

The Contribution of Architectural Design Concepts for Sustainable Urban Farming: The Case of Addis Ababa, Ethiopia

Bruk Getahun^{*}, Essayas Deribe

Department of Architecture, Collages of Civil Engineering and Architecture, Addis Abeba Science and Technology University, Addis Abeba, Ethiopia

Email address:

bruk782.bg@gmail.com (B. Getahun), essayasder@hotmail.com (E. Deribe)

^{*}Corresponding author

To cite this article:

Bruk Getahun, Essayas Deribe. The Contribution of Architectural Design Concepts for Sustainable Urban Farming: The Case of Addis Ababa, Ethiopia. *Landscape Architecture and Regional Planning*. Vol. 7, No. 1, 2022, pp. 8-20. doi: 10.11648/j.larp.20220701.12

Received: January 26, 2022; **Accepted:** February 19, 2022; **Published:** February 25, 2022

Abstract: The city of Addis Ababa is in the rapid urbanization era which leaves the city with less farm land, less green cover, unemployment, increase in market price of food and increasing greenhouse effect. Since, Food supply and production are still from the rural parts. And urban farming is showing potentials to solve these problems. There are many practices and advancements that take the idea of urban farming beyond possibility and make it wholly sustainable in the city. This research on the contribution of architectural design concepts for sustainable urban farming in selected urban farms from Addis Ababa, Ethiopia, Has a main objective of assessing and evaluating urban farms on the selected criteria of sustainability, then identify the problem areas and prospects to forward architectural solutions. To achieve this goal six criterions were devised, all based on the three pillars of sustainability (ecological, social, and economical), with the help of reference materials covered in the literature review. The case study method was helpful to gather, analyze and evaluate input data. In this research it was evident that most of the urban farm in Addis Ababa didn't fully achieve the sustainability criteria. For an urban farm to be wholly sustainable a variety of systems must be in place. The systems must range from different growing methods, to a multifunctionality of systems involving and educating the public, and they must utilize different aspects of the site. It is also equally important that the systems are interdependent and work toward functioning as a larger system.

Keywords: Urban Farming, Wholly Sustainable, Economical Sustainability, Ecological Sustainability, Social Sustainability

1. Introduction

The research will focus on sustainable way of architectural and urban development concepts related to urban farming. Nowadays many data and evidences are showing that cities and capitals are multiplying their population and their ecological footprint on the course of rapid and unsustainable urbanization [4]. Constructions are booming everywhere; Cities are becoming apart from their food sources and the respective natural environment [2] which leave cities with less farm land, less green cover, increase in global warming, unemployment, increasing in market price of food [17]. Since, Food supply and production are still from the rural parts and adopting urban farming as a strategy to address the increasing urban unemployment, poverty, hunger and

nutritional requirement is becoming the primary targets for various cities in the developing world [13]. There are many practices and advancements that take the idea of urban farming beyond possibility and make it wholly sustainable.

In another perspective our development policies and strategies are not helping for the sustainable development of our cities, when it comes to cities like Addis Ababa the problem is getting worse in every construction step of the way. Farming is being excluded and diminished, but the urban architecture and its development can be improved to support the agriculture sector by introducing architectural concepts to the already existing concept of urban farming [5]. This is where architecture comes to integrate with urban farming technologies and make it dynamic with in the contexts of a city. This type of architecture responds to

social, economic, physical and environmental sustainability issues when building a farm in the context of the city.

2. Sustainable Urban Farming

Kahn writes that the paradigm of 'sustainable development' described in *Agenda 21*, in fact, rests on three conceptual pillars. These pillars are 'economic sustainability', 'social sustainability', and 'environmental sustainability'. The theoretical framework elaborated by Kahn posits that economic, social and environmental 'sustainability' must be 'integrated' and 'interlinked'. They must be coordinated in a comprehensive manner [1]. A sustainable urban agriculture integrates three main principles of sustainability [15].

1. Environmental health: Sustainable urban agriculture is supportive of environmental health in that it requires low input of water and low to no use of fertilizers and pesticides.
2. Economic profitability: Sustainable urban agriculture reduces transportation costs of shipping between local producers to local markets.
3. Social wellness: Sustainable urban agriculture provides opportunities for social interaction and individual recreational opportunities.

Multifunctional Sustainability of urban farms can be seen and evaluated as follows; which are dependent on the three pillars of sustainability as discussed in the above literatures. this pillar will be more of general criteria for evaluation. To be more specific another sub-criterion under those general ones is developed.

- A. Ecological (Interdependency effect and Low impact);
- B. Economical (Profitability and Energy efficiency);
- C. Social (Public good and educational platform),

3. Research Methodology

This research consists of both descriptive and explanatory research types. The goal of descriptive research is to describe a phenomenon and its characteristics. This research is more concerned with what rather than how or why something has happened. Therefore, observation and survey tools are often used to gather data [6]. Methodology for this research is summarized by discussing criterions to evaluate urban farming. This study could take both qualitative and quantitative elements to study. Qualitative approach allows it to explore different ideology, concepts and experiences in detail. And study deeply the real-life phenomena related to urban farming which will be supported with quantitative data. Methodology for this research is summarized by discussing criterions to evaluate urban farming what makes an urban farm sustainable, what are the criterions to evaluate an urban farm will be described.

The study was conducted in different areas of Addis Abeba, Ethiopia. The study uses a case study approach and descriptive-analytical-qualitative method to get deeper information about the problem. Urban farms with in the city

territories with different typologies are selected for the study. In general, seven (7) urban farms were selected for a case study based on purposive stratified sampling criteria, including; Ato Hailu Wudneh Private residential vertical farm, Ethiopian Standard Agency (ESA) Garden, Bulbula Kebena Atikilt Amrachoch Mahiber (Atlas Bole), The Mekanissa and Saris Vegetable Producers' Cooperative, Bole Sub City Bureau (Megenagna) Vertical Farm, Lebu Medhanalem River Side Atikilt Amrachoch Mahiber, Etege Memen secondary and preparatory school vertical farm. Those urban farms are samples that will represent other similar typologies in Addis Abeba.

Based on the availability of respondents around the urban during data collection, their willingness to participate in an interview, the richness of information gathered from them, the time and budget allocated to the research, (3) respondents (users) and (1) owner are taken for each urban farm case studies. The cases study urban farms are analyzed in different criterions in qualitative data forms and presented using images, tables, and maps. The data are analyzed using different previously mentioned six set of criterions. Direct observation, interview, and document review are the sources of data for the research. The study used different software such as MS Word, Adobe illustrator, and simple graphics then presented in maps, pictures, graphs, tables, and 3D images.

And Purposive Stratified Sampling was used to select different urban farm cases based on the following criteria:

- 1) The experience gained during the selection of the study area.
- 2) Being within the city boundary of Addis Ababa.
- 3) The availability of information on the case.
- 4) The purpose of the study.
- 5) For the need to reach the targeted issues and criteria.
- 6) The type of the urban farm (typologies).
- 7) Ownership types - Private, institutional and cooperative.
- 8) Orientation types - Vertical farm or horizontal farm (traditional),

4. Presentation and Analysis on Selected Cases

4.1. Ato Hailu Wudneh's Residence

Ato hailu wudneh is just motivated individual trying to incorporate urban farming to his family and to his life. His project # skyfarmh is not a community project. He tries to create a private educational platform to the neighbors around his g+3 residence in Tulu dimtu, Addis Ababa, Ethiopia by being a Pioneer practitioner of "sky farming" as he calls it.

Farm products and Food is not sold, it is only for house hold use. So the project is not involved with income generation yet. But he produces light vegetables like: Spinach, garlic, tomato, lettuce, cabbage, fosalia, Tena Adam, pepper, onions, tea-spices. The project's Water input is from the daily use of the house. And there is no issue regarding lighting because all the vegetable farm structures utilize natural light only. Since the farming structure are more

of free-standing elements not benefiting the structure and vice versa. The Free-standing plastic structures are in a re-use purpose here, so there is no waste coming instead it uses waste products as inputs. The overall farming is taking up a very small space making it a more efficient space usage.



Figure 1. Ato hailu wudneh residence, growing units, taken by the researcher.

4.2. Ethiopian Standard Agency (ESA) Garden

Ethiopian Standard Agency, as the national standards body of Ethiopia, has the responsibility of providing information service to industry, trade and the general public efficiently and effectively which is located in Bole Sub city, Woreda 6 (Ring-road side, next to AMCE). They have a well-functioning vertical farm which is designed from experiences gained through international visits from Singapore, the hub of a well cultivated culture and expertise in urban/vertical farming.



Figure 2. ESA vertical farming structure, pictures taken by the researcher.

The farm for the time being gives service only for the staffs in the compound. It employed 5 farmers and functions in a 300 square meters plot of land, the vertical farm structure has increased the area by almost three times. The farm is covered with a greenhouse plastic that gives the plants moisture, heat and protection against wind, rain and direct sun light. They used a drop irrigation technology for watering

of the vegetables which is installed by local engineering firm. The plants produced in here are mostly vegetables and some others which includes; light vegetables like: Spinach, garlic, tomato, lettuce, cabbage, fosolia, Tena Adam, pepper, onions, tea-spices and lavender. Even if the production is for sale, it is only for staffs and the generated money goes to social affairs of the institution for extracurricular socializing events.

4.3. Bulbula Kebena Vegetable Producers' Cooperative (Atlas Bole)

This cooperative is a riverside urban farm project in the heart of the city around atlas, bole. Its formation is basically on the existing Kebena and Bulbula rivers. Next to the farms there is a botanical garden (peacock park) which is a refreshing and calm place to visit in the chaotic Addis Ababa city.

These cooperatives are involved in intensive farming and are located on the banks of Kebena and Bulbula rivers, using natural waterfalls or intake canals, with production destined mainly for the local market and a small amount for household consumption.

The urban low-income households' decision to cultivate was led by the need to feed their families and the expectation of improved returns in the absence of better paying jobs.

Because UA is a labor-intensive activity, if it is given the necessary support, it can have significant employment-generating potential. For example, the combined household and cooperative strategy of the urban producers has created full-time employment for the heads of the households and their spouses, and part-time employment for the children and other members of the households. It has reduced unemployment within the family group and improved the overall levels of family income.



Figure 3. Bulbula Kebena vegetable producers farm along river, pictures taken by the researcher.

4.4. The Mekanissa and Saris Vegetable Producers' Cooperative

There are many cooperatives working around Akaki River and this Mekanissa and Saris Vegetable Producers' Cooperative bases in the meeting junction of Tinishu akaki and Akaki River in the upper parts of the river.

The formation of the Mekanissa, and Saris Vegetable Producers' Cooperative was inspired by the members themselves, that is, on their request and interest. It was not imposed on the members. The decision to form the cooperative was a strategy to strengthen the members' protection against any threat in their survival process.

Thus, the strategy to organize themselves into a producers' cooperative has created a situation where the urban farmers will not always be the most exploited sector or the most dependent on other people. Being members of the General Assembly, which made the final decision on such matters as annual production and distribution plans and programs, the members had equal rights and responsibilities in all the activities of the cooperative. Each member had the right to elect and be elected. Shares from the cooperative were distributed on an equal basis depending on the number of "points" the individual members had earned for tasks performed for the cooperative.

Regardless of its contribution to the low-income households, however, the cooperative has not been legalized, and lack of legal recognition has hindered the possibility of getting credit to improve the productivity of the farms. It is true that the cooperatives had temporary title deeds. Although they are obliged to pay urban land tax because of this deed, it does not give them the right to invest in permanent structures. It is clear that such a situation, together with the high urban land tax, does not encourage the producers to invest and thus improve their productivity [5].



Figure 4. Mekanissa and Saris Vegetable Producers, pictures taken by the researcher.

4.5. Bole Sub City Bureau (Around Megenagna) Vertical Farm

This urban farm project found within the compound of bole sub city bureau in Megenagna is another mentionable case. They produce vegetables for market which is happily consumed by the staff members in the huge building. For now, the site is used as a show case for urban farming techniques. The site has one indoor greenhouse vertical farm and another outdoor traditional horizontal farm.



Figure 5. Low-cost vertical farm, taken by the researcher.

The farmers in here are working in this site are as private farmers. And their intention is to make the area as a case

show (serto masaya) for sustainable way of producing vegetables and other food plants with in the city using low cost growing materials like recycled plastic bottles, bamboo, new plastic pots, timber and pvc pipes.



Figure 6. New growing pots and a fish, picture taken by the researcher.

4.6. Lebu Medhaniale River Side Vegetable Producers' Cooperative

This cooperative is also a riverside urban farm project in the south of the Addis Ababa city around Lebu and Jemo, its formation bases in the existing Akaki River. Next to the farms there are two parks namely the lafto park and bihere tsige public park which give the area a refreshment and rehabilitation spot. These cooperatives produce vegetables using natural waterfalls or intake canals, with production destined mainly for the local market and a small amount for household consumption.

These Urban farmers are in a good position to change their products according to the demand of the market. The fact that they sell fresher vegetables than those obtainable from other sources that must rely on more distant production areas is a further advantage in marketing their products. The cooperative has created unity and solidarity among the members and the aspiration to strengthen themselves, to solve their common problems. The cooperative has enabled the members to understand the importance and advantages of organizing themselves, and of discussing and solving their own problems. The knowledge and building of self-confidence that it has initiated will help them to become more independent.



Figure 7. Cattle's grazing area near river side farms, Lebu, picture taken by the researcher.

4.7. Etege Mennen Secondary and Preparatory School Vertical Farm

Etege Mennen School is a female's boarding school around 6 kilo University with a capacity of more than 500

students. The campus has office building, class rooms, cafeteria, kitchen, dormitories, sport fields and two vertical farming greenhouses one containing water tanks for growing fishes coordinated with vertical farm. The system is well fed and connected with the water storage and delivery systems and irrigation systems. The vertical farm structure is mainly made up of RHS metallic elements on top of that there are half section Pvc pipes to hold soil and grow vegetables. Every vertical farm consists of four layers

of bed, and every layer has three stripes of the half pvc growing medium. Another unique technique noticed in here is the fish tanks made out of pvc water tankers usually named as “Rotto”. One water tanker is made in to two half sections of half open fishing tanks. there are four of these fishing tanks that holds up to 20,000 liters of water altogether. Fishing integrated with the vertical farm elevates the systems functional interdependency to a new and better level.



Figure 8. RHS vertical farms in Mennen school, picture taken by the researcher.

5. Result, Discussion and Summery

5.1. Theoretical Review of Urban Farming

Urban farming refers to growing food in the city to generate revenue. This involves farmers finding space in the city – back yards, vacant lots, parking lots, rooftops, parks, private or public spaces to grow food for wholesale and retail sales to urban consumers. This revenue-generating aspect of urban farming creates a whole new set of challenges and opportunities for the farmers themselves and for local governments [10].

The concept of small-scale urban agriculture and urban farming occupy a significant position in the current discourse of architecture and urban design. The concept refers to a complex mix of pragmatic practices and discursive formations, which aims at an explicit visualization of agricultural activities within the existing urban fabric, eradicates socio-economic marginalization, and creates an ethical growth of built environment [8].

Community members must be included in the design, whether that is through interactive program elements or classes offered, which is important if urban farms are going to be widely accepted and incorporated into the urban fabric. If people are not vested in a place or company, it often fails or lies dormant. Architects strive to incorporate people and their desires into design [3].

When it comes to urban farming in Addis Ababa the reason for cultivation is not clearly indicated in the study, but about 90% of those who were not cultivating stated their reason as lack of access to land [5].

Most urban farmers in Addis Ababa and the small towns in

close proximity are low-income earners who use urban farming mainly for survival and achieve a combination of nutritional and socioeconomic benefits. Hence, adopting urban farming as a strategy to address the increasing urban unemployment, poverty, hunger and nutritional requirement is becoming the primary targets for various cities in the developing world [12].

The most recent development in urban farming is that of vertical farming which nowadays have lots of technologies and prospects to work with and it come with lots of various typologies which include: external systems-both vertical and horizontal (a green wall and a green roof), indoor systems using multiple growing methods (an aquaponic farm), indoor systems using one growing method (an aeroponics farm), tray growing systems, and rotating “farms” [13].

Urban farming plays a bridging role between the city and rural world, with asymmetric situation in economic and political power which is in a concentration process in urban communities [7]. The process of integrating urban agriculture into planning and land use practices remains uneven; practitioners would benefit from the review of current regulatory trends and best practices undertaken [11]. Forchino et al., (2018) concluded from their lifecycle study that high demand for energy and water are key obstacles for achieving economic and environmental sustainability in urban farming projects [16]. Moreover, urban farming requires bringing together social, cultural and ecological knowledge and expertise [9].

Urban farming is becoming an alternative and/or permanent feature of cities/towns in the developing world enabling the urban resident access to cheaper and fresh food [14].

Table 1. *Criterial evaluation of all cases, table by the researcher.*

No	Type	Public good	Educ. Platform	Interdepend. Index	Low Impact	Profitability	Energy Efficiency
1	Ato Hailu Wudneh	- inspiring the community	-pioneer introductive	- Not benefiting the structure, but the structure supports the growing apparatuses	- Small space -Space efficient - Containers are low impact Re used. - Uses Natural light, soil, and water	- Food is not sold, house hold use. -Smaller production	- Natural inputs - Outdoor natural light-source. -Multiplied growing space.
2	Ethiopian Standard Agency (ESA)	- Created Job opportunity -only permitted visitors	- Is trying to create university industry linkage.	-No integral Systems+ - The structures are not multi purposeful. - Free standing	- No Neighborhood integration+ does not use an existing building	- Products will be sold for staffs - relatively average size production	- Natural inputs+ -Multiplied growing land area. (Vertical farm)
3	Bulbula Kebena Atikilt Amrachoch Mahiber (Atlas Bole)	- Created Job opportunity for many households. - Fresh vegetable supply (healthy)	- No Classes and workshops provided - Welcomes visitors.	-No integral Systems+ -No interaction with the existing botanical garden -Dependent on the existing river and natural environment	-Natural light+ -Use an existing site -The farm has revived the area -Increased chance of erosion	- Products will be sold for the city community -Mass production	-Natural inputs+ -Does not Multiplied growing land area. -Traditional labor-intensive production. -Not Space efficient
4	The Mekanissa and Saris Vegetable Producers' Cooperative	-Created Job opportunity for many households. -Fresh vegetable supply (healthy)	-No Classes and workshops provided	-No integral Systems+ -No Neighborhood integration -Dependent on the existing river and natural environment	-Natural light+ beneficial for environment. -Use an existing site -The farm has revived the area -Natural light+ beneficial for environment. -Use an existing site - Used bamboo for construction of vertical farm Space efficient	-Products will be sold for the city community -Mass production	-Natural inputs+ -Does not Multiplied growing land area. -Traditional labor-intensive production. -Not Space efficient
5	Bole Sub City Bureau Vertical Farm (Megenagna)	-Created Job opportunity for some individuals. - Fresh vegetable supply (healthy)	-Visits and workshops provided	-Tried to integrate fishing Systems -No interaction with the existing office buildings And Neighbourhood	-Use an existing site - Used bamboo for construction of vertical farm Space efficient	-Smaller production	-Natural inputs+. - Multiplied growing land area. -labour-intensive production. -Bamboo growing structures -Vertical farm
6	Lebu Medhanialem River Side Atikilt Amrachoch Mahiber.	-Created Job opportunity for many households. -Fresh vegetable supply (healthy)	-No Classes and workshops provided	-No integral Systems+ -No Neighborhood integration -Dependent on the existing river and natural environment	-Natural light+ beneficial for environment. -Use an existing site -The farm has revived the area - Uses Natural light, soil, and water - No Neighbourhood integration+ does not use an existing building	-Products will be sold for the city community -Mass production	-Natural inputs+ - Does not Multiplied growing land area. - Traditional labour-intensive production. -Not Space efficient
7	Etege Mennen secondary and preparatory school vertical farm	- Created Job opportunity for few - only permitted visitors	- classes and tours for the students.	-fishing thank integral Systems+ vertical farm - The structures are not multi purposeful. - Free standing		- Products will be sold for staffs - relatively average size production	- Natural inputs+ - Multiplied growing land area. (Vertical farm)

5.2. Result and Discussion

Seen on the above table, displays the nine different cases with the six Criteria Evaluation points. And it is evident where most of the Addis Ababa urban farm systems are not fully achieving most of the criteria. The diagrams bellow also show this more clearly. In the above table there are seven urban farm cases that are in Addis Ababa and one successful case from America, the Brooklyn Grange being evaluated and one architectural project, Hope University College which is not an urban farm at all but have the promises and trials how to incorporate the public spaces with the natural environment, and make the community realize and learn

ways to be sustainable.

5.2.1. Ato Hailu Wudneh

Ato hailu farm is basically on the existing building structure which makes use of the existing site with little to no impact on it. the building is a living space again it supports the farm as an additional system in it. Even if the number of systems working together is small, it shows little interdependency of systems. The trials and displays by themselves are tools to educate the community around him. Plus, to this now he is trying to speak out about the subject matter in social medias like that of Tv shows social medias including YouTube.

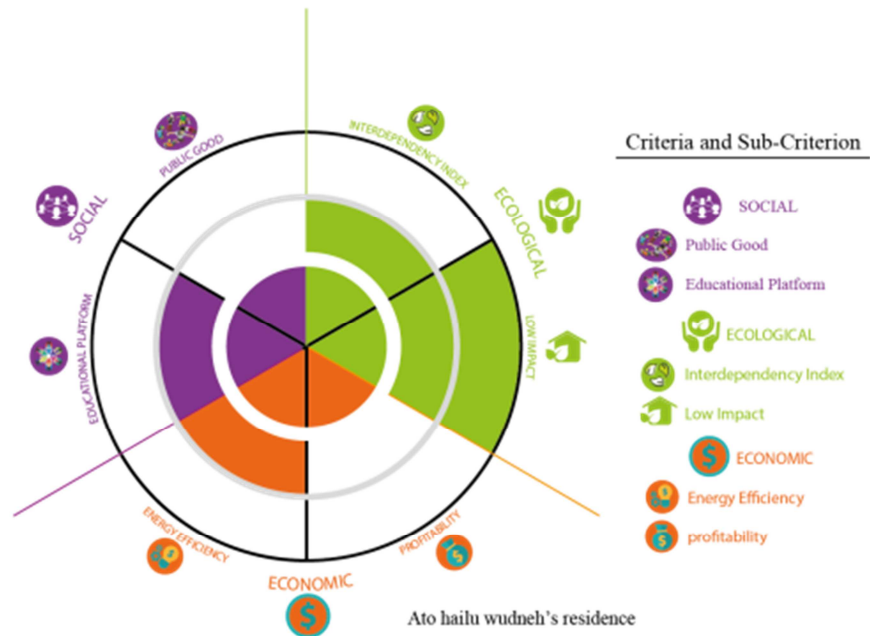


Figure 9. Evaluation Criteria for Ato Hailu Wudneh's residential farm, drawn by the author.

5.2.2. Ethiopian Standard Agency (ESA)

Compared to all the other selected cases the Ethiopian standard agency vertical farm has achieved better results by being space efficient with its strata of vertical growing structures conservative use of water with controlled drop irrigation. But the farm is poor when it comes to having variety of systems working together being interactive with community. In other

cases, like creating interaction with foreign and local educational institutes to learn and teach about urban farming is admirable. The institution has arranged a visit to Singapore to learn about urban farming and how to construct one. Now lots of institutions like that of the university of Addis Ababa science and technology has requested a study and cooperation chance with ESA to work and develop one for themselves.

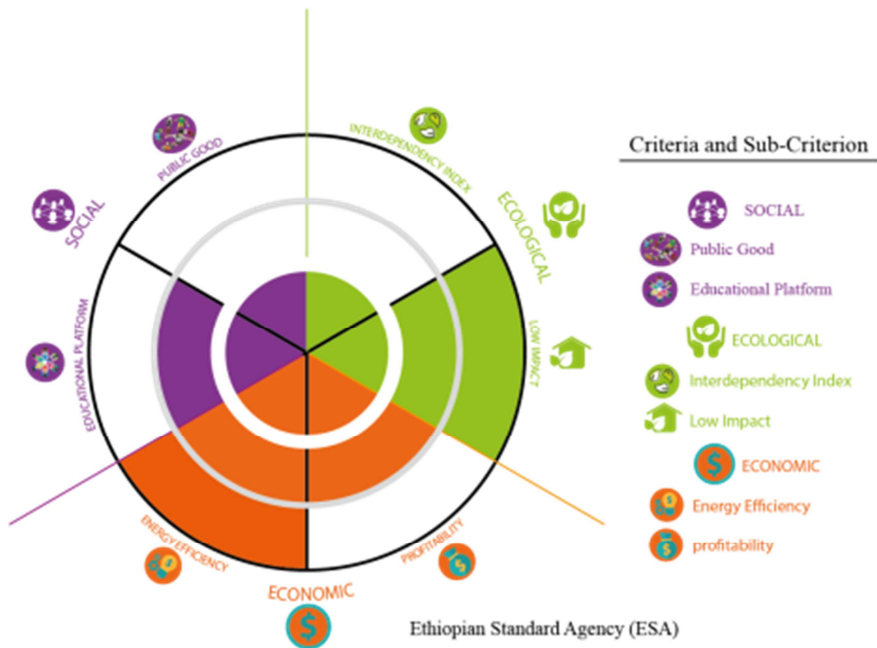


Figure 10. Evaluation Chart for Ethiopian Standard Agency (ESA), drawn by the author.

5.2.3. Bulbula Kebena Atikilt Amrachoch Mahiber

The Bulbula and Kebena vegetable producer's cooperative is mentionable for the average rehabilitation of

the dumpster site that was along the rivers of Bulbula and Kebena, now the site is more attractive, healthy and productive. And the farm has created a job opportunity to every individual working in this farm were jobless and now

they are able to raise money to better their and their family's life in the city. In the other perspective the farms are not accessible by the community and no farmers market

to let them sell their products to the community. Because of this their ability of being an educational platform for the wide public has been bottled-up.

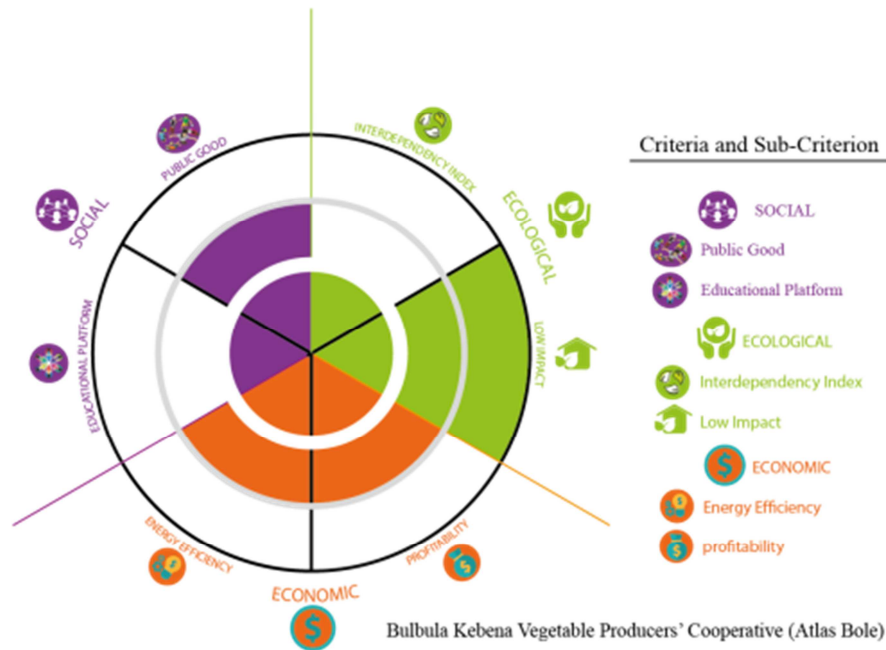


Figure 11. Evaluation Chart for Bulbula Kebena Vegetable producer's cooperative, drawn by the author.

5.2.4. The Mekanissa and Saris Vegetable Producers' Cooperative

The Mekanissa and saris vegetable producer's cooperative like the other river side projects is also mentionable for the average rehabilitation of the dumpster site that was along the Akaki River, now the site is more attractive, healthy and productive. But not safe to be relied on because of the strong and destructive flooding issues during the rainy seasons which wipes

out the whole vegetable area and leaves the farmers fruitless. The farm has created a job opportunity to every individual working in this farm were jobless and now they are able to raise money to better their and their family's life in the city. In the other perspective the farms are not accessible by the community and no farmers market to let them sell their products to the community. Because of this their ability of being an educational platform for the wide public has been bottled-up.

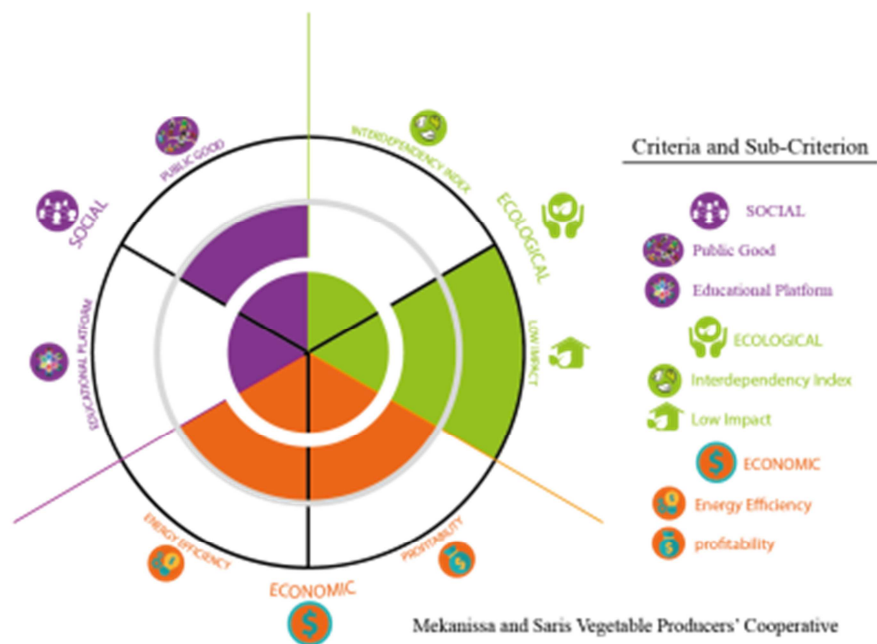


Figure 12. Evaluation Chart for Mekanissa and Saris Vegetable producer's cooperative, drawn by the author.

5.2.5. Bole Sub City Bureau (Megenagna) Vertical Farm

This farm being constructed for an experimental show case has tried to grow fishes' side by side with vertical vegetable farm which increased the number of systems to two compared to other farms its showed better

interdependency index. Plus being accessible for the public it to learn about farming adds to the intentional educational platform created. The vertical farm being constructed from available low-cost materials makes it more energy efficient.

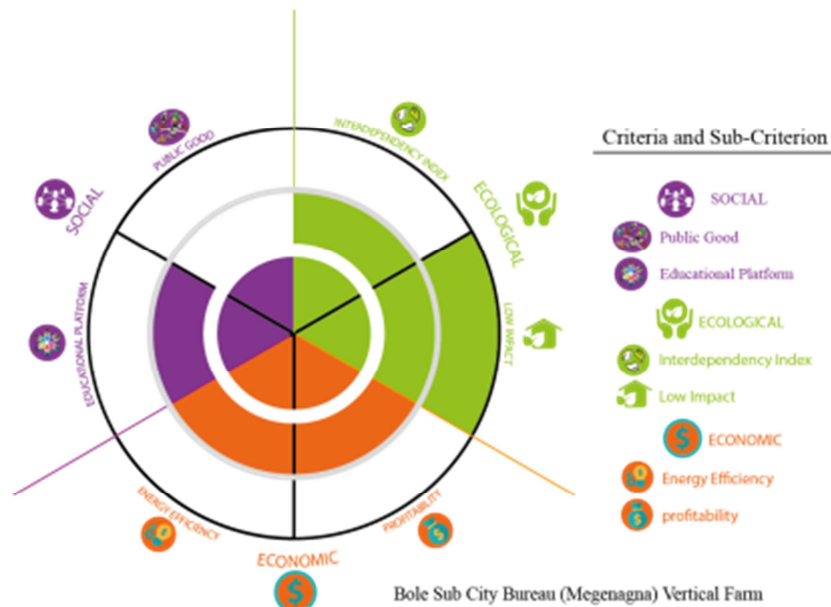


Figure 13. Evaluation Chart for Bole Sub city Bureau (Megenagna), drawn by the author.

5.2.6. Lebu Medhanialem River Side Vegetable Producers' Cooperative

The production process is traditional and is mainly based on the accumulated experience of the members like the other

cooperative farms. Thus, yield per hectare from the communal farms is very low. But still it has created job opportunities for many households, and has revived the site in an exciting way making it healthier and more productive.

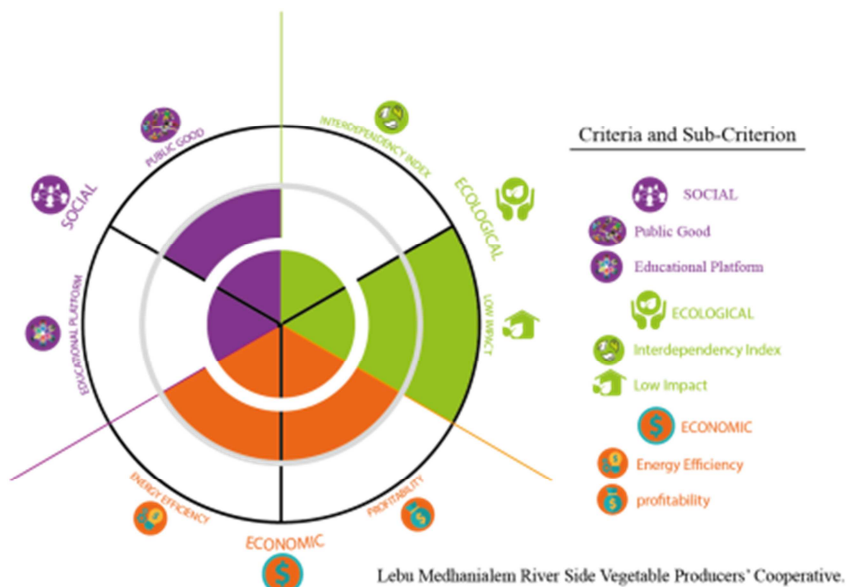


Figure 14. Evaluation Chart for Lebu Medhanialem Vegetable producer's cooperative, drawn by the author.

5.2.7. Etege Memen Secondary and Preparatory School Vertical Farm

This project shows more promises and trials of a

successful urban farm that it touches most of the criteria's compared to the other six urban farms in Addis Ababa. The integration of vertical farm with another related

system of fishing elevated the interdependency index and the existence of systems that work interactively. It has created opportunities to study, learn and observe such systems in the school. Plus, it is mentionable and

recommendable figure in the vertical farming realm. But still as the other urban farms this project also fall short to incorporate the community in the social and public good categories.

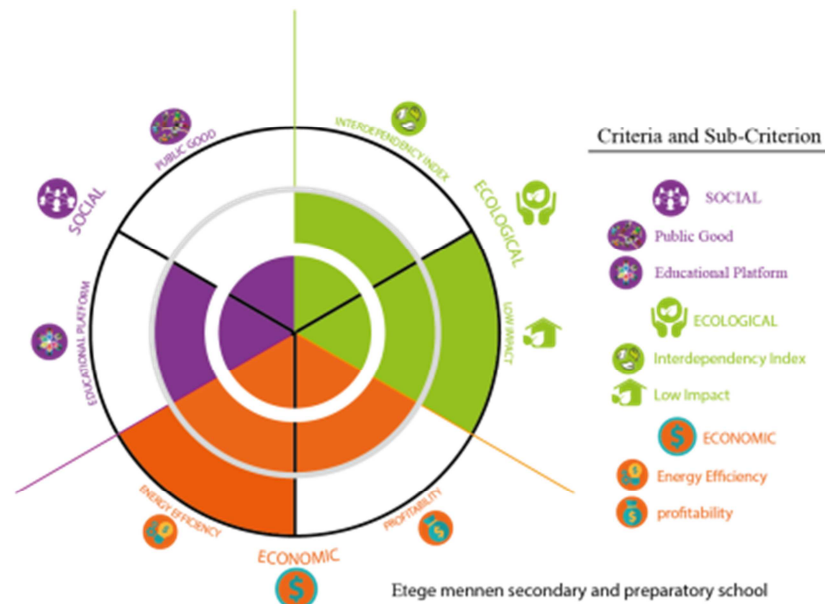


Figure 15. Evaluation criteria for Etege Mennen secondary and preparatory school vertical farm, drawn by the author.

5.3. Summary

Currently there are urban farms that function at a different level: they occupy one space and produce food for the local area but are not interacting with the community past the point of sales. Many existing urban farms that are focused solely on food production do not offer tours and while some have volunteer participation it is only for harvesting activities. The early urban farms, in urban settings, were established in areas of cities that were there is river and vacant river side lands. This trend happened because this riverside areas in the city are not preferable for construction, the lack of an active community, and proximity to city centers (areas to sell food) [5]. Farms started to take the surrounding community more into consideration; certain vertical farms started to expand by producing a variety of crops on site and opening the farm for educational purposes. Some of the site-specific vertical farms have begun to focus on a neighborhood approach where they offer tours and certain educational classes, farmers' markets, and on-site lunches and dinners.

Farms began to consider the surrounding community more; some vertical farms began to expand by growing a range of crops on site and offering the farm to the public for educational purposes. Some of the site-specific farming systems have started to take a neighborhood approach, offering tours and educational workshops, farmers' markets, and on-site lunches and dinners. The next phase in urban farming should be to serve the entire community rather than just the top crust. Programs should be designed to appeal to a wide range of demographics and social groupings. Architects may help with program design for a vertical farm, which can

contain various producing sections as well as various locations and aspects to accommodate a diverse spectrum of community members.

6. Finding, Conclusion and Recommendation

6.1. Finding

According to the findings of the study, most urban farms in Addis Ababa failed to meet the whole sustainability criterion, as evidenced by the outcomes of the selected urban farms in Addis Ababa.

1. The social aspect of sustainability is frequently overlooked. The majority of the farms are not designed to provide educational platforms or other community-based public services. Many individuals are unaware that they exist. The institutional farmers were demotivated by their inability to be recognized and discovered. As a result, the farms are isolated from the rest of the neighborhood.
2. Even though it was clear that the farmers benefited financially from the farms. Profitability and energy efficiency are not properly tracked and quantified in terms of economic relevance. And the revenues aren't enough to cover the farmers' basic needs on all of the cooperative farms. Institutional farms, on the other hand, are less lucrative since their output is too little and the revenue is not utilized to maintain and improve the quality of the farms in order to produce better and larger quantities.

3. It is undeniable that these green urban farms have a great influence on the natural environment, from revitalizing neglected areas to enhancing the city's green beauty. As a result, most cooperative farmers have done an excellent job of restoring and using the natural environment along the river's edge that has been ignored and discarded. Multiple systems in the farm establish an interdependent relationship that feeds one another while also assisting the natural environment and surrounding ecology in becoming healthier and more rejuvenating.
4. In Ethiopia, there is currently no declared policy on urban farming. Farming in the city has a lot of promise if the right financial and legal inputs are available. The Addis Ababa urban farm authorities have stated that there are positive possibilities for developing policies, and they have been working on it for several years. And they assured those positive policies will be implemented soon.
5. Extension staffs can help create modern agricultural production practices and awareness with the help of specialists from the Ministry of Agriculture, the city's urban farm bureau, or other related institutions.
6. It's critical to pay attention to a little-discussed but potentially substantial area of concern for urban farming growth, planning, and management.
7. It was also clear that such farms had no intention of involving the community or other technology improvements that might assist them in being more profitable than ever. Since it became clear that there are several strategies and technologies that may simplify the agricultural system by enhance productivity, conserve space, utilize natural inputs, recycle resources, raise profitability, and produce with less waste.
8. It was also clear that trained and experienced employees, consultants, and investors needed to be involved in the urban agricultural industry's improvement.

6.2. Conclusion

While farming in the city has showed evolutionary achievements in the past decades and so does the urbanization, it is necessary for this urban farm to advance themselves with the upcoming technology and policy restrictions, increasing land and property values. so, a futuristic approach and advancement is expected. Farming in the city will come with greater and sophisticated challenges. The majority of selected urban farms in Addis Ababa Ethiopia are functioning in a preservative way instead of integrating the system into the surrounding community. a successful and regenerative urban farm will not exist unless there is community buy-in which means, the community must have a connection to the farm. The urban farms in Addis Ababa had been launched with a productive mentality intent and are still there. While some other countries are trying to be advanced and moved on beyond production and widen their focus to new systems and the community in mind. As a result, our farms must consider establishing and

maintaining community participation, pre-planned spatial design, and energy-efficient technologies that all function together and benefit one another while also including a pleasing aesthetic. Along with increasing the productivity of urban farming, the people must be encouraged to modify their food patterns. Vegetable intake in Ethiopian families is low, not due of scarcity or expense. As a result, in addition to producing nutritious food, offering educational venues to promote awareness is critical.

Urban farming has the potential to influence economic, environmental, social, and health benefits for future cities by boosting local economies, lowering pollution levels, repurposing blighted areas, improving food security through more equitable distribution, and providing educational opportunities and new jobs. Urban farming is one option for reusing abandoned structures or land in Addis Ababa's city, which has numerous derelict zones that need to develop or adapt. Consider driving by those decommissioned strip malls that are now home to hydroponic indoor farms and lovely green vegetables on the roofs. The problem is a lack of government or municipal support, as well as the need to reform zoning limitations to allow urban farming as a viable solution for rebuilding the city's failing sections. Provoking change in these impoverished areas would give them hope for the future and give them pride in their civic life.

However, owing to a lack of experience, policies, technology, and technical involvements, farming in the city may become difficult in the future unless experts begin to participate to help urban farming grow beyond the stagnant stage it has been in for a long time in Addis Ababa, Ethiopia. From the city to the simplest structural levels, a strong push is needed to advance and include urban farming in city development plans. Architects, landscape designers, and urban planners are crucial players in this process, and they should educate themselves, government officials, policymakers, contractors, investors, urban farmers, and the general public about wholly sustainable urban farm.

6.3. Recommendation

6.3.1. General

This study demonstrates how an urban farm may be productive while also serving as a platform for public education and improving the neighboring city neighborhood. The flower, vegetable, fruit, and other greenery plots, as well as composting, may offer a range of seasonal possibilities. The soil may also be designed and altered to be ideal for a variety of crops. The examination of the eight typological case studies and one related example revealed that a range of systems are required for an urban farm to be environmentally, socially, and economically viable. The systems must include a variety of growth techniques as well as multifunctional systems that include and educate the public, and they must make use of various characteristics of the location (for example, using the indoor and outdoor space). A diversity of systems is necessary, but they must also be interconnected and work together to form a bigger system.

6.3.2. *The Role of Architects*

Indoor activities must complement outside activities, which can be accomplished through systems flowing into one another or by functioning as a companion area. Workshops, culinary courses, private and public parties, and an alternate area for people to sit in and out are all examples of community activities and events that require multifunctional spaces bringing the production and farming regions closer to the life of the community. The stacked produce saves space and allows for easy monitoring and climatic adjustment of the growing system. In order to get rid of pests, it is crucial to use as little soil as possible. Artificial light is kept to a minimum thanks to the revolving mechanism. The aquaponic system has two purposes: produce may be produced all year in a low-energy system, and the goods (crop and fish) can be marketed. Integrating a bee farm with a flower farm can assist pollinate the flower garden and rain garden plants, as well as create honey that may be sold to local businesses or on site (at a farmers' market). Outdoor areas augment interior systems by providing additional alternatives for production and events. Due to weather constraints, the outside areas would not be viable on their own. (Green roofs are not always accessible.)

It was critical to concentrate on picking systems that worked well together and could be implemented in the existing area. To manage the urban farm and meet the six sustainability criteria, a combination of indoor and outdoor spaces is required. Community Buy-in not only leads to profit, but it also creates a space that people want to visit and are invested in its success. Some aspects of the urban farm, such as outdoor garden elements or interior space, must be adaptable in order for the systems to remain mutually beneficial, whilst others, such as aquaponics or the digester, must be more permanent in order to focus on year-round output.

Whether it's a farmers' market, a food truck expo, seminars on bee farming and pollination, or composting workshops, the outdoor and indoor event spaces provide opportunities for a range of community events. The various systems provide a platform for teaching the local community about various food production techniques and how to use the various products (fish, produce, flowers, honey, etc.). If the program elements aren't built to feed off of one another, the system won't operate as well. The elements should be chosen based on what they will contribute and what they require, and positioned on the site in accordance with their surroundings. A good example is that vegetable gardens, composting and beekeeping all need to be close to each other so that they can work together to produce.)

6.3.3. *The Role of Agricultural Experts*

This is critical for the proper functioning of the systems in the urban farm from start to finish, including the veggies and production life cycle management, in order to achieve greater health and higher yield. They should also keep up with current developments and innovations in the field of urban farming. One strategy to teach the community about urban agriculture is to give sensible, economical, space and

material efficient home-made techniques for the entire community, encouraging everyone to participate even if it is a small amount to a better future.

6.3.4. *The Role of Local Authorities and Policy Makers*

The city's total land usage in the future should include room for food production. The cost of transportation and gasoline should be factored into the viability of this production. The product would be more expensive the further the producing region was from the place of sale. Based on an evaluation of the population's needs, allocating land to compatible uses-with urban farms is essential. A shift in mindset is required, as well as a readiness to comprehend the worth of land in connection to human needs. The riverbanks, which are typically utilized as dumps, places that are unsuitable for building or would be too expensive, and other outskirts of the city might also be used for urban farming. But currently farming in the city is possible through variety of techniques and technologies making it available and easy for the wide community to try and use it in their home within the available surrounding spaces. so governmental organizations like the Addis Ababa urban farm authorities should introduce and educate the community about the easy and simple ways to grow food within the existing provisions.

6.3.5. *The Role of Owners*

Owners are the business's investors, as they are the ones that fund the enterprise and collect the earnings. These proprietors might be self-motivated individuals who are interested in urban farming or connected government agencies. They should, however, learn more about urban farming and the methods and technology that go along with it. It is critical to focus on the demand and needs of the city community, as well as the available environmental resources, in order to earn a good living from urban farms. It's also critical that they collaborate with specialists from diverse fields and heed their advice and suggestions.

Finally, we now require a fully sustainable urban farm that considers and meets the following six criteria, as well as aims beyond.

Declaration of Conflicting Interests

All the authors do not have any possible conflicts of interest.

Acknowledgements

The author would like to thank the editors, anonymous reviewers and the advisor for their helpful comments on this paper. This research was supported in part by Addis Abeba Science and Technology University.

References

- [1] Basiago, A. D., 1999. Economic, social, and environmental sustainability in development theory and urban planning practice. The Kluwer Academic Publishers, pp. 145-161.

- [2] Berhanu Keno Terfa, N. C. D. L. X. Z. a. D. N., 2019. Urban Expansion in Ethiopia from 1987 to 2017: Characteristics, Spatial Patterns, and Driving Forces. MDPI, Sustainability, Issue 25 April 2019, p. 21.
- [3] Buddenborg, J. L., 2006. Historic, Changing Mindsets: Sustainable Design in, 2006 August: Cornell University.
- [4] Bundervoet, T., 2018. Internal Migration in Ethiopia: Evidence from a Quantitative and Qualitative Research Study. © World Bank, p. 47.
- [5] G. Egziabber, A., 1994. Ethiopia: urban farming, cooperatives, and the urban poor in Addis Ababa. IDRC, p. 165.
- [6] Gall, M. D. & B. W. & G. J., 2003. Educational Research: An Introduction. 7th ed. Boston, new York: ReaserchGate.
- [7] Julián Briz, M. K. I. d. F., 2019. Smart Urban Environment. In: M. K. I. d. F. Julián Briz, ed. Multifunctional Urban Green Infrastructure. s.l.: Depósito Legal: pp. 23-36.
- [8] Karim, F., October 2018. Urban Agriculture, Ecotopia and Architecture's Social Engagement. ResearchGate, p. 16.
- [9] Lovell, S., 2014. Designing a sustainable urban agriculture. Missouri: Research Gate.
- [10] Lunarc-golder, H., 2013. The Urban Farming Guidebook. Vancouver: Reaserch Gate.
- [11] Mahbubur Meenar, A. M. & L. B., 2017. Regulatory Practices of Urban Agriculture: A Connection to Planning and Policy. Journal of the American Planning Association, pp. 1-16.
- [12] Mekuria Delelegn, & M. M., 2018. The Status of Urban Agriculture in and Around Addis Ababa, Ethiopia. Journal of Sustainable Development in Africa, Volume 20, No. 2, (ISSN: 1520-5509), p. 20.
- [13] Mohamad Hanif, M. S. N. M. H. a. M. R. S., 2021. State of the Art of Urban Smart Vertical Farming Automation System: Advanced Topologies, Issues and Recommendations. MDPI, pp. 1-40.
- [14] Mulugeta, M., 2013. The Need for Policy Framework for Urban/Peri-Urban Agriculture in Ethiopia: A Reflection. vol. 9 (2013-07-01), p. 31.
- [15] Sarada Krishnan, D. N. G. S. a. V. K., 2016. Organic farming for sustainable architecture. In: D. Nandwani, ed. Sustainable Development and Biodiversity 9. s.l. Springer International Publishing Switzerland , pp. 325-341.
- [16] Wood, J., 2020. Vertical Farming: An Assessment of Singapore City. eTropic: electronic journal of studies in the tropics, pp. 229-248.
- [17] World Bank, g., 2015. Addis Ababa, Ethiopia-Enhancing Urban Resilience. global practice in social, urban, rural and resilience, July, p. 46.