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A Study on Sustainable Greenspace based on Urban Remodeling Design of an Old Apartment Building

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Abstract It is undeniable that urban greenspace is the soul of a city. Conventional urban greenspace such as parks, community gardens, playgrounds etc. located within a city reduce the negative effects of pollution, play a major role in the survival of the urban ecosystem, and promote healthy lifestyles. Today, 55% of the world's population lives in urban areas, which is expected to increase to 68% by 2050. Projections show that urbanization and the gradual migration to urban areas combined with the fast growth of the world's population, could add another 2.5 billion people to urban areas by 2050 and almost 90% of this increase will take place in Asia(UN, 2018). As a result, many plots in the cities are and will continue to be occupied with buildings to provide residential support to the increased population. This will dangerously decrease urban greenspaces. Moreover, worldwide, food crisis, energy crisis, and social crisis is posing a great threat to the existence of mankind. Additionally, the COVID – 19 has introduced a new lifestyle where from work culture to community configuration has drastically transformed. In this scenario, residential buildings will have to serve more than just providing privacy and shelter. As urban greenspaces are being occupied by concrete residential buildings, these buildings will have to compensate for the percentage of urban green they are destroying and the issues they are imposing in the process. The goal of this thesis is to design, architecturally define and, categorize comprehensive 'sustainable Greenspace'(S.G.S) for the multi-family housing scenario. These will be different than the conventional green (veranda, rooftop green) we commonly see in residential buildings. An old, dilapidated apartment building will be the target of remodeling to fulfill the purpose of this thesis.

Keywords Residential Greenspace, Sustainable Greenspace, Dilapidated residential building, Self-sufficient community, Restoration, Food-energy-social security, Pandemic preparedness

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1. Introduction

1.1. Research background

·This thesis will be based on the following questions –

What is the traditional understanding of the term 'greenspace' in multidisciplinary fields and in architecture and planning? What is the current trend of greenspace design in residential buildings and what are the aspects that are being ignored that need to be put emphasis on?

Why is this new kind of space needed? What are the effects of the newly designed sustainable greenspace when applied in the redesigning of a dilapidated old apartment building?

What can be the architectural definition, classification & design attributes, and benefits of 'sustainable greenspace' in a residential building?

1.2. Research goal

·The goals of this thesis are as follows –

Firstly, to establish the necessity of an alternate kind of greenspace through research and explore the rational design process. These will differ from the traditional greenspace that are defined by the presence of greeneries and mostly belong to urban landscapes. They will be capable of providing diverse functions to meet community needs, challenge global food shortage, energy shortage, future pandemics and cope with the future changes in human needs and community, reduce climate pollution, and save urban ecosystems.

Secondly, through designing these greenspace in the remodeling process, examine their effects in enlivening a highly dilapidated residential building.

And finally, to architecturally define residential S.G.S, categorize and specify necessary design attributes and demonstrate the benefits to further apply them in future research in this area of research.

1.3. Research methodology

·The research methodology will be conducted in 3 phases. The first phase is literature study. Theoretical studies will be analyzed to fully understand the existing concept of Greenspace in a broad spectrum of research fields.

The second phase is case study & site analysis, firstly, case studies will be selected and analyzed to further understand the current trend in designing greenspace in residential setting to gather data for the design process. Secondly, site selection and site analysis will be conducted. An old apartment building that is well suited to the topic of this research will be selected and analyzed.

The third and final phase is design process & outcomes. Here, the concept, design direction and guidelines will be discussed. Then, a program will be proposed to redesign the target building. This final phase will include the entire design process from reasoning to final outputs of this research. This research will be concluded with providing an architectural definition of 'sustainable greenspace' or S.G.S, their types and design properties, to further utilize them in future research.

2. Literature Study

2.1. Definition, types, benefits of greenspace

Greenspace refers to a broad variety of open spaces. Taylor and Hochuli (2016) in their study mentioned that greenspace is often interchangeably used with the terms 'green network', 'urban greenspace', 'productive urban greenspace' in Architecture, Urban Environment and Building disciplines. For the convenience of research, the existing idea of greenspace will be referred to as 'greenspace' throughout the literature study.

2.1.1. multi-disciplinary definitions of greenspace

In a journal paper titled 'Defining greenspace: Multiple uses across multiple disciplines' Taylor and Hochuli (2016) analyzed a total of 125 journals of multiple disciplines including urban planning and urban ecology that attempted to define greenspace. The result was that most research failed to give a definition of the term greenspace. Some papers provided examples of greenspace, such as - woodlots, parks, gardens, road strip corridors, golf courses, and cemeteries etc. (Carbo-Ramirez & Zuria, 2011). Examples alone could not suffice to establish a consistent description of what is meant by greenspace.

Several papers from urban planning journals that attempted to define greenspace and their criteria in defining can be observed from the following table –

It can be observed from the chart that most commonly greenspace is defined as nature and urban vegetated areas in different disciplines, including urban and landscape planning. This indicates that greenspace is perceived as large scale urban open spaces that can be naturally or artificially vegetated. In an era where population explosion and simultaneous building construction cannot be restricted, it is necessary to invent an alternate type of com- prehensive greenspace that can be integrated in a building to perform similarly and even more efficiently than urban greenspace that are disappearing rapidly. At the same time these spaces need to be defined qualitatively and quantitatively for the discipline of architecture.

2.1.2. Regional definitions of greenspace

In a 2021 article published in the journal Intech open, titled 'Role of Greenspaces for Maintaining Well-Being in Residential Community Development' regional definitions of greenspace were discussed (Prashanti Rao, 2021).

In the European context greenspace is the green areas located in urban areas, covered by vegetation. These spaces are easily accessed by the citizens for active or passive recreation. Serving diverse needs of the citizens, affecting the urban environment positively, and as a result upgrading the quality of urban life are the influences of greenspace in the cities and urban areas.

In the United Kingdom planning documents, greenspace are defined as areas of vegetations such as grass and trees in the urban environment for recreational and aesthetic purposes. The author Prashanti Rao (2021) titles greenspaces as the 'green lungs' of urban areas which improve the physical and mental health of the citizens by creating opportunity for informal recreation" (Prashanti Rao, 2021).

In the context of India, Greenspaces of the residential areas are termed as planned open spaces, which come under the local open space system. These spaces are planned for community based social facilities. Neighborhood parks are linked linearly to form an open space network of greenspace. The overall discussion about regional definitions and criteria of greenspace can be summarized in the chart below –

From the above chart it is understood that in most regions greenspace is considered as open, public spaces in the urban landscape that have visible greeneries in it. To specify, in almost all regions' greenspaces are defined on an urban scale. Therefore, it is necessary to design and define greenspace that are on micro level, can be infused in residential buildings to provide for various contemporary needs, which is the goal of this research.

2.1.3. Existing categories of greenspace and analysis of current trend in green design in residential buildings

Barchetta and Chiodelli (2018) in their research paper titled 'The variety of urban greenspace and their diverse accessibility', classified traditional greenspace (that have trees, shrubs, or other greeneries which can be observed in the chart below-

Since the focus of this research is to establish sustainable greenspace for the multifamily residential setting, first the existing greenspace in residential context need to be analyzed. Observing Table 1, we can see that greenspace in residential projects correspond to categories 4, and 5 - 'simple private greenspace' and, 'complex private Green- spaces. Clearly, the concept and importance of greenspace are undervalued in terms of spatial planning approaches and functionality in multifamily residential buildings.

In multiple fields, environmental considerations have become a crucial part in decision making. As a result, the

Table 1. Urban planning Journals and their criteria for defining greenspace

Paper title	Year & authors	Definition criteria
The spatial configuration of greenspace affects semi-aquatic turtle occupancy and species richness in a suburban landscape	2013, Jacquelyn C. Guzya, Steven J. Price, Michael E. Dorcas	Water and vegetation
Community, cooperation, and conflict: negotiating the social well-being benefits of urban greenspace experiences	2013, Elizabeth Dinnie Katrina M. Brown, Sue Morris	Vegetation and public accessibility
Green networks for people: Application of a functional approach to support the planning and management of greenspace.	2013, Darren Moseley, Mariella Marzano, Jordan Chetcuti, Kevin Watts	Exemplified as parks, gardens etc.
Spatial extent and habitat context influence the nature and strength of relationships between urbanization measures	2009, Brian TaverniaJ. Michael Reed	Exemplified as wetlands
Planning for the slow lane: The need to restore working greenspaces in maturing contexts	2011, Makoto Yokohari, Jay Bolthouse	Ecosystem services

Table 2. Regional criteria for defining greenspace

Region	Europe	United Kingdom	India
Criteria in defining Greenspace	Function, user category, accessibility, impact on quality of life	Physical characteristics, function performed, perceived benefits, physical and visual accessibility.	Accessibility and connectivity
Context	Urban	Urban	Urban, residential
Scale	Macro	Macro	Macro

green environment is being prioritized in social, political, and economic areas. Also, numerous scientific research testifies the benefits of green environment to communities. The current trend in architectural planning is figuring out an integrated planning process. However, the current reality is that the 'environment' and Greenspaces are often neglected and sometimes completely sacrificed in the residential building planning process. Cilliers (2015) in her study 'the importance of planning for greenspace' identified the reasons behind this phenomenon. These are limited budgets, conflicting development priorities, increasing housing demand due to urbanization and the under-valuation of Greenspaces. In most cases greenspace is treated as a luxury (Cilliers, 2015) a visual attribute of a project but not a 'necessity'.

To summarize, the scenario of current times is, when developing residential projects, providing for basic needs and services are higher prioritized than the green environment and greenspace. Even where green is given a little priority in planning, they are confined to 'green balconies' or 'green roofs & walls' only (referring to chart 2), and the potential of green is not fully explored. Moreover, urban Greenspaces are being erased from cityscapes to make space for more residential buildings. However, there is no comprehensive research to find an alternating space type to make up for the immense loss. Therefore, it is high time alternative Greenspaces of diverse functions are designed and architecturally defined and prioritized in building codes.

Table 3. Barchetta and Chiodelli's classifications

Types	Examples	Accessibility
Public	Urban parks, forests, greenways, grass verges, tree alleys	Very high – restrictions refer to the protection of the environmental quality
Special public	Playgrounds, sports fields, pocket & historical parks, cemeteries, botanical gardens	Rather high – limitations can apply to what a person can bring into the space
Privately run	Community and intercultural gardens	Diverse – from high to very low (access restricted to the members)
Simple private	Domestic gardens, green roofs & walls	Minimal, at the complete discretion of the owner
Complex private	Greenspace within private residential communities, urban gardens	Restricted to the members of the club or association
Privately owned	Urban teaching farms, bio parks, golf courses	High – sometimes related to payment of an admission fee.

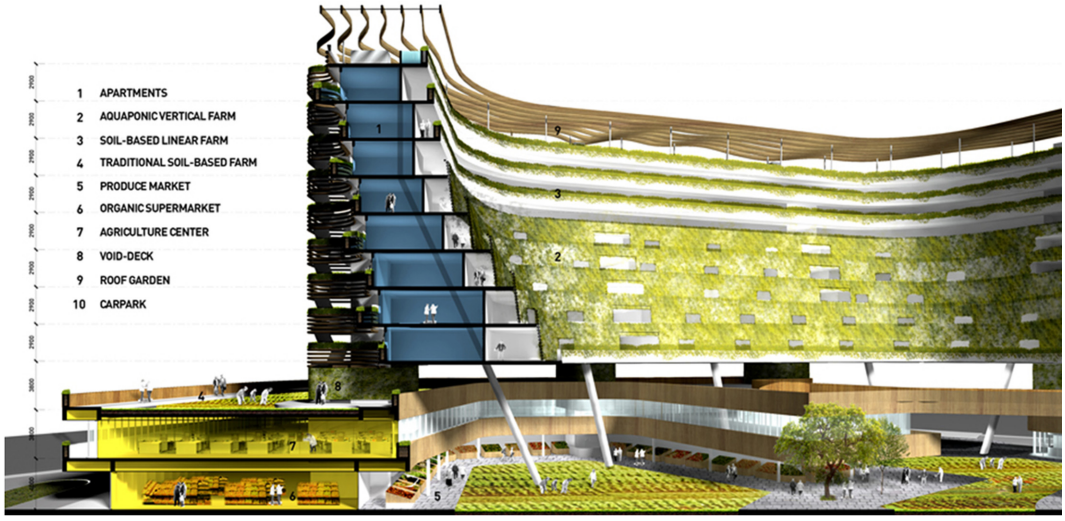


Figure 1. the farming process in section.

2.1.4. Benefits of greenspace & possible effects of greenspace design in revitalizing dilapidated residential buildings

In a study titled 'Urban Greenspaces and an Integrative Approach to Sustainable Environment', Haq(2011) discussed the immense benefits of urban greenspace. He categorized them into 1) environmental, 2) economic & aesthetics, 3) social & psychological benefits. Environmental benefits of greenspace is as a part of the ecosystem they regulate the urban climate. They reduce the temperatures of the city and reduce heat island effect. Greenspaces help in getting rid of harmful air pollutants and reduce noise pollution. The greenspace represents the biodiversity reserve in urban areas.

Economically, the greenspace reduce the building energy costs by providing insulation, reducing energy use. They decrease carbon footprints. The presence of greenspace enhances the aesthetics of any project attracting visitors to a project. In recent years, greenspace has been responsible for the increase in land value.

The social and psychological benefits of greenspace are many. They provide people with recreation and promote wellbeing. Multiple studies have demonstrated that greenspace improve mental and physical health. Therefore, the connection between nature and people is crucial indeed.

A dilapidated apartment building is a building that is old and generally in a bad condition. The bad condition may be due to the building falling backwards from one or all the following aspects - physical, functional, economic, social, and technological. From section 2.1.6 (benefits of greenspace) we learn that greenspace can help alleviate all these drawbacks effectively.

First, greenspaces can physically improve an old buildings condition aesthetically and functionally. As Greenspaces produce and save energy through renewable energy sources, the building becomes sustainable. This and the added aesthetic increase the buildings economic value. A technologically backward building becomes more technologically independent and advanced with the help of greenspace's renewable energy sources, ecofriendly components, and environmentally friendly decisions in planning. A major reason for the dilapidation of an apartment building is due to it not being able to fulfill the contemporary social needs and lifestyle. In this case sustainable greenspaces that vary in functions and privacy scales (private, semiprivate, semipublic, public) may provide the opportunity to fulfill the contemporary social and psychological needs in an old-dilapidated apartment building.

3. Related Design Analysis

3.1. Case study analysis

Case studies will be analyzed divided in two categories –

Case study category 1- Greenspace design with home farm model

Architectural farm 'Spark' proposed a project that introduces retirement housing in combination with urban farming. The objective was to address Asia's elderly population and food shortage phenomenon. The 'Home Farm model' integrates a simple aquaponic system.[1)] Here, three types of farming methods have been introduced – 1) aquaponics on the building façade, 2) Soil-based linear planting beds at the rooftops, and 3) Traditional soil farming.

This initiative includes jobs for senior citizens such as planting, harvesting, sorting, packing, tours, sales on site, delivery, cleaning, etc. Possibilities for the remuneration of What the senior citizens get in return for their work are offsetting rental, utilities bills, healthcare costs at the on-

[1)]Aquaponics is a food production system that combines raising aquatic animals(aquaculture) such as fish in tanks with cultivating plants in water (hydroponics). Together in a system, the plants are provided with nutrient enriched water, produced in fish culture.



Figure 2. co working arrangements at Second home Lisboa.

site health center, and free produce. Home Farm is considered as a private entity within the reach of seniors facing financial crisis. Here economic construction materials are used in modular forms. Through this concept the dwellers could benefit in many aspects such as - economy, food security and quality, social engagement, health, sustainability, place making, and healthcare provision. This case study can lead to designing a farming/agricultural prototype of SGS in the redesign process of the target site of this thesis.

Case Study category 2 – Greenspace design with co-working function

Coworking, where people can work in groups in a social setting, is typically done in a shared space, with shared resources. Coworking is constantly evolving to increase productivity. Woodley (2018) in his article 'The anatomy of good co-working space design in pictures' mentions 7 elements of good co-working space design where 'going green' is mentioned as a major factor to the efficiency of a co-working space. Plants have been proven to reduce stress and increase the aesthetics of an office space. They also promote well-being and sustainability. To alleviate the high levels of work-related anxiety, this is crucial for designing a workspace (Woodley, 2018). Some case studies of such co working Greenspaces are analyzed below-

The first project is Second home Lisboa co working space. Architect Selgas Cano's 'Second home Lisboa' is an open-plan co-working space in Lisbon, Portugal with 1,000 plants of varying sizes.

The concept is based on the evidence that being around plants reduces stress and boosts productivity. The main features of this co – working space are: The main coworking area is connected to broad hallway, the desks are curvaceous and arranged among thousands of plants and trees. It's like walking among a garden scattered with laptops. potted plants act as natural partitioning, there are 500 different kinds of desks, chairs and lamps that create a domestic interior. An advanced heating and cooling system is installed. Also, skylight on the truss roofs reduces the cost of electricity. In this co working space green is not only treated as an aesthetic component, rather strategically utilized to purify the air and dampen noise.

The second project is CoCoon co working space. CoCoon is Hongkongs largest co-working space which is very popular among startups and freelancers.

The 14,000 square meter creative space promotes environmental sustainability through cutting down on basic usages by sharing, whether it be space, supplies or other resources.

The notable features of this co – working space are- firstly, sensitivity to sustainability. Low maintenance local plants are used to cut down on plant maintenance cost. Secondly, the usage of sustainable green materials such as bamboo floor. On top of this, low energy LEDs are used for lighting, nontoxic paints have been used on the walls to reduce negative impacts of construction materials on the environment. The kitchenette has a

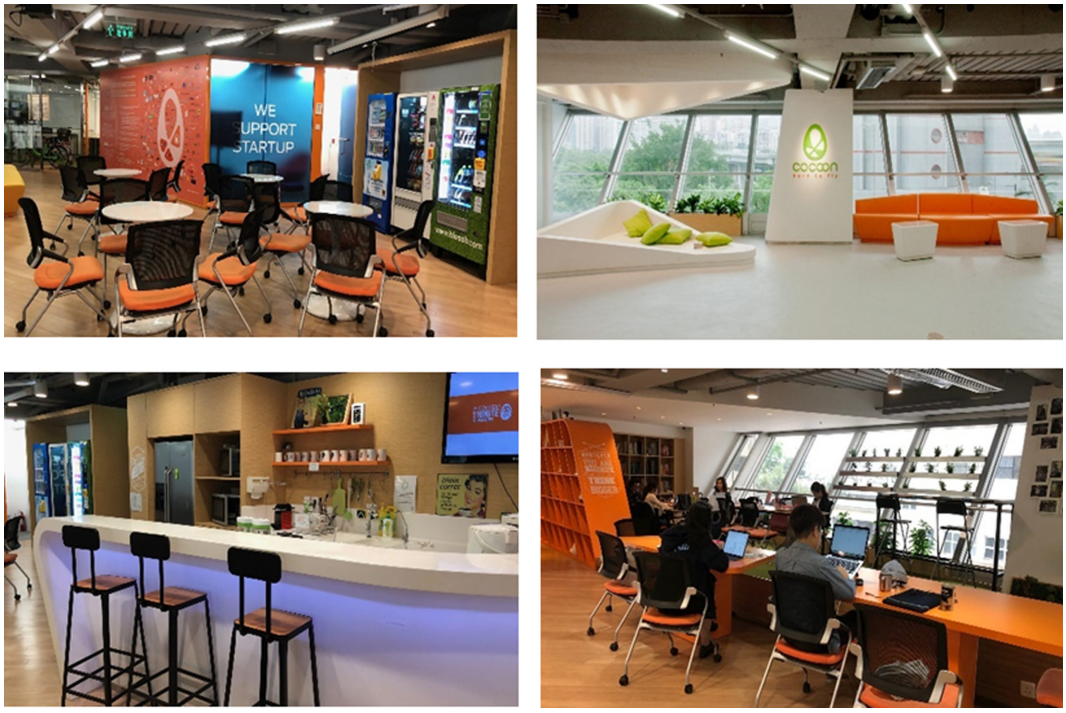


Figure 3. co working arrangements at Cocoon.

recycling system. This space is an ideal example of sustainable practices in public facilities.

4. Proposal Design Process & Outcomes

4.1 Design process

4.1.1. Site selection & analysis

History and background - Hwaehyeon simin apartment was built as part of Seoul's post war revitalization incentives (1968-1972). Hwaehyeon was the tallest of the several apartment buildings built. Its geographical location is formed with steep contour levels at the foot of Namsan. This is what initiated the decision of providing multi-level entrances and spaces utilizing the different levels of land and stimulated a unique community life which enriches its historical value.

Socio – cultural Context –

Observing the immediate surrounding of the site, there is a dominance of old apartment buildings, with namsan church on the west, hwaehyon sports centre on the north. It is surrounded by popular locations like Namdaemun, Myongdong and namsan. However, the existence of Soparo, cuts the connectivity physically. The site can be accessed from Hwaeyeon station. Eastern noksapyong road cuts it off from the block adjacent to myongdong, while Twaegaero at the north – west cuts it from Namdaemun sijang. On the west is the area adjacent to Seoul station business district which is separated from the Hwaeyeon site by Sowol-ro street.

When apartments were built in Gangnam and Yeoido, it lost its qualitative value. On the south, the site has a huge latitude gap with the foot of the namsan hill, Soparo is at the top of this. Additionally due to various disputes, and ownership agreement issues the redevelopment was never utilized. Which in turn, turned this area into a 'backward' town, almost invisible to its surroundings.

Table 4. Basic site Information

• Project name - Hwaehyon citizens apartment • Location - Seoul Junggu Hwaehyondong 1 ga 147-23 • Year - 1970 • Structure - reinforced concrete • Floors - 10 upper floors		
Plot area		4400 m^2
Total Ground area		18,275 m^2
Individual Floor area	1st floor	1400 m^2
	2nd to 10th floor	1875 m^2/floor, Total 16,875 m^2
Floor area ratio		415%
Parking number		30(surface)
Number of households		Capacity for 353, current - 180
Unit area		16 Pyeong / Unit in average
Land use category		Type 1 general residential area, History-cultural aesthetic zone, Maximum altitude zone.

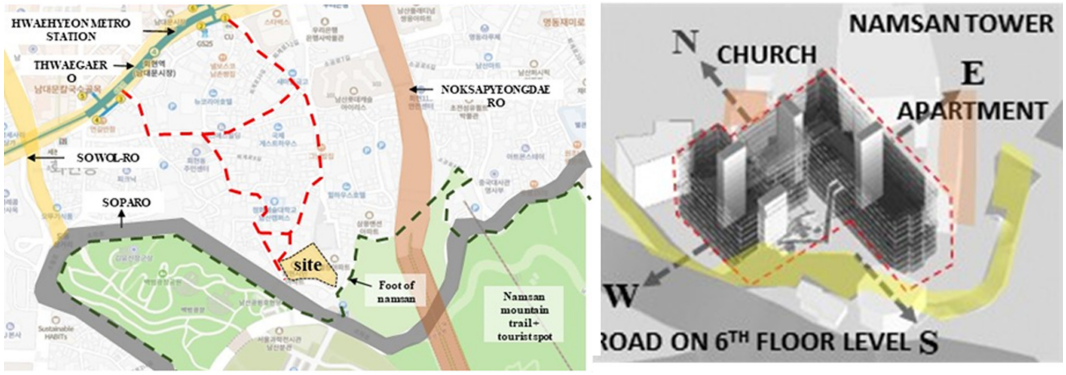


Diagram 1. road network and cardinal disposition of the site.

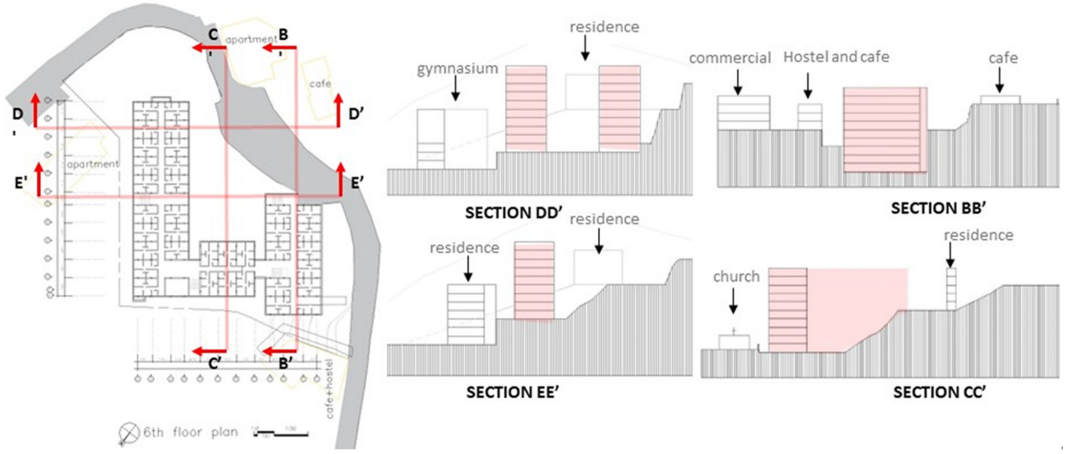


Diagram 2. Existing geographical complexity in plans and sections.

Architectural significance –

On the first remodeling phase of the units, the wall between the kitchen and living room was demolished to introduce the kitchen-living combined space, following contemporary apartments. The exterior windows were made into extended balconies. Elevation formed by the repetitive steel structures give an expression of 'brutalist architecture'.

The most significant space is the central courtyard formed by the shape of the building. This space naturally turned into a community space where household activities took place, the traces of which are still there at the site. Because of abandoning this place is used for storage. Even the staircase has been restricted of access because of the poor structural and functional condition of the space.The most prominent view from the site is of the Namsan tower located South – east to the Apartment plot.

Because of the angular cardinal disposition, the view is blocked towards the northwest and southwest. To the east of the site there is an abandoned playground adjacent to the mountain trail of Namsan tourist spots.

4.1.2. Concept and design direction

According to the World Economic Forums 'global risk report' of 2023, "Food supply crisis","Energy supply crisis"; "Cost-of-living crisis" are among the top risks for 2023 with the greatest potential impact on a global scale. Also, the COVID introduced a "new normal" that is basically refocusing on the basics – food, energy, and social security (economic/occupational, community). Communities are fracturing due to no longer being able to match the contemporary lifestyle and this is resulting in declination of social stability. In Korea, elderly population and single-family households are increasing rapidly. At the same time, youngsters are seeking more occupational flexibility by quitting conventional jobs and leaning more towards startups.

An article published in The Korea Herald on May 2021, titled 'Green architecture brings fresh air' described the Seoul Metropolitan Governments (SMG)"green roof" project initiated in 2002. This initiative was taken to convert building roofs to green gardens.

For the past twenty years, over 764 buildings have been brought under this initiative by transforming more than 314,000 square meters of roof space into gardens. From 2002 to 2021 only public buildings were eligible for the funding. In 2021, the SMG announced to support another 10,000 square meters of rooftop gardens on private buildings.

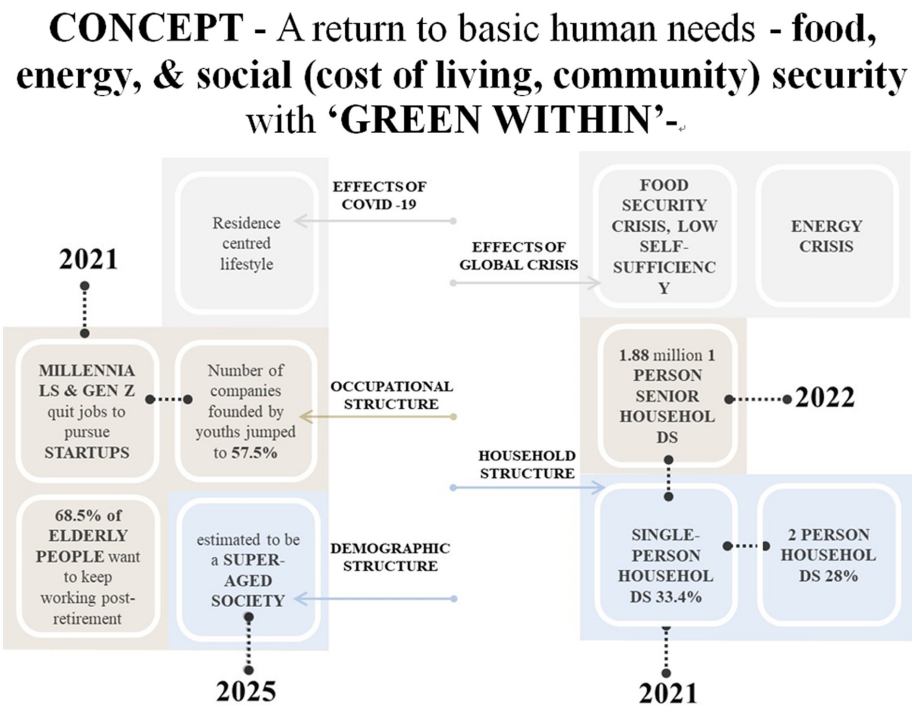


Diagram 3. Statistical factors (for South Korea in the context of various global crises) that influenced the proposal.

According to the SMG, the average temperature of buildings with green rooftops dropped by 3.1 degree Celsius, alleviating the urban heat island effect.[2] Air conditioning and heating energy consumption for buildings went down by 12 to 15%.

The Seoul Metropolitan Governments environmental concern is inspiring and the success of using green roofs as an agenda to reduce energy consumption of residential buildings is a clear indication that more types of sustainable greenspaces need to be researched, designed, and applied to residential projects for even larger positive impacts.

4.1.3. Design guidelines and program formation

Program formation was done by comparing the traditional urban structure, its relationship with existing greenspaces (internal and peripheral) with the newly thought urban structure in combination with S.G.S residences.The objective was to secure the activities of the vanishing urban greenspaces and challenge global crisis of food, energy and social security by introducing a self-sufficient community by designing S.G.S. Additionally, focus was given for the proposal to support and match the post covid lifestyle by fulfilling contemporary human needs and integrate flexibility and stay prepared for unforeseen disasters and pandemics.

4.1.4. Proposed Greenspaces, their application in 4.1.3:

Proposed greenspaces, their application in redesign & features

The following diagram shows how sustainable greenspace were planned and applied to the target site. Each space and their connectivity target the creation and sustainance of a self-sufficient residential community that grows their own food on site. Also, the whole system influences the surrounding environment and communities to build a self-efficient city.

Feature 2 - Energy security – Part of the entire building's energy needs are fulfilled by a number of integrated systems. Waste products from the aquaculture in Aquaponic farms in the vertical farming greenspaces supply nutrients for the plants that grow hydropnically. Used water from the farms and residential zones are treated in a water treatment plant. Agricultural waste is burnt in a steam turbine to generate electricity alongside the solar panels. There is also a unique system of rainwater collection. The slanted glass walls and roof of the aquaponic farms collect maximum rainwater as well as intaking maximum sunlight for reducing the load on artificial lighting equipments. How all these systems operate together and form a 'zero waste energy system' can be seen in the diagrams below –

Transport being a major user of energy, is the biggest cause of environment pollution in urban areas. The burning of fossil fuels results in emission of carbon dioxide. As a result, degraded air quality, noise pollution, water pollution and climate change take place. Transportation also directly or indirectly affects ecosystems. Also, the

[2] Urban heat island effect takes place when urbanized areas become warmer than their peripheries. This happens because densely built structures absorb and radiate more heat than natural surfaces.

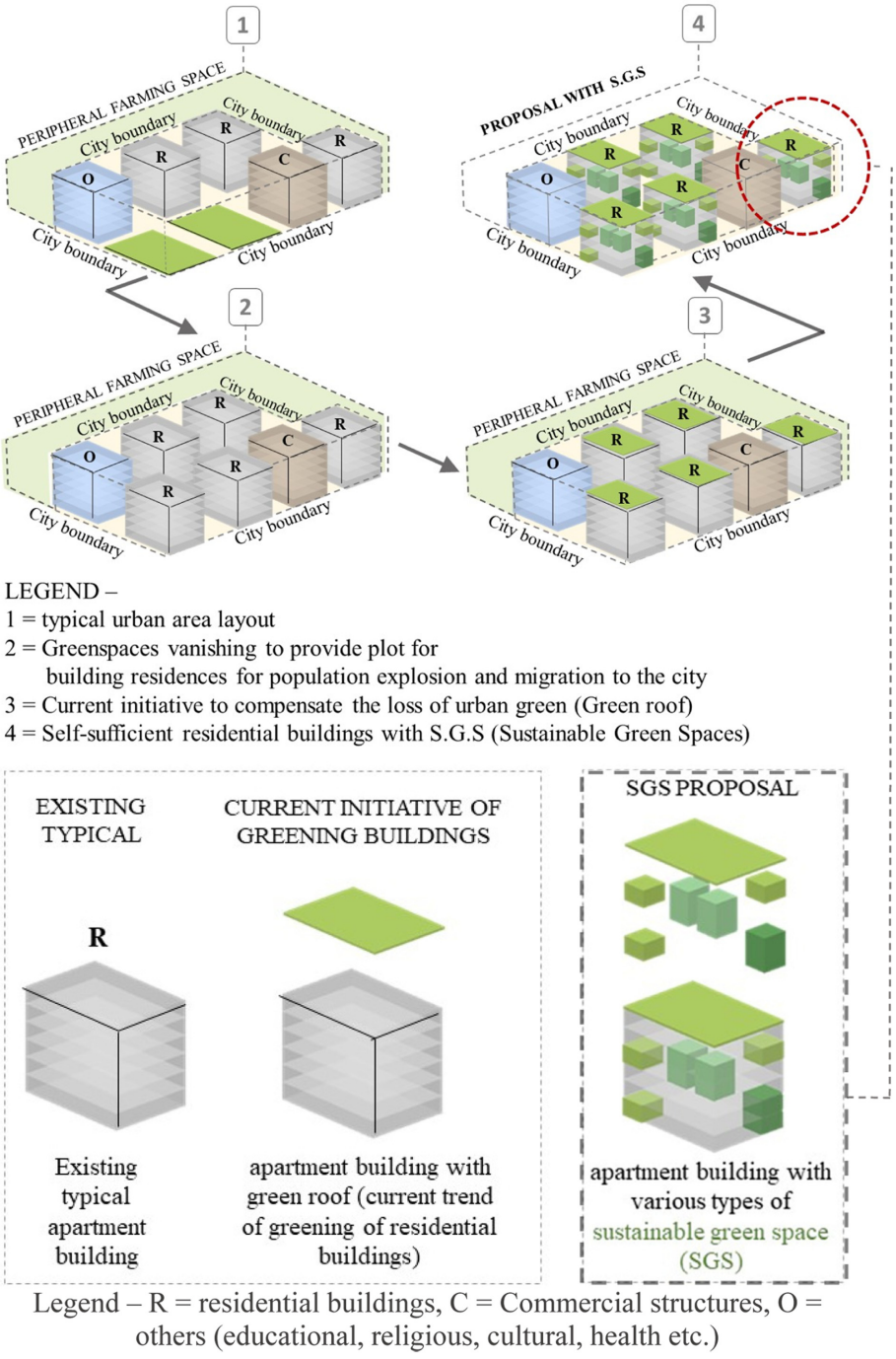


Diagram 4. Design direction & derivation of the proposal of S.G.S.

surface water scarcity worldwide, calls for the need to recycle and reuse water.

The urban farming system requires transporting of goods (from seeds to crop yields) at various stages of production, supply, and consumption. This system is taking a toll on the climate and ecosystem by causing multiple types of pollution.

With the integration of S.G.S in residential building, the entire food production system becomes a close loop of energy usage, where surplus energy is produced throughout the cycle for energy security. At the same time, it reduces carbon footprint drastically as the entire process takes place within the residential community without the need of transportation in each step. Also, it introduces two more steps to the conventional production system – 1) Inspiring and supporting green based business/startups, & 2) promoting green based healthy lifestyle to sustain the newly introduced S.G.S system amongst inevitable social and cultural changes. The entire cycle can be observed in comparison to the traditional urban production system,

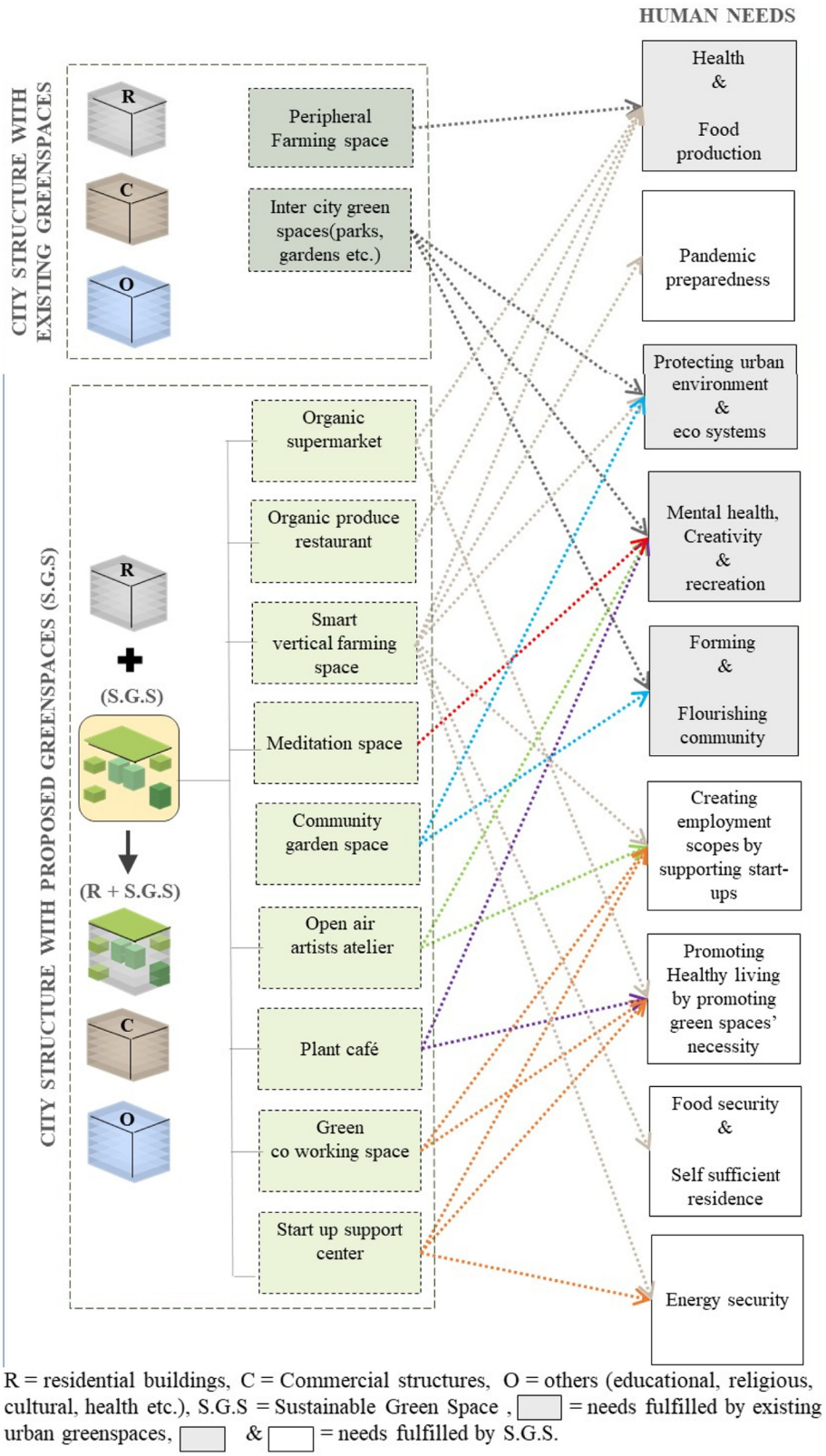


Diagram 5. Program formation in relation to the targeted contemporary needs.

from the diagram below -

Statistics Korea estimated by 2025 — with 20.3% of the population aged 65 and older, South Korea will become a super aged society. This growth will continue untill South Korea becomes the world's most aged society by 2067, when 46.5% of the total population will

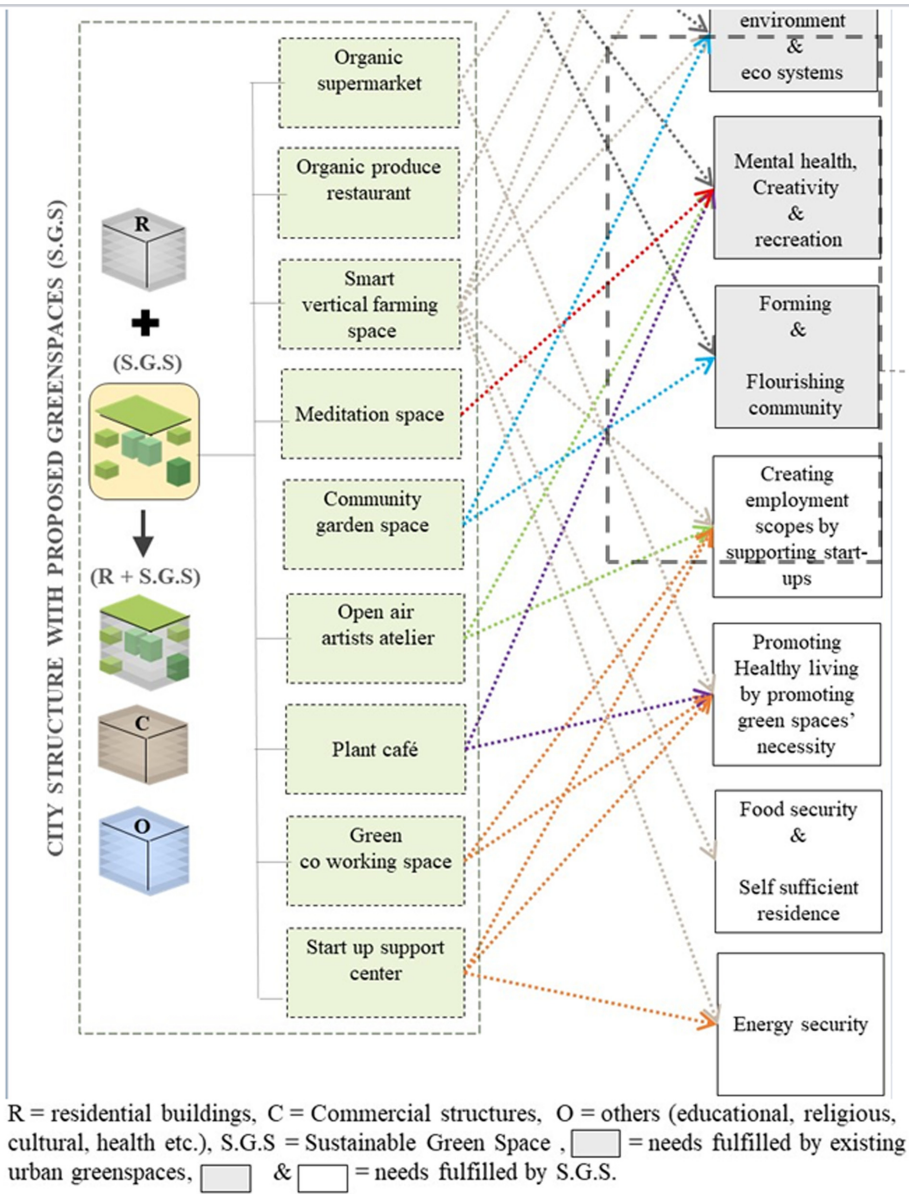


Diagram 6. Program formation in relation to the targeted contemporary needs.

be elderly population. Also the single person household trend is ever increasing where in 2021, 33.4% people lived alone. The elderly population is also following this trend due to the contemporary lifestyle as a result of socio cultural transformations. In 2022 there were 1.88 million 1person senior households. Alongside 'millennials' and 'gen Z', who are quitting stable jobs leaning towards the financial freedom that comes with startups, 68.5% of elderly people want to keep working post-retirement.

The residential programs in the design target these single person households, alongside the 2 person households (28% of the whole population). The idea is for them to mesh and create a community that shares lifestyle and ideas with external communities, creating a completely new contemporary community that can be labeled as the 'S.G.S community' that is one of the outputs of this research. This community is a micro-scale model of lifestyle practices and technical system that are much needed, to challenge the food, energy, and social crisis the world is facing today.

4.2. Research outcomes –

4.2.1. Architectural definition of S.G.S(sustainable Greenspace)

'Spaces that are architecturally planned, to substitute the contributions of disappearing urban green plots, to challenge the global crisis of food, energy, and social security (occupational, lifestyle), and build self-sufficient residential communities by fulfilling contemporary needs as well as having the capacity to support the needs of future generations and tackle unforeseen pandemics and disasters, can be referred to as 'Sustainable Greenspaces'

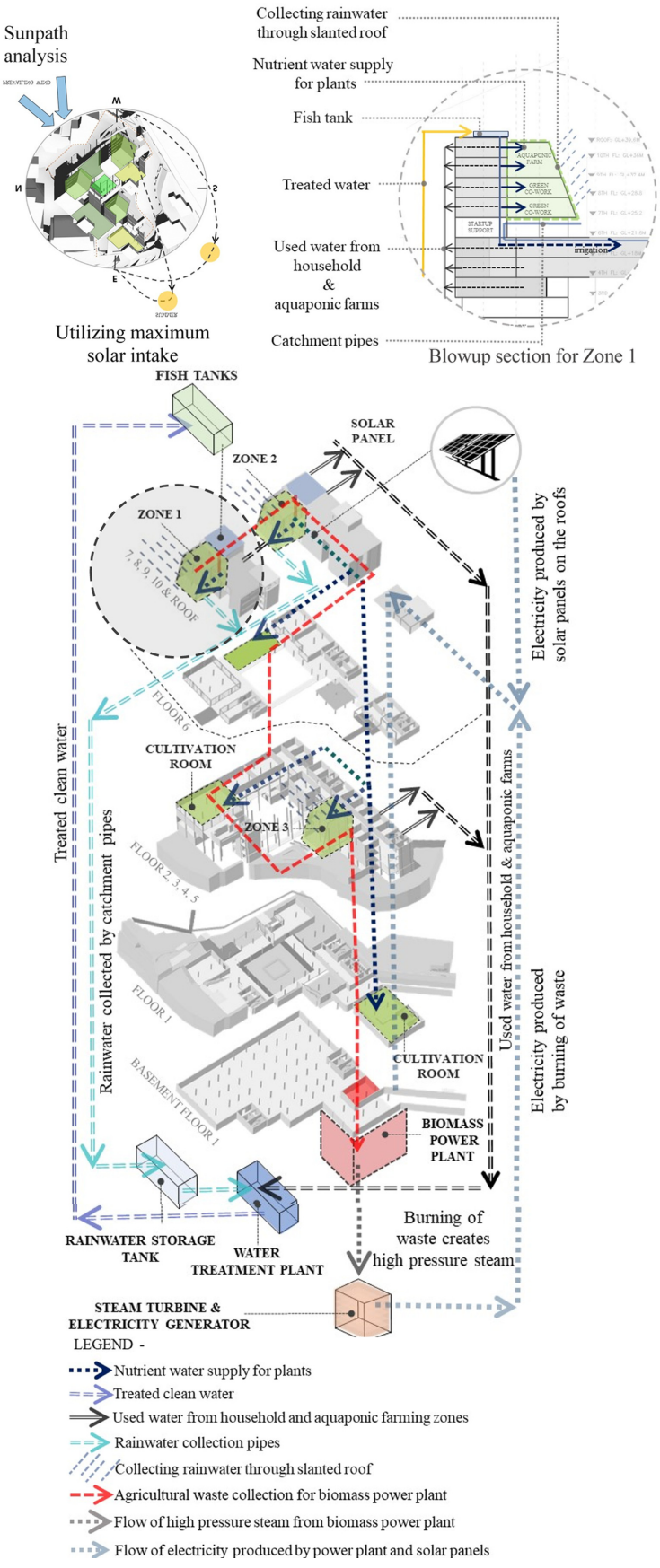


Diagram 7. Zero waste system of S.G.S.

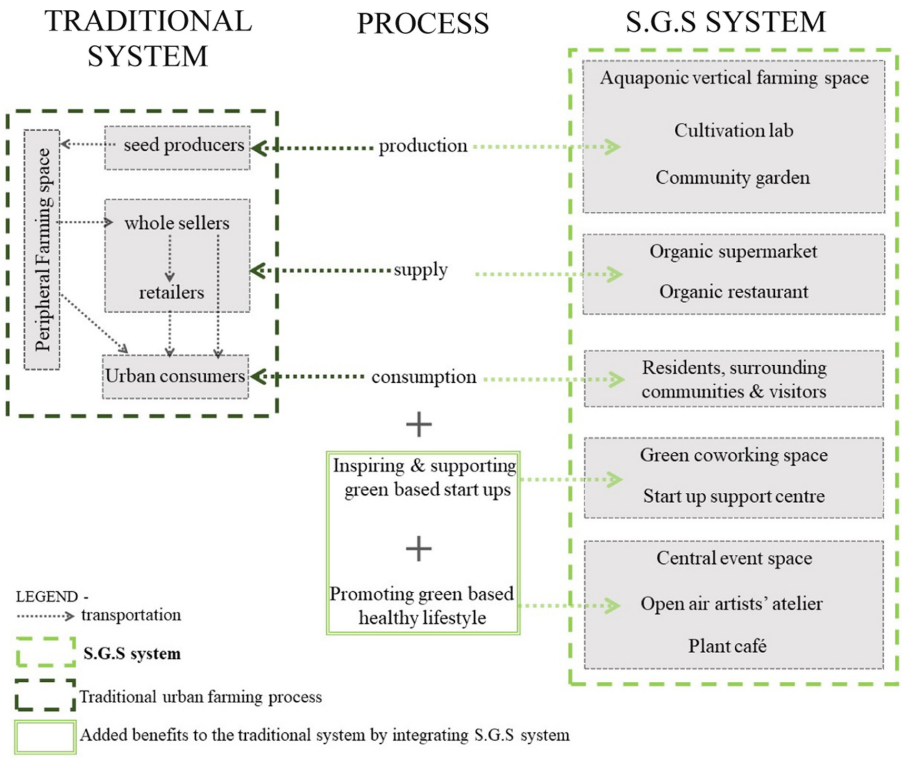


Diagram 8. S.G.S system transforming the conventional urban farming system to save the environment.

or S.G.S.' The community that operates and sustains through S.G.S can be called the 'S.G.S community'. The broader impact of these communities is that, together, they alleviate the negative effects of environmental pollution and, contribute positively to the urban ecosystem by being an integral part of it.

4.2.2. Classification & design attributes of S.G.S

S.G.S Classification – Through this research S.G.S can be classified into 2 main categories -

Type 'A' –Type 'A' S.G.S are the sustainable Greenspaces that have all the design attributes and elements that contribute directly to the purpose of S.G.S.

Type 'B' – Type 'B' S.G.S is basically supplementary to type 'A'. Despite not having all the design attributes and elements of S.G.S, to utilize the full potential of Type 'A' S.G.S, type 'B' supports and operates together with it for the success of the entire system.

Design attributes of S.G.S –

Design attributes can be divided into physical attributes and behavioral attributes. The attributes and their relationship with S.G.S (both types) can be demonstrated as below –

4.2.3. benefits –

1. Environmental benefits–The S.G.S system allows

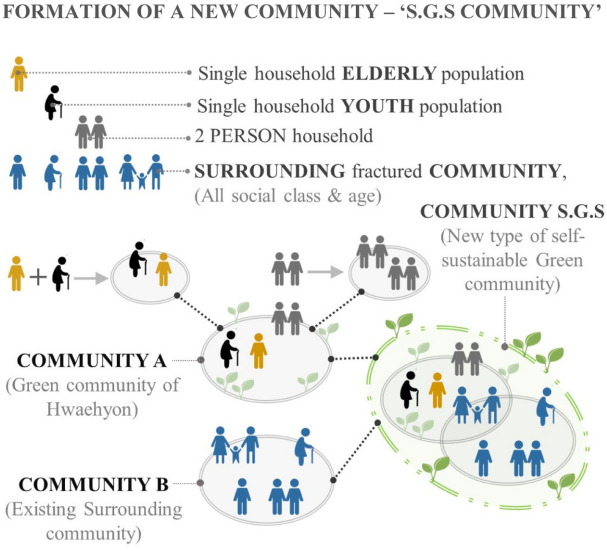
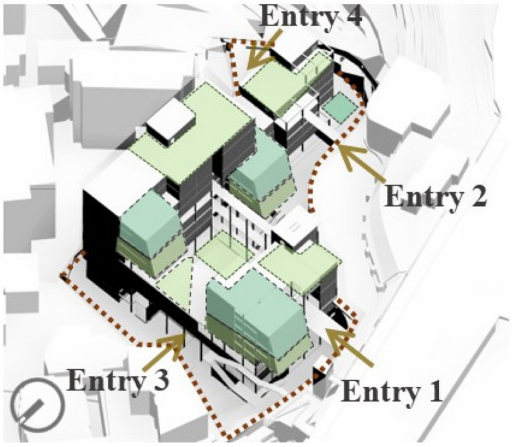


Diagram 9. Formation of S.G.S community.

onsite production and consumption by reducing the carbon footprint. By reducing the need for transportation, it saves the environment by reducing noise, air, and water pollution. **2. Diversifying community-** In the residences planned with S.G.S, a self-sufficient diverse community of retired elderly population and youth is formed who share a common ground in terms of occupational flexibility and lifestyles. This community blends with the external communities in the public S.G.S zones and



LEGEND –
S.G.S type A S.G.S type B

Diagram 10. S.G.S types applied to the Hwaehyon Simin Apartment project remodeling.

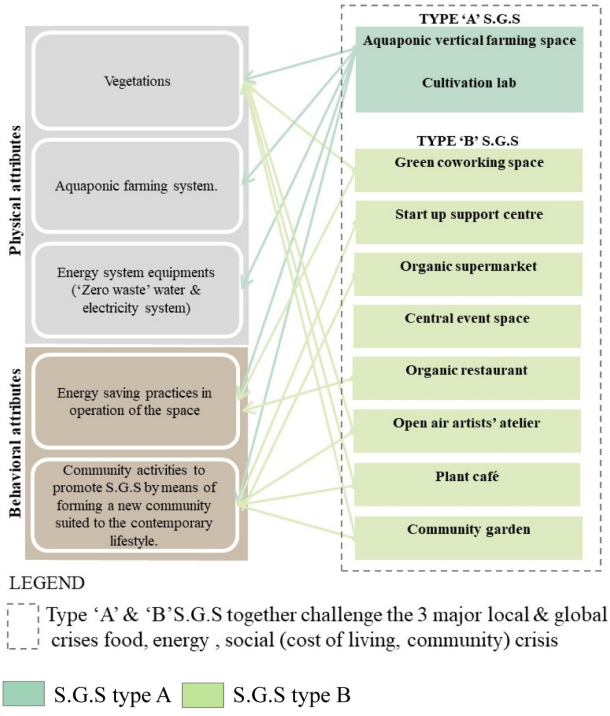


Diagram 11. S.G.S (Type 'A' & 'B') and their design attributes.

creates a new S.G.S community that has the capacity to sustain amongst uncertain socio-cultural and economic changes. **3. Health–** S.G.S promotes healthy lifestyle, not only among its residents but the entire system influences the surrounding communities to adopt this lifestyle by various public functions such as public aquaponic farming zone, green co working zone, organic supermarket, restaurants, and plant cafes etc. The central event space holds various events that help promote healthy living. **4. Food safety –** Food production in the aquaponic farms of the S.G.S continues all the year round, as this system does not depend on seasons. In this way food safety is ensured. Also, no pesticides or fertilizers are used as food is grown in a controlled environment. **5. Occupational safety–**The startup support centres in combination with the aquaponic farming zones and labs, offer training that is open to all. The green co working spaces stimulate diverse interactions inducing new startup ideas related to green production and other areas. Consequently, new businesses that are much more flexible and diverse than conventional jobs are grown, ensuring occupational safety. **6. Energy and cost efficiency –** The S.G.S system is a zero-waste system that recycles and reuses energy. Water is recycled and surplus rainwater is stored for further use. Electricity is also produced through burning agricultural waste (refer to diagram 7) and solar panels. South Korea depends heavily on imports in terms of vegetables. The food production system will reduce the import cost. **7. Pandemic preparedness –** The S.G.S system, by providing for basic needs such as food, energy, occupational and community safety, creates a residential community that is well equipped for unforeseen future disasters and pandemics.

5. Conclusion

The crisis in the modern world is trying to tell us that it is high time to come up with solutions that allow a healthy, safe and efficient life by securing the basic needs of food, energy, social and occupational security. Population explosion can not be stopped, so is vanishing of green plots in the urban areas. What this research attempted to do was establish an architectural definition of 'sustainable Greenspaces' or 'S.G.S' qualitatively and quantitatively, its classification, design attributes and benefits. The main objective was to establish the term 'Sustainable Greenspaces (S.G.S)' in the field of architecture where greenspaces have been superficially defined till date. Although other desciplines' attempted to define it in terms of examples, it was much needed to define it in architecture and planning so that further policies and building rules could be imposed on the basis of it. This research establishes that, S.G.S, as an ideal concept of residential greenspace, has the capacity to act as an alternative to solve the food, energy and social crisis by building self-sufficient residential communities.

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References

Alicia, B.(2021),'A few ways we can green our buildings', ACB consulting services, webpage: https://www.acbconsultingservices.com/sustainable-construction-project-management/the-architecture-and-design-of-green-spaces-in-buildings/

Bastian, O., Haase, D., & Grunewald, K.(2012). Ecosystem-properties, potentials and services − The EPPS conceptual framework and an urban application example. Ecological Indicators, 21, 7-16. D

Moseley, D., Marzano, M., Chetcuti, J., & Watts, K. (2013). 'Green networks for people: Application of a functional approach to support the planning and management of greenspace', Landscape and Urban Planning, 116, 1-12

Carbo-Ramirez, P., & Zuria, I.(2011). The value of small urban greenspaces for birds in a Mexican city. Landscape and Urban Planning, 100(3), 213-222. doi: 10.1016/j.landurbplan.2010.12.00

Dinnie, E., Brown, K. M., & Morris, S. (2013). 'Community, cooperation and conflict: Negotiating the social well-being benefits of urban greenspace experiences. Landscape and Urban Planning, 112.

Elizelle, J. (2015). 'The importance of planning for Greenspaces', Science PG.

Ida, S. Chrissan, N.(2021), 'Urban Greenspaces: combining goals for sustainability and placemaking' Europe Now.

Lucy, T., Dieter, F.(2016), 'defining greenspace: multiple uses across multiple disciplines',Landscape and urban planning. 27, 29

Lucilla, B. Fransesko, C., The variety of urban Greenspaces and their diverse accessibility., Gran Sasso Science Institute, P -14

Prashanti, R. (2021), 'Role of Greenspaces for Maintaining Well-Being in Residential Community Development', P-2-3.