

A Modular Landscape Model for Low Cost Settlement. Case study: Sylhet, Bangladesh.

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Abstract

This study aims to innovate an affordable landscape design model for under privileged urbanized areas of a growing cities. The lower income population from rural areas, frequently migrate to the urban areas for short or long-term basis to ease their poverty. This internal migration takes place for several reasons caused by manmade and natural disaster and dream of better life expectancies. These migrant people may get work and money in a certain number per single family, but it keeps them neglected in terms of living environment. This poor living condition in urban slums are threat to the migrant urban poor dwellers, the civic dwellers and the environment. All these harmful impacts can be resolved with providing a standard and healthy living atmosphere at their settlement through considering an eco-responsive landscape design. This study tries to propose a low cost, self-sustaining and affordable landscape module for these low-cost settlement dwellers following the mixed method. The data has been collected through physical survey, field observation, documentary reviews in Sylhet city, and case studies. This study has proposed a modular and multi scaled landscape model named as nucleus module, group module, cluster module, communal module and settlement module which will apply to urban slums and low-cost settlements in various cities of Bangladesh. A set of recommendations has been proposed at the end to implement the landscape models, which could be implemented to other contexts as well.

Keywords: Modular landscape, urban poor, affordable housing, Low cost settlement, landscape model.

1. Introduction

'Modular landscape model' refers to a system development method that contains the use of interchangeable landscape elements. It can ensure a low cost, self-sustaining and affordable settlement to enhance the living quality of migrating urban poor (MUP) dwellers. In Bangladesh, poor rural people move to urban areas in search of livelihood opportunities. But after coming in urban areas, at first, they face difficulties with their living accommodation. Lack of shelter, high cost of land and high rent of accommodation become the major obstacle to live there. Neither public, nor private sectors arrange a quality settlement for lower income people of the society. From limited private entrepreneurs, they are being arranged to stay in low-quality places where the basic human rights could not meet, and an informal (slum type) settlement occurs [1]. As the poor family members have no scope of work and recreation, so often they pass their leisure times with nonproductive activities, even engaged themselves with various

criminal activities and it disrupts social environment, similar for the women as well. An unrest condition occurs in terms of social, political, economic, environmental and even individual for both poor and rich dwellers in the society. In these circumstances, there should have some considerations to ensure standard living accommodation to enhance the life pattern of internal migrant urban poor (IMUP) and a better environment for all neighbors with the limited resources. The purpose of this study is to design a modular landscape model which meets the basic needs to ensure a low cost, self-sustaining, and affordable and income generating landscape model focused on the outdoor places. As the low cost settlement (LCS) of IMUP are an integrated part of urban areas, the Government should take initiatives by providing incentives for developing a breathing landscape both for the dwellers and the city people. The administrations, the entrepreneurs and the local leaders should work together. Mass training and awareness should be grown up in mass levels. An approach of the Nucleus Module of landscape to a

Settlement will make easier to reach to the target for LCS landscape development even over the country. This modular landscape model will help other areas both regionally and nationally to overcome the LCS landscape crises of IMUP and the civil neighbors as well. This modular landscape model may help other countries to overcome the living accommodation scarcity for poor urban migrants and the civil neighbors as well.

1.1 Background of research

Sylhet, a metropolitan city, is located at 24.8917°N 91.8833°E, in the north-eastern region of Bangladesh (Fig 1) [2]. It is the administrative seat of Sylhet Division. The city is on the right bank of the Surma River in northeastern Bengal. It has a subtropical climate and lush highland terrain, and nearly the annual average rainfall is 4,200 millimeters here between May and September [3]. The city has a population of more than half a million. It is an important city in Bangladesh for its spiritual and cultural values. It is one of the most important cities of Bangladesh, after Dhaka and Chattogram because of its importances to the country's economy. It produces the highest amount of tea and gas in the country. Sylhet region has a strong historical platform of values and norms from the very beginning of its orientation in terms of social, economic, political, commercial, religious, environmental, and infrastructural aspects [4].

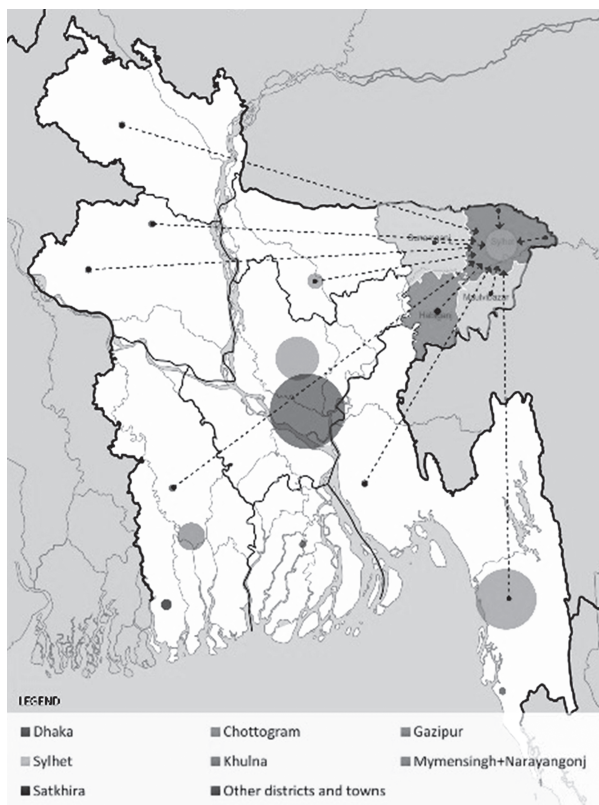


Figure 1 Internal migration flow in Sylhet city and also intensity in different cities in Bangladesh.

Sylhet is the 3rd most attractive city for internal migration just next to Dhaka (Capital city) and Chattogram (port city) in Bangladesh. Poverty, natural calamities e.g. flood, drought, soil erosion, river erosion etc. and socio-cultural factors e.g. marriage, family conflicts, social discrimination, social problems, political chaos, dominating by the village elders are the push factors, and better employment, better life living, better education, previous migrant relatives etc. are the pull factors behind the internal migration in Sylhet. The chart (Fig 2) represents the internal migration ratio in different cities in Bangladesh. The capital city Dhaka and the port city Chattogram are hosting 59.2% and 20.1% respectively. Though Gazipur is hosting 2.9%, it is going to be a part of Dhaka zone. Next, Sylhet is an attractive place for internal migrants which is hosting for 1.9% and it is increasing day by day. Then, Khulna, Mymensingh and Narayangonj, Satkhira are hosting 1%, 0.6% and 0.4% respectively. The rest 13.2% is hosting by other districts and towns in Bangladesh [5]; [6].

Here (Fig 3), the internal migrants are taken place by 72% and 28% of push and pull factors in Sylhet where poverty, unemployment, natural calamities, and better opportunities, high wages, preferences of relatives are 42%, 23%, 7%, by push and 17%, 10%, 1% by pull factors [5]. In addition, Socio-cultural (marriage, family

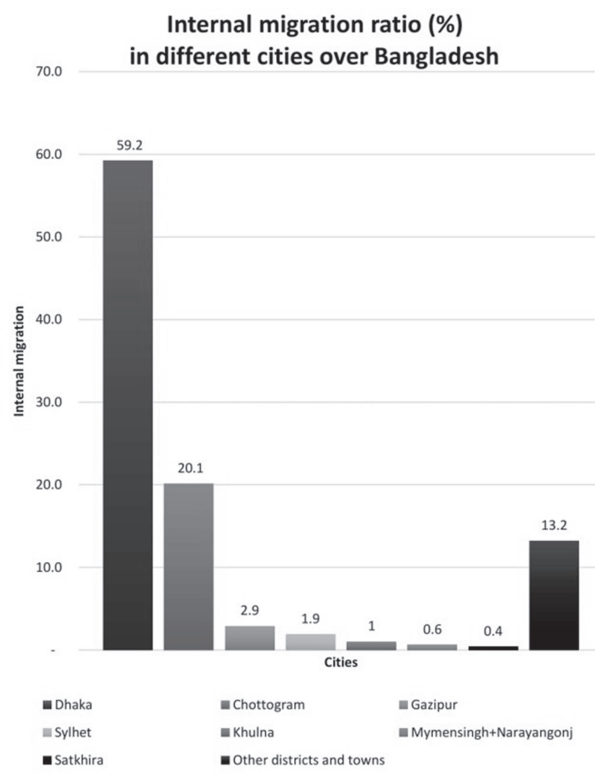


Figure 2 Internal migration ratio (%) in different cities, Bangladesh (edited by Author)

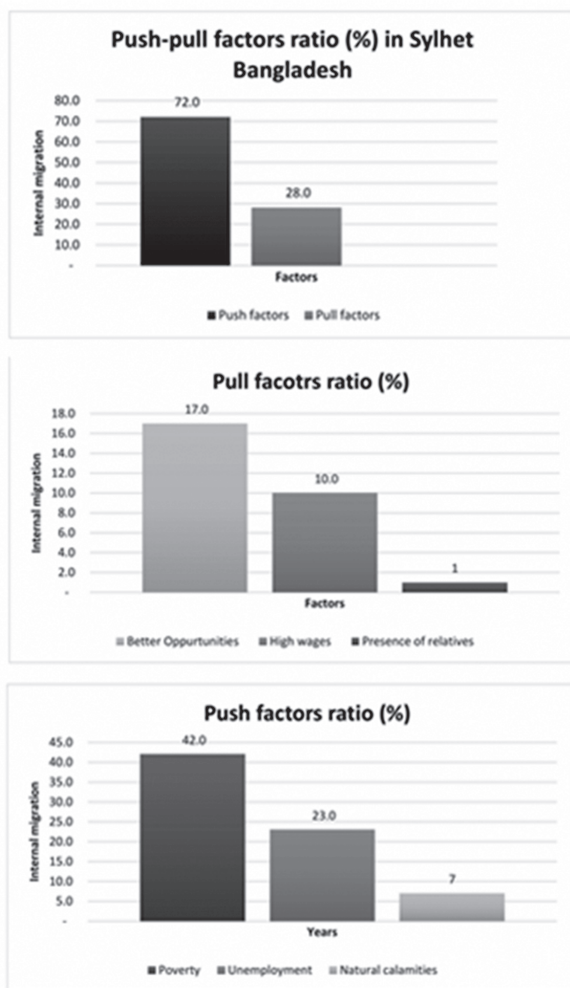


Figure 3 Reasons behind the push and pull factors ratio (%) and Push-pull ratio (%) for internal migration in Sylhet (edited by Author).

conflicts, social problems and avoidance, domination by elders) and socio-political (domination by locals, political unrest, and discrimination) are also reasons for internal migration from rural to urban areas, and among these the push-pull factors ratio is 72.0% and 28.0% [5]. According to the necessities (Fig 4), facilities and opportunities, they stay (0-1) years, (2-3) years, (4-6) years and (7-more) years in a short-term and long-term basis [5, 7, 8].

1.2 Low cost settlement (LCS) need for internal migrant urban poor (IMUP)

Among the resources, scopes and possibilities to provide a good settlement landscape are as- developing country, high dense population 1240/sq. km. Nearly 24.3% (2016) people are poor dwellers [9], unemployment rate 4.3% (2018), disaster caused by the nature and human, unavoidable rate 6.7% (2019) of internal migration [9], no remarkable initiatives for standard living accommodation for migrant's urban poor by the

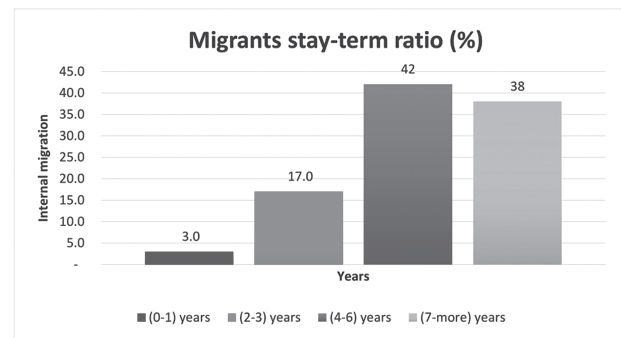


Figure 4 Internal migrant's stay-term ratio (%) (Edited by Author)

Government, the private entrepreneurs or NGOs, the migrant poor have works, have a minimum income \$1.90/person per day (2018) [10].

It is mentionable that around 40% settlements have no urban facilities to live in. The seven missing facilities are- 01. Security of the tenure, 02. Availability of services, 03. Material and infrastructural facilities, 04. Affordability, 05. Habitability, 06. Accessibility, 07. Location and cultural adequacy [11]. Government meets only 7% of annual housing demand and have relies on the private sectors to fill the giant gap [12]. The settlement provider in Bangladesh are- Formal (public and private), Informal (slum), Ministry of Housing and Public Works (MoHPW), National Housing Authority (NHA), House Building Research Institute (HBRI), Real Estate and Housing Association of Bangladesh (REHAB), House Building Finance Corporation (HBFC), Individual entrepreneur and self-help [13]. The largest 6 cities in Bangladesh including Sylhet are facing a massacre condition of dwellers by 35% (in 2005) to meet the demand and it is still unchanged. Nowadays, the IMUP are getting a living area of about 21 m² (both indoor and outdoor) at their settlement [12], 21% have personal sanitation and rest have shared, and 35% have drinking water and rest have no as well [12]. In this situation, getting good landscape facilities are out of reach. But the government has emphasized on affordable housing in the 7th Five-year Plan (FY 2016-2020). The government has approved "The National Housing Policy 2017" with addressing the fragmented design considerations for housing [13]. In the meantime, the RAJUK (Rajdhani Unnayan Kortripokkhyo) has kept reserved 1.2%, 4.3% and 7.5% of land for low-income people in the Purbachal, Uttara (3rd phase) and Jhilmil projects [12].

The IMUP from nearby and well connected rural areas are frequently migrating in Sylhet city in a temporary and permanent basis, and it is almost saturated with about 14 spotted slums. The IMUP are living below the basic needs, they are involving with many criminal activities and thus they are becoming threat for the society. It is

time to ensure them a standard living for the sake of social peace, security, and also for the overall environment.

1.3 Landscape features of low cost settlement (LCS)

There are identical and mostly similar landscape features seen in the LCS areas in Sylhet city. There are defined and/or undefined territorial boundary exist. The accessibility may be through the permanent/temporary road/bamboo bridge/boat connection. The IMUP dwellers are kept detached by physically, visually and/or even psychologically by the society as different communities within a single communal area. The tight circulation is used for both movement and common gathering space. The topography is plain or being prepared plain by cutting the contours and/or by earth filling the wetlands where there is no context, community spaces, known materials. LCS are placed in either in a grey zone or near/adjacent/within a wetland as detached from the major community in an unhygienic manner. Their habitat has no well protection, no water runoff system, no sufficient drinking water and no aesthetic aspects, health, education, amenities, utilities and services which bring harm to the environment, urban fabric and biodiversity. The IMUP are being kept as a separated and neglected community. The result brings an unsafe, unsecured and environmental harm to the society.

1.4 Problems and possibilities

This study is going to investigate the following statements that to be improved sequentially regarding the LCS issues- the dense population with unplanned landscape creates a landscape crises and environmentally harmful structure, the development pattern is unmerged with local urban fabric, there is a lack of fulfilling the human basic needs, no specific policy and design for LCS, the IMUP are kept neglected by the existing system of LCS, there is no training opportunity for the young generation and women, there is an invisible wall to divide coexisting communities of rich and poor dwellers living in a single area, the structure of social safety, security, comfort and peace for all dwellers remains poor, there is unhealthy environment both in indoor and outdoor areas, there are less working people (normally 1 and hardly 2) in a 6-8 member's family (primary data sources) and almost no scope for the dwellers in LCS to convert them as human resources.

The positive impacts for providing a good LCS landscape which will integrate the whole society in a single frame in an interactive communal manner as- it will break the invisible dividing wall in between the rich and poor in communities, will bring a safe, secured, comfortable and peace living society to all the dwellers, will ensure the human basic needs for the IMUP, will open windows for women to work and children to study;

busy mother and educated children will be the civilized people for the country, will encourage the entrepreneurs to develop this sector profitable within the same resources.

2. Methodology

This research study conducted the issues related to the IMUP dwelling landscape which impacts urban fabric, environment, human activities and behavior pattern. Simultaneously, the study has a target to propose a modular landscape model for those dwellings for the betterment of environmental and social aspects. Because of these reasons, the research study depends on the primary and the secondary data sources together.

First, for the primary data in terms of quantitative method, the study uses some photographs collected by the author and other sources to analyze the existing condition. And it also depends on the trace method as a data source. For the secondary data in terms of the same method, the study uses the database from SCC (Sylhet City Corporation) and SDA (Sylhet Development Authority) resources to analyze. Some public and published reports are used in this case. In parallel, it follows some books, articles, journals and reports for the standards on landscape considerations depending on government and private organizations. Simultaneously, the study depends on some articles, journals, books and reports on both the European landscape pattern and the Asian to reach to a competitive design solution for the targeted research in terms of environmental and contextual issues respectively. It also sometimes depends on Google website, Google Earth Pro and Google Street View as a resource for maps and photographs analysis.

Second, for the primary data in terms of qualitative method, the author interviewed having a scope to direct contact with the user group during the research. The data collection also depends on observation, photographs, and hand sketches as a data collection mood to make the facts more understandable. In addition, for the secondary data following the same method, the study tries to find variety of place making ideas from some mentionable existing and proposed cases located in Europe, Asia and Bangladesh as well to relate environmental, contextual and local aspects to enhance a contemporary design solution. Sylhet is a historical city for thousands of years. So, some well-known historical books are linked here as data source. Furthermore, the study also depends on some website to get the updated data on climatic issues, e.g. rain, water, soil, air and temperature. It is mentionable that all the primary and secondary data sources are duly acknowledged in this research study.

2.1 The context and landscape features of Low cost settlement (LCS) in Sylhet city

The haphazard pattern of settlement brings an unethical development of slum having no landscape issues in terms of environment, breathing activities, safety and comfort to live in (primary data source) (Fig. 5). The dwellers get only a shelter without landscape aspects. The owner converts the incomplete multi-storied structure, for time beings, into vertical slum where many dwellers are living in a single plot. There are scopes to provide more accommodations in less land area with landscape design. The LCS without landscape and recreational activities expands to the vacant surrounding in a dense manner. The old become sick staying home, the young misuses the time and do criminal activities staying outside, the children fall in accident playing at road side. Usually, the vacant, untouched, dumping area, sometimes, are illegally occupied by the IMUP. The unplanned existences, misuses and criminal activities bring distraction to the nature. The indoor, no furniture space, is the private activity area for a family (6-8 members) and the outdoor circulation area is used as a communal activities zone e.g. walking, playing, drying cloth, cooking preparation, sharing others due to having no breathing landscape. Generally, there exist a breathing area and waste dumping area in front of the rich and poor dwelling units respectively. The poor dwellers never get facility from the breathing areas living in close due to the

invisible wall for social classification. The land owners and dwellers do environmental destructive activities in these areas by chopping down trees and hills, filling the wetlands and urban water reservoirs without considering ecology and environment.

Being an unavoidable part, the social structure cannot move toward tomorrow in a perfect manner by neglecting the IMUP in LCS area. The society and the country are not getting better services from them. The female and the male are not using their time into productive purposes. The children are not getting education. The young are not getting better environment to think for better future career. So, the society has to bring them into account for the better community, society and environment for all by eco responsive landscape.

Living in LCS is a struggle between the dwellers who need to stay and the municipality who needs to clean up the slums. The drinking and the household water are collected from the municipality water supplies and ground water. The rain water and the domestic grey water are drained to the river through both the contour slope and the segmental drainage infrastructures. Most of the time, one single lavatory is shared by many dwellers. Most of the areas in these type of settlements are not equipped with the community garbage containers and not carried out by the municipal. The dense settlements, wooden-bamboo house forms and poor electrical wire

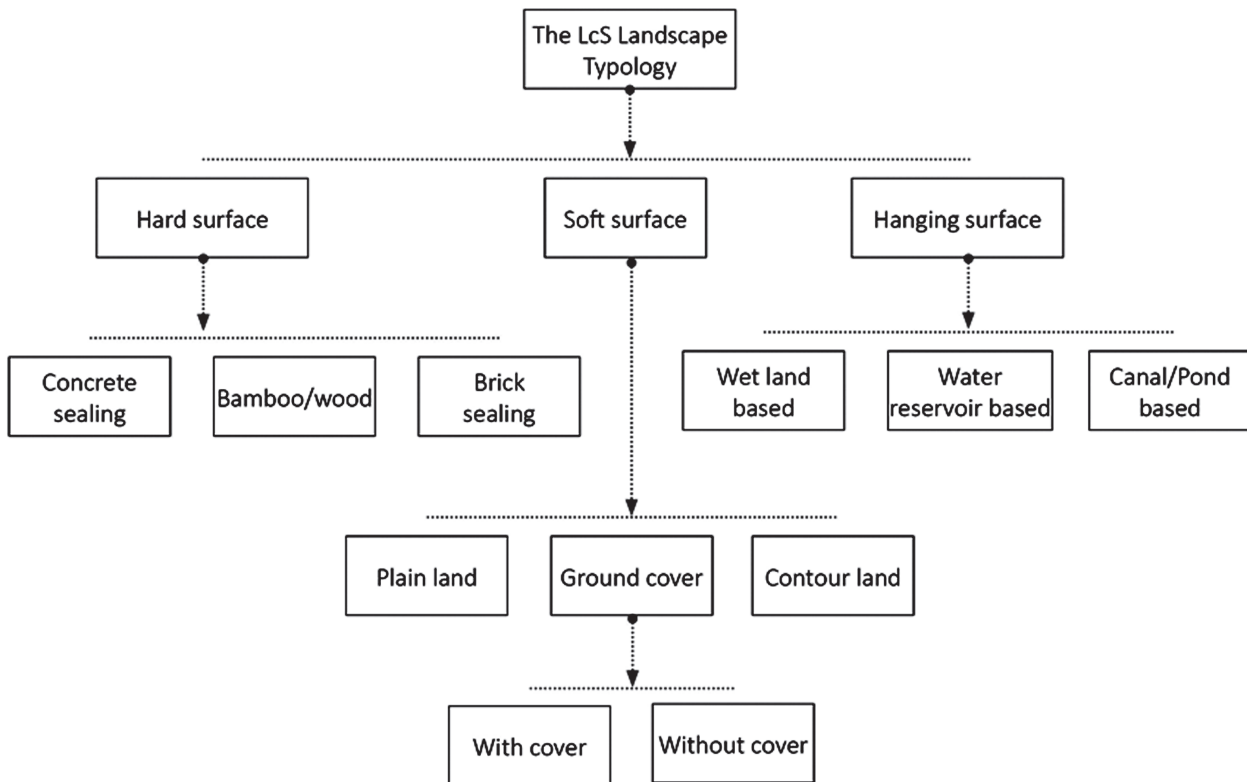


Figure 5 The LCS landscape types in Sylhet city.

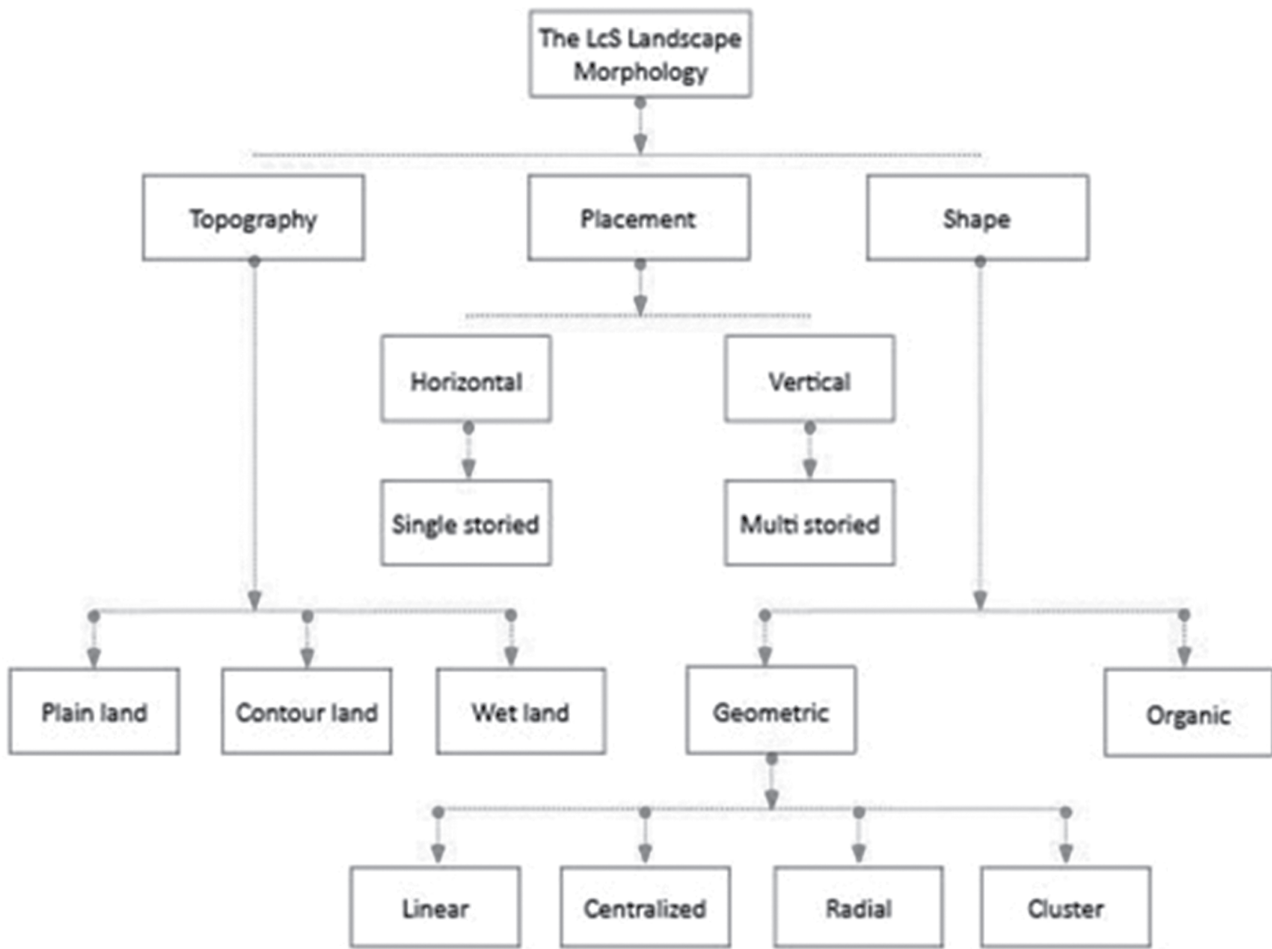


Figure 6 The LCS landscape morphology in Sylhet city

are enhancing the fire hazards. Moreover, the width of the pathways are insufficient for even free walk to enter. There are insufficient open spaces to play and walk as a healthy public space. The IMUP and their settlements are an integral part of the city landscape. It is wise to measure those slums into urban villages by providing (a) a proper designed order (b) active municipal contribution (c) public awareness (d) self-help development and (e) law enforcement [14, 15]. Figure 6 shows some distinct pattern of LCS landscape which makes it identical with urban fabric in Sylhet region (primary data source), [16]. The LCS landscapes are more or less imbalance considering the morphological patterns, aesthetics and functions which are misleading the atmosphere in terms of landscape development. As- circulations are linear and narrow, the service functions are not well organized, the landlords and even the dwellers reshape the natural landscape to provide more house forms, no dedicated area for the domestic vegetation and animal farming, the left over areas, river and canal sides are used for waste

dumping purpose which degrade the landscape environment, the polluted river water, negligible amount of supply water and insufficient numbers of tube well are shared for water collection, the shared sanitation system is also insufficient in numbers and unhygienic, the drainage infrastructure is completely poor and serving improperly, they do not get any dedicated areas for community interactions, the female and youngsters do coloring works on their house facade and left wall by themselves, the land top goes under water partially due to heavy rain fall, the dwellers nearby the riverbank are used to commit crimes, the road and rail sides LCS are risky for the children, a certain vertical development offers more open land for landscape.

Developing of low cost settlement is also encouraged in Bangladesh National Housing Policy-2016 that mentioned in several clauses by providing incentives, individual Tax base, funds and research [13].

2.2 The Biodiversity of Sylhet region

Sylhet is rich with different types of habitat pattern and ecosystem; take place by plain lands, wetlands, haors, beels, swamp forests, hilly areas, contour lands, rivers and canals, forest, stone quarries, heavy rainfall, warm humid weather and steady temperature which enhance the variety of life and life cycle in Sylhet region [4]. The lack of proper guidance, lack of public awareness, dense population, blocking water stream, dense structures, chopping trees down, chemical dependencies, no rotational cultivation, industrialization, mismanagement, less implication of nature conservation acts, life cycle, inter dependencies mobilize the extinction of many species from this region [1]. Some remarkable (also related to the LCS landscape) fauna and flora, habitats, and human activities are shown in Table 1 [17, 18, 19].

2.3 Environmental needs and landscape requirements of Low Cost Settlements (LCS) in Sylhet city

The circulation should be permanent with quality and material, and also the width should be sufficient enough to serve the purposes and to allow the emergency vehicles. The connections in between the internal path to the outer road to the main street with proper materials and width have to be ensured. The connecting access path should allow fire vehicle and ambulance to serve the emergency needs. The vehicular roads, pedestrians, drains, greens, house forms and makeshift shops are necessary to be well planned by placement as to work together for the best integrated outcome of landscape elements. The baths, lavatories and the kitchens should be placed separately not to hamper other functions to run properly. These service functions should be separated by

Table 1. List of flora and fauna in Sylhet.

List of Fauna in Sylhet		List of Flora in Sylhet	
English name	Scientific name	English name	Scientific name
Fishing cat	<i>Prionailurus viverrinus</i>	Bokul flower	<i>Mimusops elengi</i>
Monkey	Rhesus macaque	Jesmin	<i>Jasminum sambac</i>
Frog	<i>Humerana humeralis</i>	Kadam flower	<i>Anthocephalus cadamba</i>
Kalibaas fish	<i>Labeo calbasu</i>	Krishnachura	<i>Delonix regia</i>
Aor Fish	<i>Sperata aor</i>	Milk flower	<i>Tabernaemontana divaricata</i>
Black drongo	<i>Dicrurus macrocercus</i>	Bael	<i>Aegle marmelos</i>
Blue-bearded	<i>Nyctyornis athertoni</i>	Banana	<i>Musa paradisiacal</i>
black-bellied tern	<i>Sterna acuticauda</i>	Guava	<i>Psidium guajava</i>
Domestic chicken	<i>Gallus gallus domesticus</i>	(Hamilton's Bamboo	<i>Dendrocalamus hamiltonii</i>
Lesser Whistling Duck	<i>Dendrocygna javanica</i>	Mehogani	<i>Meliaceae swietenia</i>
Bats	<i>Pteropus giganteus</i>	Shirish	<i>Albizia lebbeck</i>
Butterflies	<i>Papilio demoleus</i>	Wild lemon satkora	<i>Wild lemon satkora</i>
Green Marsh Hawk)	<i>Orthetrum Sabina</i>	Segun teak	<i>Tectona grandis</i>
Grasshopper	<i>Aularches miliaris</i>	Jackfruit	<i>Artocarpus heterophyllus</i>
Bugs	<i>Dysdercus Cingulatu</i>	Bottle sedge)	<i>Carex rostrata</i>

male, female and numbers. Two baths are required to be provided for twelve families; the male bathing place may be open but the female one should be enclosed, and of course should have water facility and connected with the drainage system. The separate lavatories are required for male and female. A twelve-family informal LCS should have two separate lavatories; one for male and another for female with four toilets each. The water facility should be there internally. A four-burner kitchen setup with open space for working together should be provided for a twelve-family module (the above mentioned numbers are proposed by the authors based on some case projects in Bangladesh and Indonesia). The self-help vegetation as food for them, secondly work for the work less women, thirdly money to support economically, and of course a good and breathing environment for the community being a part of the whole greeneries. Grass and water are available and natural elements in LCS landscape area, and is helpful for the animal farming e.g. duck, chicken, sheep, goat and cow. Like the vegetation,

this farming can provide them the required protein, can strengthen the economy and provide works not only for the female but also for male. The coexistence of these natural elements like contour, hills, wetlands and canals along with the manmade elements has to be ensured.

There should have sufficient facilities (central and/or community tube well)) for drinking water, and also for watering the vegetation fields. The drainage infrastructure should be permanent and sufficient in number, depth, width and top cover to drain out the grey water and waste water to the outer sewerage line. The natural water sources like ponds, ditches, canals, wetlands and rivers are the water reservoir for the entire area should be protected to ensure function, aesthetics and environment. There should have an effective waste management system internally and externally provided by both the public and the private initiatives. The landscape should contain a dedicated place for the community interaction in different scale and separated for different aged groups. The IMUP are also belonging a good taste to have a

Table 2. Proposed framework with phases and interventions.

Phase	Proposed interventions inside phase
1st Phase Time duration : 2 years	1. Land acquire 2. Raising Climate awareness 3. Existing plantations reservation 4. Designing Circulation (movement, firefighting, medical service), 5. The water sources will be developed initially 6. New plantations for landscape 7. Providing Services like water management, drainage infrastructure, sanitation infrastructure, waste management policy. 8. Open area reservation (community areas, educational and training areas, children's playground)
2nd Phase Time duration : 2 years	9. Providing Financial support for community stake holders 10. Ensuring Affordability 11. Fulfilling Sustainability including environmental ,social, economic needs 12. Respecting habitat and material culture
3rd Phase Time duration : 2 years	13. Farming (vegetation, animal, garden)
4th Phase Time duration : 2 years	14. Animal aided design implementation, 15. Landscape scenery 16. Tourism and entertainment.

quality landscape at their LCS area. The land top should be raised enough to avoid water logging. Every LCS should have identical and individual landscape to serve the dwellers. The landscape should contains some places to generate the community activities like tree shed training, vaccinating, educating, exercise club areas. There should be properly planted trees to provide shade, wood, fruit, flower, medicine, vegetation, soil retention and fresh air. The domestic and other common areas should be defined by the landscape to ensure no collision of community functions. There should have a local administration formed with the selective dwellers to ensure a good governance and maintenance [20, 21, 22]. There are some similar case projects as "Disappearing land: Supporting Communities Affected by River Erosion" and, "Gopalganj Housing model" in Bangladesh, "Artist Village" in India, "Ledok Tukangan", "Ledok Jogoyudan" and, "Ledok Code" in Indonesia, "Kleinhouse", and, "Schrebergarten" in Germany which were assessed as a potential case studies. [23, 24, 25, 26]

3. Results and discussion

The integrated landscape should have interactive community places. It should be low by investment cost and high by return benefit. The landscape should be affordable both for the tenants and the owners. A good negotiation with the social and local leaders and administrations is needed. There should have an easy understandable and bearable bank loan scheme. Some

charity training programs to awaken the general public awareness can be ensured. The local flora, fauna, habitat pattern and materials should be considered for the landscape. Profitable and medicinal plants, shrubs and ground covers should be planted over the landscape area. The development should be priority, phase and policy based. Authors have proposed 4 (four) phases of intervention for the proposed framework in table 2.

This framework is proposed as a participatory approach including all prospective stakeholders and some case projects in Bangladesh, India, Indonesia and Germany. The entrepreneurs as Individual, Cooperative, Cooperative group, Cooperative society, Developer, Promoter are necessary to work in a feasible and participatory approach to execute the LCS landscape in a successful manner. The POE (Post Occupancy Evaluation) system is necessary to be activated. The LCS dwellers are to be account as a social part.

3.1 Design approaches: In case study area

To implement the framework, a case study area was taken as a low income settlement. 'Bharthokhola' colony was selected to develop the landscape models. The 'Bharthokhola' colony is in most vulnerable condition in terms of poor livings for the IMUP. The site is located at the bank of river 'Surma' adjacent to the city entrance gate and occupied about to 6,300.00 m² (Fig.7). Most of the house forms are made with temporary materials and only few are with semi-permanent in a dense manner.



Figure 7 Case study area: Bharthkhola Colony in Sylhet city.

The illegal extension of house forms take place according to the dweller's needs day by day.

As proposed in the framework, firstly it is necessary to reorganize the house forms to ensure open space for landscaping for outdoor activities. According to the BNBC, the 50% area of a plot will be kept as open space and the 50% of the open space will be as water penetrable. The study is proposing a two storied module to make around 60% area free as water penetrable land and then the free area will be used for landscaping in a rational formation for the users in this prospective landscape module from smaller scale to larger (Fig. 8). The smallest modules is a nucleus module in an intimate neighborhood scale and even implementable in terms of plot size and location. A nucleus module mainly consists of a kitchen garden of private vegetation for a single house form of a 6-8 member's family (primary data collected by author). Then a group module has been

proposed. A group module is a group of 6-12 nucleus modules do share their kitchen, baths, and lavatories together in close neighbor manner. As third, a cluster module has been design including 2 - 3 group modules. An interactive outdoor with green shed has been proposed. This green space would provide a neighborhood scale to the community. The fourth proposed module is a communal module in a community scale. Around 3-6 cluster modules together create a community centering a community landscape area to held their communal interactions. Finally, in settlement scale, a settlement module will tie up all the communities with shared landscape elements. Proposed 5 (five) modules should be implemented based on the requirements of the stakeholders (Fig. 9) from nucleus scale to settlement scale.

Proposed five modules should be implemented in phase by phase from nucleus scale to settlement scale.

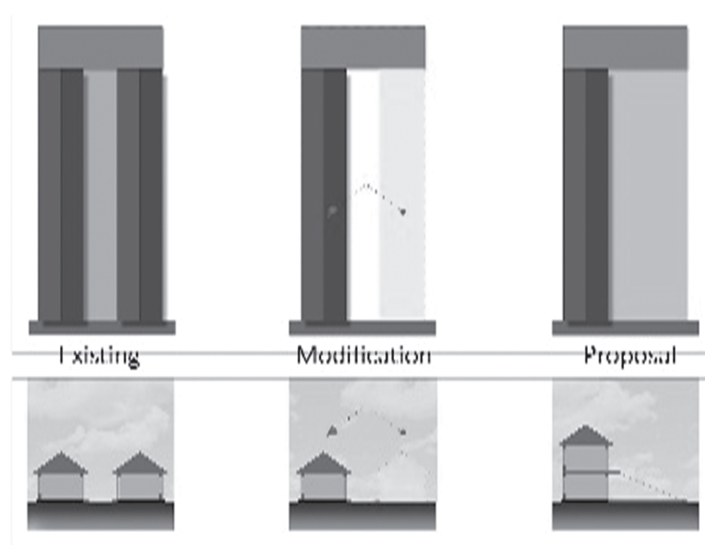
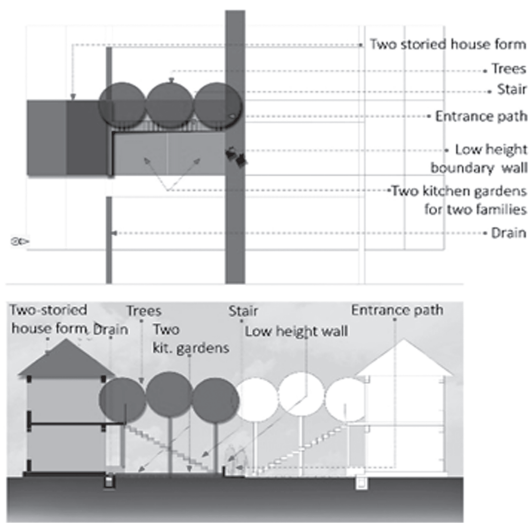
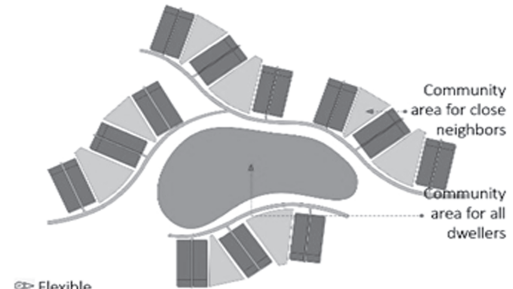
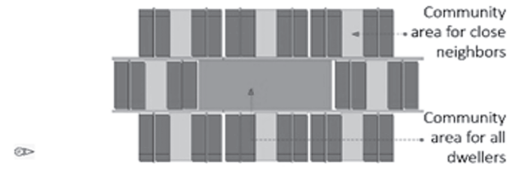


Figure 8 Making free open space to reorganize for landscape.

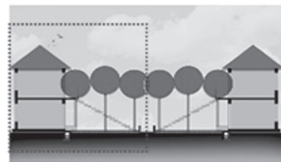
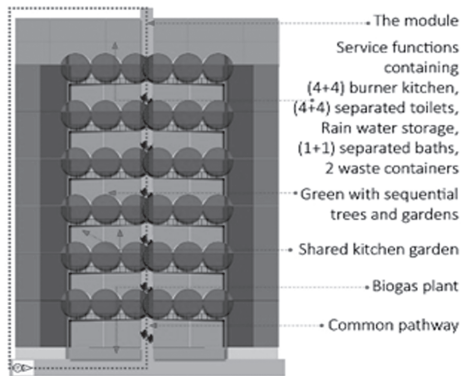


a) Nucleus Module

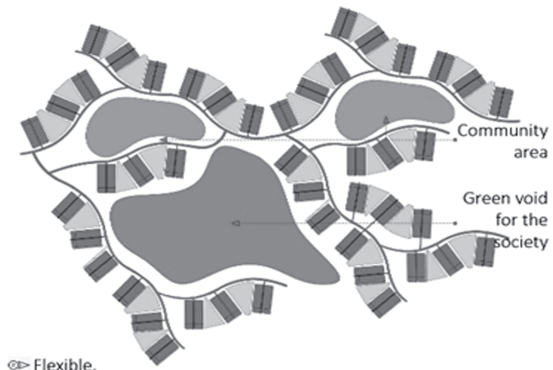
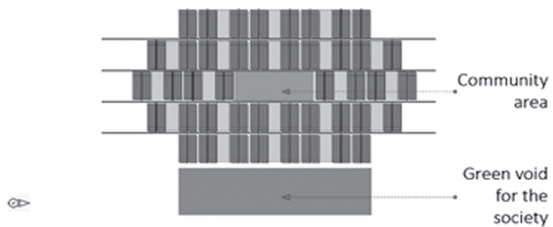


Flexible.

d) Communal Module

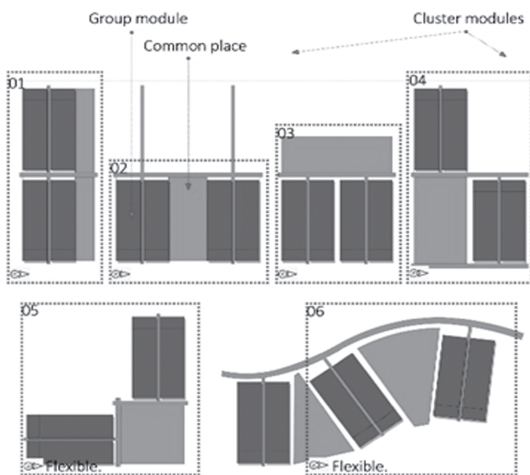


b) Group Module



Flexible.

e) Settlement I Module



c) Cluster Module

Proposed Modular Landscape models :

- a) Nucleus Module
- b) Group Module
- c) Cluster Module
- d) Communal Module
- e) Settlement Module

Figure 9 Proposed modular landscape models for low cost settlements. (Produced by authors).

This study is proposing to develop a LCS area following the mentioned modules due to its easiness, rigidity, flexibility and effectiveness (Fig. 10).

waste and air pollutions, and in parallel it will also provide them fuel energy and fertilizer for vegetation in a sustainable manner. Amenities (e.g. playground,

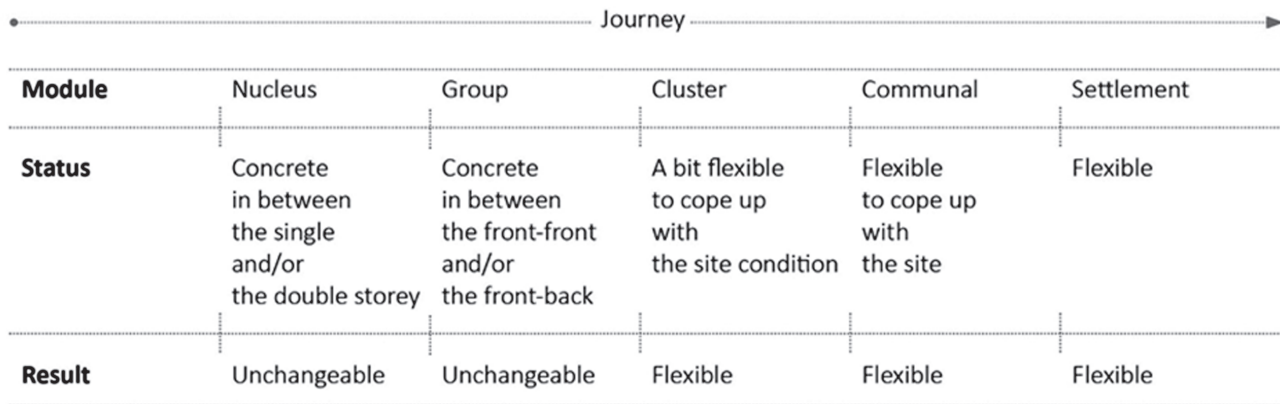


Figure 10 Implementation phases for landscape model from nucleus to settlement scale

3.2 Possible recommendations for design, policy and implementation

The design considerations will reflect the existing landscape typology, flora, fauna, biodiversity and habitat pattern, and also the population density in a relaxed approach where 60% open areas with gardens, circulations and community spaces could be provided with the similar number of existing dwellers. The LCS landscape will have both features of self-identity and homogeneity with the urban fabrics. This research provides a set of design and policy recommendations to ensure landscape model more implementable and self-sustainable. Following recommendations will be useful to guide the landscape development process in a sustainable way.

- a) Circulation design: A sequential and rational approach of circulation is necessary as the primary circulation should allow emergency vehicular access, and the secondary and tertiary circulations will be for the mass movements. The landscape design will respect the existing biotope and the existing trees.
- b) Using existing land topography: The existing land slope will be used to drain out the grey and excessive rain water. If no, a covered drainage system should be provided properly here. The land top will have ground cover to prevent the top soil erosion due to heavy drought and rain. The air breeze flowing from the open river side will be guided to penetrate inside the landscape area and even indoor places to reduce the use of electricity for cooling.
- c) Energy and amenity provisions: The rain water harvesting system should be considered to ensure the water crises as having almost 7/8 months rain in a year here by location. There will have waste containers and biogas plant following the modules to

prevent the open areas, clubs ...), utilities (e.g. water supply and drainage, biogas plants, farming facilities ...), and services (e.g. circulations, fire and medical facilities ...) will be considered to ensure better living environment in the entire social arena.

- d) Scope for gardening: A private kitchen garden for each nucleus module will be provided to ensure domestic vegetation and animal farming which will help dwellers to meet the family vitamin and also to earn money. There will have community gardens (e.g. commercial flowers and fruits) to provide work opportunity and to increase income. The implemented modular design (the nucleus module to the settlement module) will bring a comfortable microclimate within a settlement in a sustainable manner.
- e) Community facilities: A children play ground shall exist in every LCS area. There will have the landscape infrastructures for children, women and old for education and training. There will have some community places in a regular interval with tree shades and sittings to ensure integrated interactions. The river bank, the adjacent green patch, the half-done civic plaza, a parallel green landscape of this LCS area will enhance the relationships between the IMUP and the city people, and tourism activities. The nucleus module and the group module that are designed in this research, are core, fundamental and uniform in size, shape and type. These landscape modules can be implemented in any LCS area (size, shape and type) in Bangladesh. Then the other facilities in terms of landscape should be provided in a balanced scale to form the cluster module, the communal module and the settlement module as well. Thus, this research found that the landscape modules will be a role model for all the LCS areas in Bangladesh.

f) Policy recommendations: Functional, effective and feasible rules, regulations and acts will be considered based on individual, group, communal and social needs. And, policies regarding 60% mandatory open areas for kitchen and commercial gardens, playground, community spaces should be mentioned specially for LCS area development and, the 40% areas for house forms should be two-storied to ensure that open areas. Easy and understandable loan scheme e.g. the scheme policy may be following the lowest interest rate and long term return basis. The Government may take initiatives of incentives to encourage the private entrepreneurs. An integrated developing plan between the urban sectors and local sectors will be taken by a higher regulatory authority to ensure a balanced and rational combination of landscape. The administrations and the social leaders will have to work together to ensure an integrated and interactive community landscape. The phase based and interlinked landscape development will be taken. Educational and playground facilities will be considered to build up a responsible future generation. There should be training facilities (e.g. open and tree shaded areas) for youths and women to develop their skills in productive works.

4. Conclusion

A modular landscape consideration will be easy and feasible for LCS landscape development. The proposed modular landscape approach in this research will be low cost, affordable and self-sustainable for the LCS areas in Sylhet city and over the country as well. Government should take initiatives to ensure economically benefited both the dwellers and the entrepreneurs. Higher authority can take action for the exposure regarding to the IMUP handmade products and the tourism facilities which can enhance their financial state in LCS area. It will strengthen the social awareness on youths and women well-beings. The landscape development works will be priority and phase based to avoid construction and functional chaos. The proposed and the conscious implementation of the modular landscape of LCS area can ensure a better green environment for the dwellers, city people and environment. And, this study showed that it will be a model case for the LCS landscape development over Bangladesh. A researcher needs to be careful and sensitive enough in terms of the public participation, collecting the primary data and, implementing the proposed design with the locals. This research outcomes will be helpful and informative for the future interested researchers in this field for further study. It will bring a better green environment by a successful execution of the proposed modular landscape design and will work for other LCS areas in Bangladesh as a model.

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