Layout housing typology using hydroponics system

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Abstract. Along with the development of settlements in the middle of the city, the reduction of green land in each of the housing units has diminished. The desire to grow crops in the housing unit is increasingly gone. But now, all can be made using hydroponic techniques. Hydroponic technique is six cultivation by utilizing water without using soil by emphasizing the fullness of nutritional needs for plants. This farming technique is now being tucked away as an effort to present green land in a settlement with small and dense land. Therefore, a lay out design solution that accommodates residents in the housing area can be planted with hydroponics. Hydroponics is a business for urban farming. The research method used is an experiment with qualitative research. The plan for conducting the research activities will be a survey and field data collection, then continued with drawing work and designing layout.

Keyword: Layout, Housing, Hydroponics

1. Introduction
Along with the development of settlements in the middle of the city, the reduction of green land in each of the housing units has diminished. The desire to grow crops in the housing unit is increasingly gone. This is called Urban Farming. Urban farming is the concept of transferring conventional agriculture to urban agriculture, which is different from the actors and the growing media.
Urban agriculture design is a process of finding opportunities to match the availability of land, water and waste as a source of nutrients, and small-scale companies and housing and communities available, as a natural connection to diversify and improve the quality of land, water and food. Watson, D. (2003). Time Saver Standard for Urban Design. Types of Urban Farming according to the Agriculture and Food Security Office of Bandung City, consisting of several types (Table 1):

| Types   | Types of Urban Farming                                                                 |
|---------|---------------------------------------------------------------------------------------|
| Type A  | plantations in pots / polybags / other recycled containers                              |
| Type B  | a house with productive plants in the yard (one tree house)                           |
| Type C  | home garden useful vegetables or ornamental plants                                     |
| Type D  | plants on the wall (verticulture)                                                     |
| Type E  | vines on the fence                                                                    |
| Type F  | utilization of sleeping land (community)                                              |

All can be made using hydroponic techniques. Hydroponic technique is six cultivation by utilizing water without using soil by emphasizing the fulfillment of nutritional needs for plants. Water requirements in hydroponics are less than water requirements in soil cultivation. Hydroponic Planting is a landless farming method.
3. Classification of residential and residential environments based on the provisions of a balanced residential environment: distinguished above

- luxury houses, mansions are non-collateralized houses built on land with a land area of 54 m² to 2000 m² and construction costs per m² between the highest unit price per m² for the construction of applicable type A official housing and non-clustered houses built on land with an area of between 600 m² to 2000 m² and the construction per m² is not smaller or equal to the highest unit price per m² for the type A housing construction that applies, with the building area of the house being adjusted to KDB and KLB which permitted in the applicable spatial plan.

- Medium-sized houses, Intermediate Houses are non-building houses built on land with a land area of 54 m² to 600 m² and construction costs per m² between the highest unit price per m² for construction of type C official housing up to unit price per m² the highest for the construction of type A official housing that applies and non-building houses built on land with a land area of between 200 m² to 600 m² and the construction per m² is not smaller or equal to the highest unit price per m² for the construction of type C housing applicable, with the floor area of the house being adapted to the KDB and the KLB permitted in the applicable spatial plan.

- Simple house. Simple house is a residence that is habitable and affordable for low and middle income people. Therefore, the formulation of the problem for this study is:
  1. Which type of hydroponics can be applied in a residential unit?
  2. Housing layout design how will be used as a housing typology with hydroponic planting patterns?

2. Methods

This study uses qualitative methods, with descriptive analytics that aim to find, analyze and describe layouts that are in accordance with the hydroponic planting approach in urban housing. Data analysis method is done by descriptive analysis, based on the results of interviews in the field by looking at the similarities and dominant differences, and looking at the distribution and frequency of each variable. From the data on environmental conditions, an in-depth analysis will be carried out using the appropriate hydroponic techniques.

3. Result and Discussion

3.1. Housing
According to the Republic of Indonesia Law No. 1 of 2011 concerning Housing and Settlement Areas, Housing is a collection of houses as part of settlements, both urban and rural, which are equipped with infrastructure, facilities, and public utilities as a result of efforts to fulfill livable houses. Whereas Settlements are part of a residential environment consisting of more than one housing unit that has infrastructure, facilities, public utilities, and has support for other functional activities in urban areas or rural areas. Basically, housing has a variety of shapes and patterns, there is a patterned housing that is elongated, centered or spread out. There are several factors that influence which pattern is used to be applied in a housing, including physical factors such as: landform (related to slope / land contour), landform, condition of vegetation or other obstacles.

The general housing pattern can be categorized into 5 patterns, namely:
- Grid, the principle is linear but intersect each other to form space like a grid structure pattern.
- Centered / Loop, is a pattern that seems to have a center and surrounded by other objects. It can be said to be the dominant space in the middle and surrounded by other spaces around it.
- Linear, is a sequential pattern / line in one line. When viewed from the spatial aspect, this pattern is a repetition of paired spaces in a row forming a linear line
- Cluster, groups that are grouped together based on 'closeness' relations, both because of the similarity of characteristics, shapes or similarities of other objects.
- Culdesac, housing patterns that have ends, and usually for housing or settlements on contoured land

Settlements are parts of the environment outside protected areas, both in the form of urban and rural areas that function as residential or residential environments and places of activity that support livelihoods and livelihoods that are equipped with environmental infrastructure and facilities, and workplaces that provide services and opportunities limited work.

Housing and Settlement Area is an area designated with the main function as a place of residence or residential environment. Housing and Settlement neighborhoods are residential and residential areas that have clear boundaries and sizes with structured land and space, infrastructure and facilities in a structured environment. Housing and Settlement Areas are structuring of housing and settlement areas that are harmonious, commensurate, and in harmony with the objectives of improving ecological quality, economic growth and socio-cultural development to achieve humane and sustainable housing and settlement development.

3.2. Hydroponic Plantation System

The Hydroponics Plantation Systems are:

1. The Wick System
   Simple passive hydroponic method. Not expensive. Roots in pots. Using material that is very simple without electricity, but not for plants that are rather large. This type is a hydroponic type
   Simple passive hydroponic method. Not expensive. Roots in pots. Using materials that are very simple without electricity, but not for plants that are rather large. The types of plants that are suitable using this technique are mustard greens, lettuce, pakcoy, spinach,

2. The Drip System
   A very popular hydroponic system to use. Root nutrients are absorbed by the roots and then returned to the water tank. Water is given through dripping pipes (drip) to the plant and then to the roots and rotates the water into the plants again. This system is suitable to be applied in conditions of dry sandy land, limited water, dry climate, and commodities that have high economic value. This technique keeps the plants from getting water and nutrients throughout the day in the form of droplets that drip continuously over time.

3. Ebb and flow
   Is a system that is also popular in a hydroponic system. There are gallons of water tanks that spread water through a pipe to pots of hydroponic plants passing under the pot to the
hydroponic growing media. Types of plants that are suitable on a hobby scale with this technique are mustard greens, lettuce, and pakcoy.

4. DWC (Deep Water culture)
   The simplest active hydroponic system is provided in a large tank so that the roots are submerged. In the Deepwater Culture hydroponic system, the roots are suspended in nutrient solutions. An aquarium air pump oxidizes the nutrient solution, this causes the plant roots to sink.

5. NFT (Nutrient Film Technique)
   Plants are given nutritious water with a different slope which decreases to the plants below them. The working principle of the NFT is to drain nutrient water in the roots of the plant where the water flows thin as thick as about 3mm and circulates continuously, the nutrient water flows according to gravity from the high to the low (slope 5°). Some suitable plants use this system are lettuce, mustard greens, pakcoy.

6. Aeroponics
   The most challenging system because the nutritious water is sprayed to the root from the bottom. An aeroponic pipe system that supports three small containers for plastic-covered cultivation and is equipped with sprinklers. Plants that are cultivated in this system are placed on inner media and the plant roots are left to hang in the air without media, the nutritional needs will be fulfilled by spraying to the roots to form a mist.

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**Figure 3. Hydroponic system in a residential environment**
Source: Yanita Mila Ardiani Documentation

3.3. *Hydroponic Planting Pattern in Housing*
This hydroponic plant pattern will be adjusted in 5 types of housing:

| The Housing pattern | The Wick System | The Drip System | Ebb and Flow | DWC (Deep Water culture) | NFT (Nutrient Film Technique) | Aeroponics |
|---------------------|-----------------|-----------------|--------------|--------------------------|-------------------------------|------------|
| Grid                | v               | v               | v            | v                        | v                             | v          |
| Centre/loop         | v               | v               | v            | v                        | v                             | v          |
| Linear              | v               | v               | v            | v                        | v                             | v          |
| Cluster             | v               | v               | v            | v                        | v                             | v          |
| Culdesac            | v               | v               | v            | v                        | v                             | v          |
The following is an analysis of the housing model and the hydroponic system that fits within it

1. Grid System
This Grid system is a system used in housing in general, the shortcomings of this grid system are insecurity in housing, so that now housing with this grid system portals are installed along the roads. The housing system is very organized by planting flat and sweet plants in the front. All are equally impressed, but when this housing develops, the owners distinguish one house from another according to their personalities. In this system, it can be seen that the plant has space in the front, and the back of the house except the house has developed so that the building is full to the rear.

2. Centralized system
In a centralized system this is usually called a loop system. The loop system is rotating, the occupant enters into a group of housing, then in the middle of the ad open the occupants and guests can circle the park or directly into the residential area. The park in the middle is made into a central area where everything is aimed at a large main park. In one large main park this can be given a DWC hydroponic system (Deep water flow) where hydroponic plants are given a large sahi tub and root roots soaked at the bottom.

3. Linear system
A linear system is a monotonous system that is naked, and most do not think of a central garden. With this system, you can use an hydroponic system: Wick and drip inside the house, also NFT in the part of the house. The NFT system is made with pipes that can be made not only in the house on the first floor but also on the 2nd floor.

4. Cluster System
This cluster system is made in groups, and groups housing one another. This can be seen in a contoured housing on a hill. Where housing is made to gather in the direction of the contour. By gathering like this a lot of communal space that occurs is not by itself. These communal spaces can potentially place a hydroponic plant. The age for this cluster housing is NFT, Wick and Aeroponics. For types of Ebb and flow can also be applied to the communal space.

5. Culdesac
At type culdesac where the type is a dead-end alley that is given a garden in the middle. Oada type housing like this is almost the same as a loop of all types of hydroponics can be used. There are housing with this culinary type some houses face a circle in the middle. In some others it is a linear form. The linear form behind it can still be possible the type of hydroponics planted is NFT.
Figure 4. The hydroponic system in 5 types of Housing
Source: Yanita Mila Ardiani Documentation

4. Conclusion
With the various forms of residential areas (linear, centralized, radial, cluster, grid) as described above, the relationship between the pattern of the region and the hydroponic methods of farming is obtained.

1. Hydroponics is very dependent on water, therefore the availability of water becomes very important. In a normal environment and sufficient water is available, hydroponic activities can be carried out.

2. In the hydroponic method with a pooled and floating model, it requires relatively little water because water is only stored in the media (bottles or ponds) and can be used continuously until the plants are harvested. For other hydroponic models, more water volume is needed because the water is 'spinning' to irrigate all hydroponic plants. Indeed, water used does not need to flow like a river, but it is sufficient to be used in the 'loop' system where the flowing water is collected at the end to be pumped and re-flowed at the initial point of the hydroponic plant groove.

3. On a broad scale, hydroponic activities will require greater water availability. If it involves extensive hydroponic land, then that area must also be able to flow. Amid the limitations of water in urban areas, the use of water will be more efficient if using a 'loop' system where water can be flowed back to the beginning.

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