—facing south side—is remarkable. The accessibility to natural light and fresh air is outstanding. In addition, in front of the site is a badminton field that has always been the center of inhabitants’ activities. With this huge potential, adaptive space for this third model house is intended for guest house function. The zone between public and private spaces is divided into 3 levels. Level 1 is the ground floor used for living rooms and family rooms; level 2 is the ground floor, which is located at 1.5 meters below level 1 and is used for two bedrooms for inhabitants, a kitchen, and a bathroom; while level 3 is the first floor that serves as a guest house. Level 1 and level 2 are connected by a patio and void up to the first floor. On the first floor, staying guests can access views of the forest and rice fields through wide window openings facing the south side. In addition, if the community is holding activities in the field, guests can see it through a window on the north side.
Figure 5. House design on the third site context: (a) front-back section; (b) isometric section.

Overall, the space layout is made in simple structural modules. Completion of the roof using one side roof also allows a fast and easy construction process. Access roads for transportation of material into the site also make it impossible to make complicated house models. The building mass is very simple, but the building elements are arranged to be responsive to the site context. Structural elements use materials that are already available on the market so that the manufacturing and transporting of materials are easier to do.

Table 3. Basic space requirements and economic functions are expected in all three house designs.

| Site context | Site context 1 | Site context 2 | Site context 3 |
|--------------|----------------|----------------|----------------|
| **Floorplan**| ![Floorplan](image) | ![Floorplan](image) | ![Floorplan](image) |
| **Basic space requirements** | 2 bedrooms  
1 bathroom  
1 kitchen  
1 piece of adaptive space | 2 bedrooms  
1 bathroom  
1 kitchen  
1 piece of adaptive space | 1 living room  
2 bedrooms  
1 bathroom  
1 kitchen  
1 bedroom lodge + bathroom |
| **Economic function to be stimulated** | Stalls / shops  
Gallery  
Workshop | Stalls / shops  
Gallery  
Workshop | Guest house |
5. Conclusion
The problem of urban settlements like what happened in Kampung Sruni is a common phenomenon in various urban area in Indonesia—both in the well-established one or the new one. It is undeniable that Wonosobo district, which was formerly better known as a rural area, is now experiencing morphological changes to become denser in several areas. Population growth along with the need for residential spaces cannot be avoided. However, houses in public settlements are generally established without adequate planning and design, mainly related to natural light and air circulation. In fact, the wrong design cannot achieve optimal space functions, such as dark interior spaces during the day. The people don’t realize that this is a serious problem that arises due to poor house design or stuffy space due to non-smooth air circulation—which in the long term can cause respiratory problems to the inhabitants. If this is left in the scale of a residential area, then a decrease in quality of society and a more massive environment may occur.

The high cost of living in the city also influences the use of housing as a source of economy. We can easily find house buildings that are not only functioned for habitation but also for commercial functions—such as shops, galleries or workshops. Unlike the shop houses that are built along the main road of the city, the residential function with shop in these kampung’s houses is very important. The connection between habitation activities while keeping the shop are very close. Unfortunately, the space for commercial function sacrifices residential functions quality in the house. As a result, the basic living space is made in a relatively narrow size. Therefore, planning for an adaptive space for commercial functions cannot be avoided. Like canvas, providing adaptive space in a home building can be creatively processed by the community independently and creatively, without the need for architectural assistance.

Another problem found in urban settlements like this is the loss of green areas. Green areas as a form of environmental responsibility are eliminated in order to obtain more floor area. In fact, the green area is not only useful as a provider of oxygen, but also as a water catchment area. Volumetrically, green areas are a well-like void that can penetrate natural lighting and fresh air into the interior of the house. With the natural lighting entering the interior, the use of artificial lightings and fans in the day can be suppressed. Building elements related to green areas need to be processed so that the benefits of the green areas can be obtained optimally to the interior of the house.

The three house models provided are solutions that respond to problems of density, green space, lighting and ventilation, as well as consideration of the space for comprehensive and sustainable economic activities that occur in Kampung Sruni. Similar problems can certainly occur in various other cities in Indonesia. Completion of the house model design is now often done by making typical houses. Settlement characters are very different from housing, one of which can be seen from the shape, size of the site, and the surrounding houses. However, as an architect, making a house one by one according to the needs and preferences of each family member is also impossible. For this reason, understanding of the site context, general and specific problems needs to be carried out as a design guide that can be replicated to other sites. Of the three houses offered as models, the design logic is the same, but what makes it different is the context of the site specifically translated into design.

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