



# SPATIAL SITE REFERENCE, ANALYSIS AND IMPROVEMENT: JAFFNA TOWN CENTER DEVELOPMENT UNDER POST WAR CONTEXT

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## Abstract

*Jaffna is one of the districts and capital town of Northern Sri Lanka. Jaffna town is a historical and cultural space of Sri Lankan Tamils and Hindus. It has been functioning as a hub for administrative, commercial, educational, health, recreational and transportation service for entire province by accommodating public and private investments since 1800s. The space was evolving as production of societies in respect to their core values and customs until mid 1970s. Westernization and modernization scenarios are highly influencing the re-development pattern and function of Jaffna town space after the end of the civil war in 2009. The Jaffna town center is defined as a site to refer spatial and functional changes in every single plot due to rapid development under post war context. The study focused to identify and delineate the site that highly observes the spatial pattern and functional changes under the rapid development context, to analyse the spatial issues that cause for the spatial pattern and functional change of the identified site, and to develop comprehensive spatial model for improving the identified site. Site planning process is mainstreamed in the entire investigation. Temporal pattern and functional and morphological studies are used for site selection, delineation and reference. Situation, user and spatial analysis are carried out to identify the issues and potentials of the site. Site improvement plans are designed based on the results of CAP workshop and Space Syntax analytical models. Flash flooding, traffic congestion, underutilization of land resource and water contaminations are crucial issues. Developments are happening arbitrarily due to the private ownership and not much centralized planned development occurred in the space. Three decades of war is a major factor for delaying on formulating rules, regulations and policies relevant to spatial and functional development. The study concludes that Jaffna general hospital and bus stand are core elements in the site. Improvement of hospital should be carried on towards the north direction and bus stand has to be transformed as well structured bus terminal to accommodate state and private buses. Jaffna Municipal Council and Urban Development Authorities have to pay high attention on formulating and implementing by laws and controlling and managing the spatial and functional development properly with private and public participation.*

Key words: Site, Space Syntax, Morphology, Interpolation, Contamination, Integration

## **Introduction**

'Space', a term that well used in the field of Earth science to interpret the physical arrangement of natural phenomina in the Earth planet. It has been widely used in the field of Social sciences to define the physical space that inhabited by diverse communities and societies in terms of their functionality for last couple of centuries. Site, a physical space, defines as an area that contains complex functionality with the inhabitation of diverse societies in the form of user.

Space, that is "the space of social relations, the space between us as members of society which implies how we are situated in relation to one another" (Henri Lefebvre - 1974/1991). 'Social Space' that is "the area inhabited by a group(s) which are the fundamental units of social life, were conceived either as territorial entities or as classes, and the organizations which structure social relations such as families, associations and bureaucracies attracted practically no attention at that time" (Emile Durkheim and his team from Chicago school). Social Space' is something conceived as the area where a group or a class is living (Karl Marx).

Jaffna is one of the districts and capital town of Northern Sri Lanka. It has been functioning as a hub for administrative, commercial, educational, health, recreational and transportation service for entire province by accommodating public and private investments since 1800s.

Jaffna town is a historical and cultural space of Sri Lankan Tamils and Hindus. The town settlement pattern, interior and exterior designs of physical features, and surrounding environment had been highly reflecting the socio – economic uniqueness of inhabited society even though the town space emerged during the colonial period. The space was evolving as production of societies in respect to their core values and customs until mid 1970s. The society driven development has not been continue after 1980s because of continuous displacement of people, destruction of physical structures, and life uncertainty due to the ethnic conflict.

During the period of Cease fire agreement from 2002 to 2006, between Sri Lankan Government and LTTE, timely space was created for emerging from social and physical destruction. Limited number of public and private investors who were financially sound utilized that space for regaining from destructions. But it did not exist longer due to the cancellation of cease fire agreement. Then the town has started to rapidly re-develop after the end of the civil war in 2009.

Development scenarios in these two occasions are not same as past. Westernization and modernization scenarios highly influence the re-development pattern and function of Jaffna town space. There is no intellectual expressiveness needed to understand this radical change. It is clearly reflected by the space itself.

On one hand, it becomes as a subject for debating on whether this change could be suitable or unsuitable, acceptable or unacceptable and adoptable or unadoptable

under the socio – cultural perspective of traditional Jaffna. There are positive and negative arguments in both sides.

On the other hand, however the development is ongoing due to increased investment, and market competition. It raises two questions. Firstly, is this structural change of space aligning with development norms and guidelines in order to utilize resources sustainably to produce effective space?. Secondly, is this functional change of space fulfilling the needs of users without creating major issues in the space and society?

The answer is obviously ‘no’. These rapid changes make the physical and functional system more complicated in adverse direction. Lack of system integration, underutilization of resources, and contamination of water are crucial issues caused by the lack of development norms and guidelines and inefficiency of authorized institutions, private ownership, and several other factors in the town space.

Therefore, the changing scenarios are alarming about spatial issues that highly affect the efficient and effective function of the town and notify the timely need of an integrated plan for the pattern and functional improvement of Jaffna Town. Jaffna town center, a smaller area with natural sensitiveness and high density of physical and functional integration, is rooted to pay site attention for developing plan through carrying comprehensive research.

## **Background**

The Jaffna town center, known as “Yazlpaanam or Yazlpaana Paddinam”, lies in the southern part of Jaffna peninsula between 9036’ - 9042’ North, and between 79059’ - 80003’ East. It is the highest order town not only in the Jaffna district but also in the Northern Province. It is 400 km away from Colombo, Capital city of Sri Lanka, by road. The area of Jaffna town center is 20.0 Sq km. It is longer in the east – west direction, measuring a maximum of 06 km in length; while its width in the north – south direction varies from 3.5 to 4 km. The Jaffna lagoon forms the southern boundary of the town.

Jaffna was historically goes back around 104 A.D. The historical evidence says that, the kings and people who were living in the northern part of Sri Lanka had come from Southern India and settled. After the rule of the last King Cankili, the Jaffna kingdom (1215 AD to 1624 AD) came under the rule of the Portuguese in 1617. Then, the Dutch came and introduced law and order to this region and built the roads across the district. The Jaffna fort which was built by the Dutch has been appearing as a significant evidence of the Dutch colonization. Then, the British came and ruled for a long time. They built connecting roads from all parts of the Jaffna district to the fort.

The existing road system was established by the Dutch and the British. The town center grows rapidly after establishing the road network from all parts of the district to the Jaffna fort area. The Jaffna town center had been isolated from other highest town centers, which function well in other parts of Sri Lanka, from 1980s to 2002

due to the civil war. The linking road was closed. During the period of Cease - fire agreement, the Jaffna town center was growing rapidly again due to the opening of the A9 road.

At present, the Jaffna city center is growing faster because of the increased investments of local, national and international investors. Almost, all banks and financial institutions which function in Sri Lanka have opened their branches in the Jaffna town center.

Nowadays, the Jaffna city center is highly agglomerated by plenty of business and service activities. Diverse types of business and services institutions, medical, educational and financial institutions, electronic and electrical showrooms, hardware, software and auto mobile shops, vegetable, fruit and Palmyra product market, textiles, jewellery and fancy shops and whole sale grocery shops, occupy the Jaffna town center space to function at all levels. There are full of engagement of new investors among both success and failure stories regarding the functionality of services in the Jaffna town space.

The Jaffna town center growth pattern is continuously increasing with range of complexity. Therefore, proper plans and guidelines are timely needed to accommodate and regulate them properly.

## **Literature review**

### **Space, site and spatial aspects on theoretical perspective**

The theories on Space and Site (Spatial aspects): The term 'Space' conceptualizes and defines differently in diverse platforms because of the wider usage of it. In Cartesian terminology, the term 'Space' can be defined a three dimensional property with length, width and height. At the same time the term 'Space' is referred as socially inhabited area by group of people along with their functions in sociological terminology.

Condominas (1980) says that the term 'Social Space' was firstly used by Emile Durkheim, who is known as the father of Sociology, at the end of nineteen century. Emile Durkheim and Chicago school define the term of 'Social Space' as the area inhabited by a group(s), the fundamental units of social life. They were conceived either as territorial entities or as classes, and the organizations which structure social relations such as families, associations and bureaucracies attracted practically no attention at that time. For Marxist, 'Social Space' is something conceived as the area where a group or a class is living. Their thought explains the role of space in the development of social consciousness. The term 'Social Space' was used by Marcel Mauss (1904 – 1905) and Maurice Halbwachs (1938) immediately after the origin. It came into familiarization in the research and academic platforms after 1950s. Chombart de Lauwe, Henri Lefebvre and Georges Condominas refer this term 'Social Space' for their scholarly works. Accordingly, the 'Social Space' is still the space occupied and transformed by a social group.

Henri Lefebvre (1974 / 1991) defines the term 'Space' that is "the space of social relations, the space between us as members of society which implies how we are situated in relation to one another". He looks at the 'Space' in three dialectical arenas that are practically produced, then perceived, and experienced by society with their senses as lived. Accordingly, he defines the 'Space' as a "social product because; it does not exist in itself, but produced". Therefore, 'Space' stands in the order of social reality.

Massy (2005) defines the term 'space as the sphere of relations and encounters, which implies politics.' Space is required for 'simultaneous heterogeneity'. Kipfer (2008) says that 'Space' is colonized of everyday life of an individual or society. Accordingly, the term 'Space' is conceptualized in terms of that broader social reality, rather than a three-dimensional Cartesian concept in this study.

**The Production of Space:** The production of Space Theory was founded by Henri Lefebvre, French scholar, in 1974. The book 'La production de l'espace' was written, in French language, by him to explain the theory. The theory gained peak of popularity among scholars after translating the book into English with the name of 'the Production of Space' by Donald Nicholson - Smith in 1991.

The theory tries to explain the relationship between the 'Space', physical environment of the inhabited society and 'Society', living organism in the limited space. The main arguments of the theory are;

(1) There are three levels of space from very abstract, natural and more complex according to the production of them. These three dialectical levels are defined in dual perspectives. 'Spatial Practice', 'Representations of Space', and 'Spaces of Representation' are defined in one perspective and they are respectfully defined as 'Perceived Space', 'Conceived Space', and 'Lived Space' in other perspective. These levels have to be understood as being fundamentally of equal value. It means that space is at once perceived, conceived, and lived. It is called as the 'triad of space' by him.

Perceived Space or Spatial Practice means that the space is perceived in the common sensical mode with all its contradictions in everyday life. It is a social product and it embraces the idea of social practice.

Conceived Space or Representations of space / discourses on space: The conceived space is discursive regimes of theories, spatial and planning professions and expert knowledge which is conceived of space.

Lived Space or Spaces of representation / Discourse of Space: The lived space is, as it might be, moments of presence. (Table: 1)

**Table 1: Summary of the Production of Space Theory**

Spatial Practice	Representations of Space	Spaces of Representation
Physical Space	Mental Space	Social Space
Perceived	Conceived	Lived
Daily routines align with routes between places	Scientists, planners, technocratic sub dividers	Inhabitants and users

(2) Social space is a social product.

(3) Every society produces its own social space. The social production of urban space is fundamental to the reproduction of society.

The production of space is a fragmentation of space which contains both mental and real to bring together.

The Neoclassical Model theory (Economical aspects): It argues about how capital accumulation and new technologies become the dominant forces affecting economic development. This approach was pioneered by Robert Solow, who was awarded the 1987 Nobel Prize for this and other contributions to economic growth theory.

The model describes an economy in which a single homogeneous output is produced by two types of inputs, capital and labour. Capital and technique changes are the new ingredients in this growth model. It assumes that in the growth process the technology remains constant and the role of capital was dynamic. Capital goods include physical structures such as factories and houses, equipment such as computer and machines and finished goods and goods in process.

The theory explains the functions of economic growth in the following way. If  $K$  = single kind of capital good, and  $L$  = is the number of workers, then  $K/L$  is equal to the quantity of capital per worker. It calls as Capital – Labour Ratio in general forums. This is aggregate production function for the neoclassical growth model without technological change as  $Q = F(K, L)$ .

In the absence of technological change and innovation, an increase in capital per worker would not be matched by a proportional increase in output per worker because of diminishing returns to capital. Capital deepening would lower the rate of return on capital while raising real wages.

### **The theoretical view of conflict on environment (Environmental aspects):**

Conflict theorists founded that the most serious conflicts are rising between environment and consumers. Population and harmful technological innovations have been viewed as factors for environmental issue by some Conflict theorists.

Allan Schnaiberg (1992) says, many sociologists draw on the conflict perspectives and blame the dominant social paradigm of advanced capitalist societies for threatening our environment.

Susan Stonich (1989) suggests that environmental destruction in southern Honduras is intricately connected to the problem of poverty, unemployment and conflict within and between nations.

G. Miller (1972) who, they ask, is more to blame for environmental deterioration: the poverty–stricken and food–hungry populations of the world or the energy–hungry industrialized nations? It can be answered by the following information;

Conflicts they identified that 25 percentage of the world’s population who are inhabited in the West-Industrialized nations are responsible for 85 percentage of the world wide consumption.

In USA, around 6 percentage of the world’s population, consume more than half of the world’s nonrenewable resources and more than one – third of all the raw - materials produced.

Insatiable production and consumption contribute directly to the demand for more and more landfills.

### **Space, Site and Spatial aspects on applicational perspective**

In 2016, a study was conducted on the topic of Balancing history and development in Seattle’s Pike/Pine Neighborhood Conservation District by Manish Chalana.

The study tries to examine the question that weather planners and preservationists can successfully work together to maintain its neighborhood character, as recognized by its architecture, uses, culture, night life and housing in Seattle - Pike/Pine, under the context of transformation of building usage after the end of the war, through practicing Neighborhood Conservation District (NCD) approach.

Pike/Pine comprises roughly 35 square blocks along Seattle's East Pike and East Pine Streets, on the southwestern slope of Capitol Hill, east of the city's retail core. Racially, it is a reasonable microcosm of Seattle, but has higher levels of younger adults than Seattle overall. It is highly concentrated lesbian, gay, bisexual, transgender, and queer (LGBTQ) population. Pike/Pine was the city's main "auto row" district in the early 20th century (James, 2012). After World War II, as many auto businesses migrated to the suburbs, Pike/Pine accommodated an eclectic array of affordable businesses and services in converted auto-row buildings as well as housing in apartments and single-resident occupancy hotels.

NCD is one of the alternative approaches to historic district that attempt to maintain unique and vibrant places for diverse groups.

The study concludes that Planners and preservationists have varying perspectives on the type of spatial transformations occurring in Pike/Pine. Planners argue that they are promoting sustainable development by concentrating growth into urban areas and preventing sprawl.

Preservationists are happy with many adaptive reuse projects, but still bemoan the loss of substantial amounts of historic fabric from both recognized and overlooked historic buildings. Despite three amendments in five years, the Pike Pine Overlay Conservation District (PPCOD) has not been entirely successful in maintaining neighborhood character. Even as many façades have been saved at the expense of historic buildings, the neighborhood is rapidly gentrifying, with the transformations ultimately making Pike/ Pine less unique, and perhaps less safe for lesbian, gay, bisexual, transgender, and queer (LGBTQ) populations.

Communities considering an NCD to retain the neighborhood character of older neighborhoods should consider a tighter and tiered incentive structure to encourage balance between old and new, and work to ensure that the implementation of the ordinance aligns closely with preservation goals. As the case of Pike/ Pine demonstrates, the NCD has not fully resolved the persistent challenges of gentrification that threaten the cultures and communities who helped shape the neighborhood. As a result, many long-time patrons and residents of Pike/Pine would claim that the alliance between planning and preservation seems as uneasy as ever.

Review of this particular article explores that, how a traditional view of the same space can transform totally into another modern view according to the evolution of society. Secondly, it explains how far the adaption and transformation is important for preservation of urban monuments and traditional buildings. Thirdly, how a society accepts or accommodates them into this conflicting environment. Then it explores the role and responsibility of planners and preservationists to working together in the space transformation initiatives to avoid conflict occurrences. Finally it advised to balancing old and new structures under the preservation and modern development context.



In 2014, a descriptive and prescriptive study was done on conflict transformation in post war Sri Lanka by Abdul Jabbar and Fatima Sajceetha.

The study tries to identify the transformation of conflict after the end of internal civil war. It found that both of more positive and some negative transformations have happened in the places and people since the end of the war.

It concluded, as positive transformation of conflict, that demand of minorities is changed, increased number of infrastructure development projects; resettlement and rehabilitation efforts are carrying out. The democratic space is open for all.

At the same time, as negative signs, the conflict raises between civilians and armed forces, increasing of violence in different forms of kidnapping and robbery. It especially mentioned about the conflict that is turned between different ethnic groups based on the religion.

Review of this particular study explore that, with the end of the war, the government and responsible persons say that, the ethnic conflict between the Tamils and Sinhalese was resolved in Sri Lanka. It means there are no weapons, no groups, and no voices. But what happened actually was that conflict is controlled by the power. The root cause for conflict is still there and it has not been discovered properly until to date. The controlled and existing conflict is transformed into different form to come out. Therefore, the post war Sri Lanka has the possibility to a new form of conflict again among the societies.

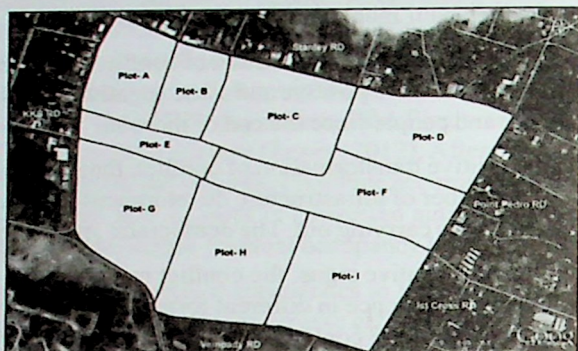
### **Objective and method**

The research was conducted to identify and delineate the site that highly observes the spatial pattern and functional changes under the rapid development context, to analyse the spatial issues that cause for the spatial pattern and functional change of the identified site, and to develop comprehensive spatial model for improving the identified site.

At preliminary stage, built pattern and functional studies and morphological study techniques are used to identify sites. Spatial and functional comparison analysis was performed to select and delineate a site for analysis and improve.

In the detail survey, morphological study used as basic technique to do site reference. Selected site is divided into nine plots (plot- A, B, C, D, E, F, G, H and I) based on the road network to easily understand the physical and functional features of the site and collect the data and information in the site (Figure: 01).

**Figure: 01 – Divided plots in the selected sites**



Source: Google Earth, on 18.12.2015 at 05.00

Topographical map of Jaffna (1966, 1978 and 2006) and Land use map of Jaffna town (1981) were considered as source maps. They were used to carry temporal analysis to detect land use changes.

Existing road network map was produced from the topographical map. Other thematic maps were developed by using Plot by plot scanning survey technique to understand the existing pattern and function of the site and analyze. Building data were collected and demarcated according to the physical boundary of them individually. Every single shop is demarcated with their boundary even though located in a building. Water bodies, drainages and storm water channels and public water supply network data were collected and mapped.

There are four issues identified in the site. Data relevant to areas that are affected by flash flooding, traffic congestion, underutilization of land and contamination of water collected from each plot by plot scan survey and put into maps.

Spatial locations of incomplete drainage and storm water channel network, drain and storm water stagnating areas into the channels, storm water channel used as waste water channels, encroached and land filled ponds, building over the storm water and drainage channels, grid pattern of city center with narrow roads which are having junction within 150 meter of distances, uploading and unloading areas in front of the road side shops which are highly involved in wholesale business, public service centers are located within the small extent of area and on street parking facility provided by the Jaffna Municipal Council for three wheelers, and motor cycles were identified and mapped individually.

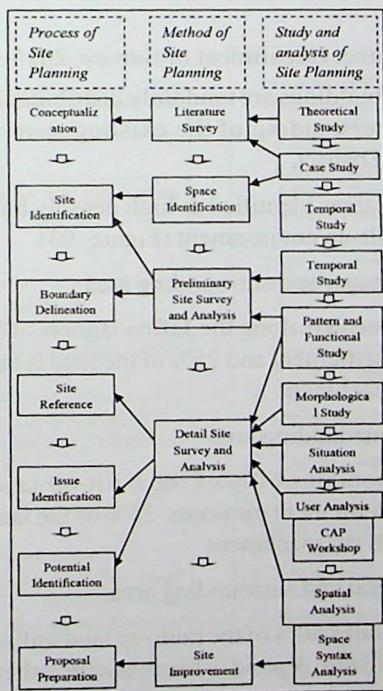
Land value of each plot was mapped by using spatial interpolation technique. Small grid pattern of the land plots and land invisibility, inaccessible land plots and sub divisions, front side development and traditional way of building construction are shown by images to justify the issue of underutilization of land properly.

Sea water inclusion into the inland water sources, sewerage water penetrated into the ground water layers, solid and liquid waste disposal into the surface water sources and channels, liquid wastes penetrated into the ground water layers and Lack of water retention and restoration issues are justified with the support of literatures that are highly investigated in water issues of Jaffna.

Root cause analysis was performed to find the causes for identified four crucial issues in the site. Users of the site were clustered and performed user analysis to investigate user perspective on site issues, potentials and needs. Especially CAP workshop technique was adopted to conduct user analysis effectively. Further spatial analysis was performed to illustrate the connectivity pattern, flow, issues and potentials in the site and surrounding areas. Especially spatial interpolation and space syntax techniques were used to perform spatial analysis (Figure: 02).

Finally, based on the results of analysis, site designs were developed and tested physical, economical and social feasibility to improve. The entire methodology is shown in a flowchart below (Table: 02). Three advanced spatial modeling and analysis software platforms, Arc Map 10.2, UCL Depth Map 10, Auto CAD 2013 were used for spatial scanning, modeling, map preparation and analysis.

**Table: 02 – Methodology of site survey analysis and improvement**



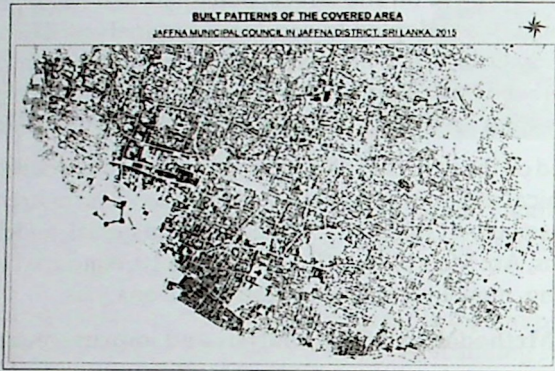
Source: Field Study, 2015

### Site delineation

Spatial pattern of the Jaffna District has been taken into consideration for selecting and delineating the suitable site for analyzing and improving. The 'built fabric' and 'functions' of the space are defined as two criteria for clipping suitable site.

Firstly, the clipping was done based on the built fabric criteria (Figure: 02).

**Figure: 02 - Built fabric of the Jaffna district**



Source: Department of Survey, 2015

The map shows how buildings are randomly distributed in the space at present and provides a clear understanding of the existing spatial pattern of built-up environment in the Jaffna District.

There were three key areas identified as high densely built-up areas according to the spatial pattern of built-up environment (Figure: 03).

1. Cross Street, Kurunagar and surrounding area.

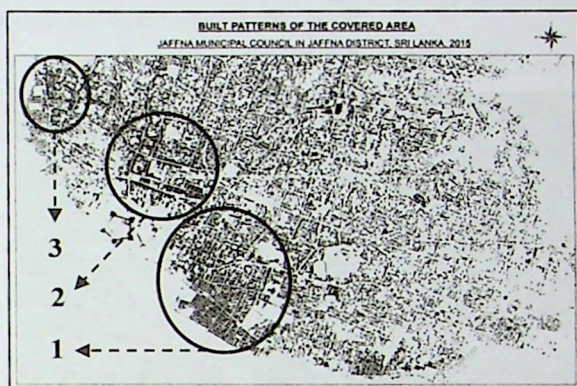
It is an area which is located along the Jaffna lagoon. 70% of the built-up land utilized for grid pattern of settlement and 25% of the land is underutilized. 08 ponds are located with high encroachment.

2. Town Center and surrounding area.

It is an area which contains 60% of the built-up land including 50% for commercial and 10% for settlement purposes. 25% of the land is underutilized. 05 ponds are located with high encroachment.

3. Paasaiur, Navanthurai and surrounding area.

It is an area which contains 60% of the built-up land utilized for settlements and 35% of the land is underutilized. A pond is located within the area.

**Figure: 03 - Built fabric of the selected Sites**

Source: Department of Survey, 2015

Secondly, based on the Built fabric demarcation, land use, connectivity and socio-economic functions (criteria-1) are defined to evaluate functionality of the areas (Table: 03).

**Table: 03 - Functionality of the selected sites**

1. Functions of Cross Street, Kurunagar and surrounding area.
a. Settlement
b. Fisheries for livelihood
2. Functions of Town Center and surrounding area.
c. Settlement
d. Commercial
- Departmental stores and shops - Grocery shops, Super markets, Stationary
- Banks - State banks, Private banks
- Insurance and financial institutions - Semi government and Private institutions
- Markets - Whole sale, Vegetable market, Local products market (Palmira products)
- showrooms and service centers - Electrical, Electronic, ICT, Vehicles
- Hardware stores
- Jewelry complexes
e. Connectivity
- Country level - A9 National highway
- Regional level - KKS road, Palaly road, Point Pedro road, Manipay road, Karainagar road, Island road and Kaitihady road
- Local level - Grid pattern of roads and Pannai bridge

f. Advance services
- Health - General hospital, Private Clinics, Laboratories, Testing and channeling centers, Pharmacies
- Education - National schools, Nursing school, Medical faculty (extension) of, Jaffna University, Private IT training centers, Public library
- Recreation - Beach and Beach park, Three star (awarded) hotel, Private accommodations, Cinemas, Cultural hall, Stadium
- Communication - Competitive communication service providers, Communication and browsing centers
g. Historical, Cultural and Archeological
- Public library, Clock tower
- Dutch fort, Statues of the Kings, Hindu temples, Buddhist temple, Churches and Mosques
3. Functions of Paasaiur, Navanthurai and surrounding area.
h. Settlement
i. Commercial
- Fundamental needs
j. Fisheries for livelihood

Source: Field Study, 2015

The town center and surrounding area (area 2) is selected as a site due to high density of built fabric pattern and land use, commercial and connectivity function (Figure: 04).

**Figure: 04** – Satellite view of the Site



Source: Google Earth, on 18.12.2015 at 05.30

Site is bounded by Standley road on the North, Palaly road on the East, Vembady road on the South and K.K.S road on the West. In addition to that 50 meter of exterior buffer zone of each road is included into the boundary.

### Site reference

At present, built-up areas are highly distributed all over the site and located along the roads and lanes. Most of the underutilized spaces are created at the back side of the buildings. It is clearly demarcated by applying Nolli map technique to the site (Figure: 05).

**Figure: 05** – Nolli map of the Site

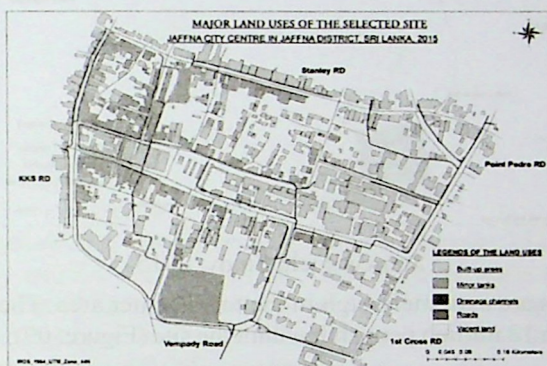


Source: Field Study, 2015

It provides a pre-visualization and understanding of the spatial arrangement and settlement pattern in the site, especially to provide a visual understanding about, how these buildings are distributed in the space.

Around 60%, 10% and 05% of the land is utilized for settlement, physical infrastructure and water bodies respectively. 25% of the land is underutilized due to the improper spatial arrangement (Figure: 06).

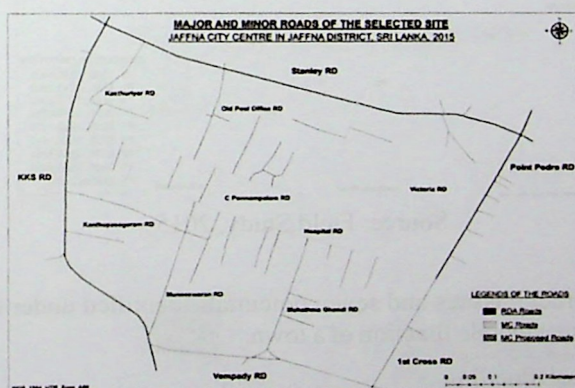
**Figure: 06 – Land Use Pattern of the Site**



Source: Field Study, 2015

Grid pattern of roads and corned junctions that were built in the Dutch and British era exist with small improvements to make effective accessibility (Figure: 07).

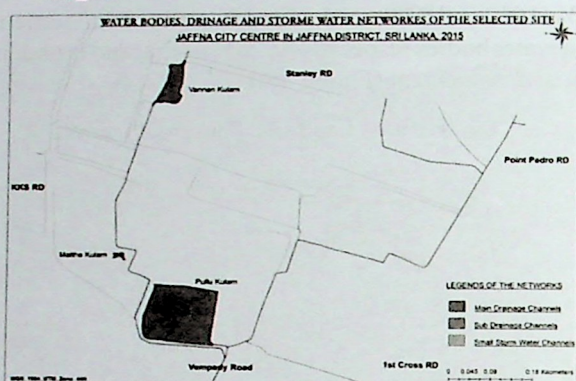
**Figure: 07 – Road Network of the Site**



Source: Field Study, 2015

Existing water bodies, drainage channels, and storm water network system are not effectively interconnected and properly managed (Figure: 08).

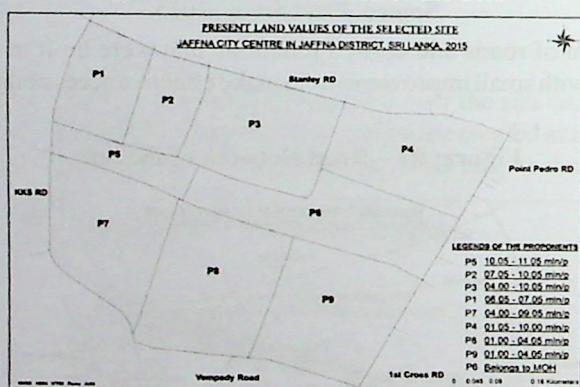
**Figure: 08 – Water infrastructure of the Site**



Source: Field Study, 2015

Land values are extremely high in the town center area. The range of value differs from 01 to 12 million per perch within the site (Figure: 09).

**Figure: 09 – Land values of the Site**



Source: Field Study, 2015

### Site analysis

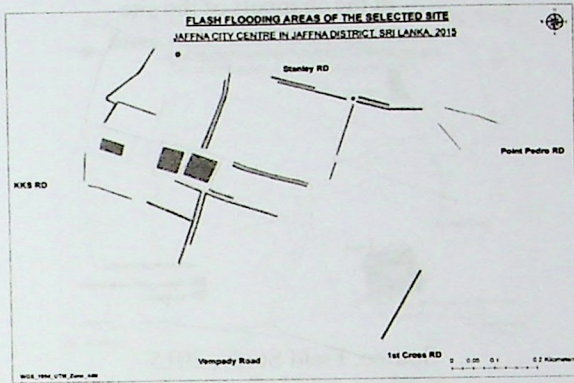
There are four crucial issues and seven potentials identified under the context of continuous and sustainable function of a town.

#### Issue- 1: Flash flooding

Site experiences flash flooding issue due to low or high volume of rainfalls. It highly occurs along the roads (Figure: 10).



**Figure: 10 – Flash flooding areas of the Site**



Source: Field Study, 2015

Incompleted drainage and storm water channel (Figure: 11), drain and storm water stagnation into the channels (Figure: 12), usage of storm water channel as waste water channels (Figure: 13), encroachment and land filling of pond (Figure: 14) and constructions over the storm water and drainage channels (Figure: 15) are identified as causes for flash flooding in the site.

**Figure: 11 – Incomplete drainage and storm water channel network of the site**



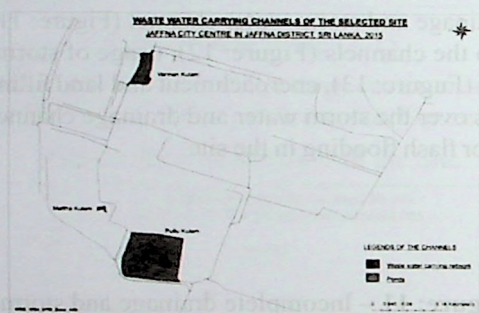
Source: Field Study, 2015.

**Figure: 12** – Drain and storm water stagnation in the channels of the site



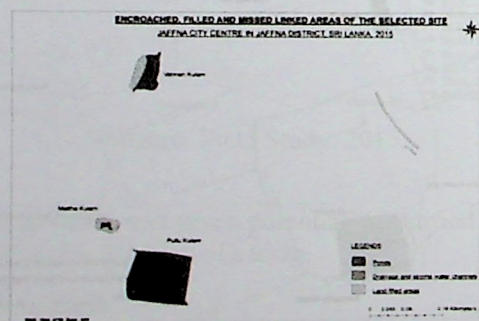
Source: Field Study, 2015

**Figure: 13** - Existing storm water channels used as waste water channels of the site



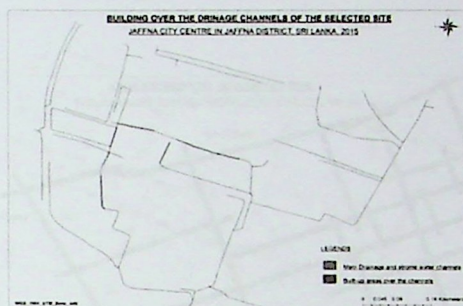
Source: Field Study, 2015

**Figure: 14** - Existing storm water channels used as waste water channels of the site



Source: Field Study, 2015

**Figure: 15** – Constructions over the storm water and drainage channels of the site

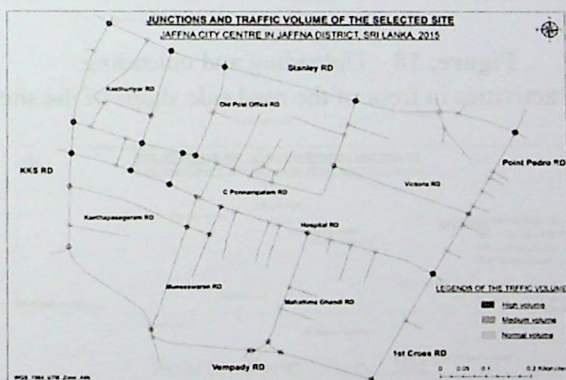


Source: Field Study, 2015

#### Issue- 2: Traffic congestion

Site is experiencing the traffic congestion issue from 7.30 am to 8.00 pm per day except Sunday. High volume of traffic congestion observed in five junctions and three main roads (Figure: 16).

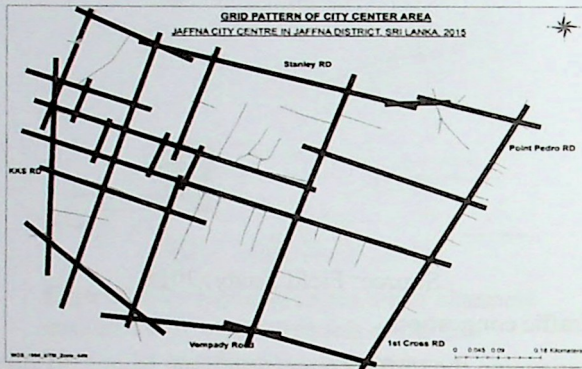
**Figure: 16** – Junctions and Road - Traffic Volume of the site.



Source: Field Study, 2015

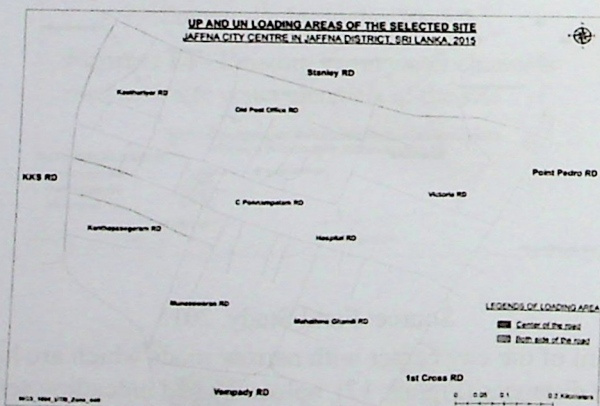
Grid pattern of the city center with narrow roads which are having junction within 150m of distances (Figure: 17), uploading and unloading activities in front of the road side shops which are highly involved in wholesale business (Figure: 18), public service centers are located within the small extent of city area (Figure: 19) and on street parking facility provided by the Municipal Council for three wheelers and motorbikes (Figure: 20) are causes for traffic congestion in the site.

**Figure: 17** – Grid pattern of city center with narrow roads of the site



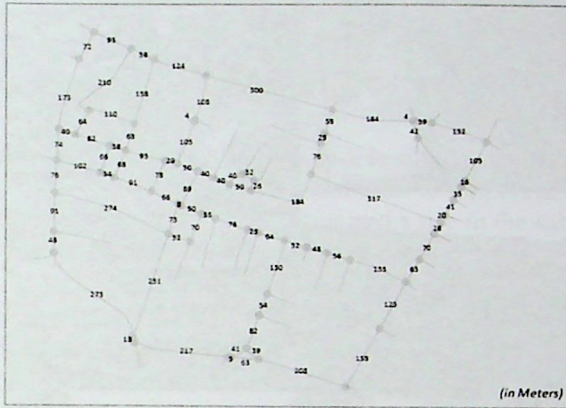
Source: Field Study, 2015

**Figure: 18** – Uploading and unloading activities in front of the road side shops of the site



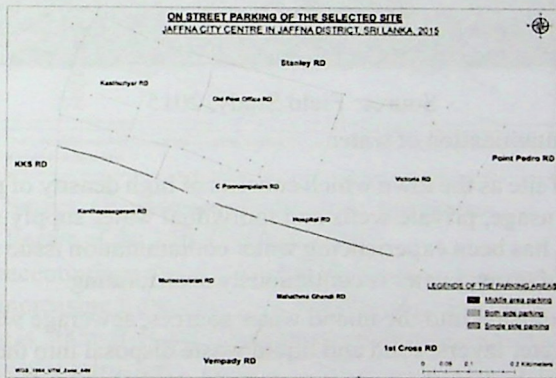
Source: Field Study, 2015

**Figure: 19** – Distance between Nodes of the site



Source: Field Study, 2015

**Figure: 20** – On Street parking facility of the site

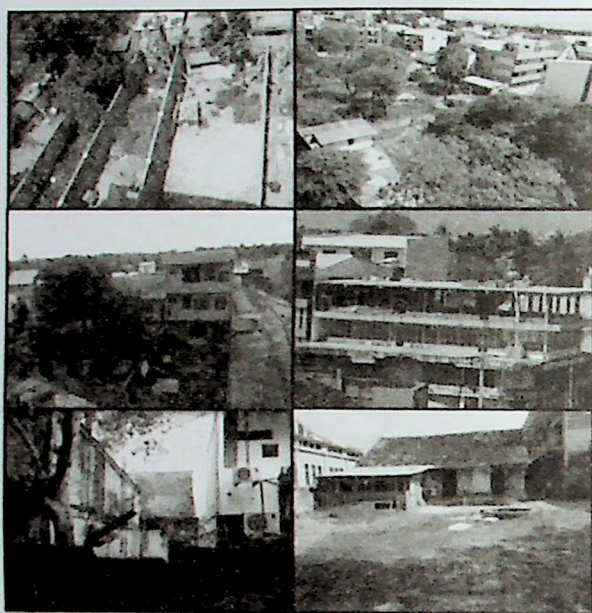


Source: Field Study, 2015

### Issue- 3: Underutilization of land resources

Land use patterns have been creating underutilization of land issue in entire site since 2006 (Figure: 21). Small grid pattern of the land plots and land invisibility, in accessible land plots and sub divisions (Figure: 17 & 19), private ownership and front side development, traditional way and model of building construction (Figure: 21) and high value of the land and property (Figure: 09) are identified as causes for this issue. Under the urban context floor areas are increasing but the utilization of them is flowing in adverse direction.

**Figure: 21 – Underutilization of land**



Source: Field Study, 2015

#### Issue- 4: Contamination of water

The selected site as the town which consists of high density of population and volume of water usage, private wells and individual water supply system, mixed land use patterns, has been experiencing water contamination issue since mid 20th century. Quality of groundwater is continuously deteriorating.

Sea water inclusion into the inland water sources, sewerage water penetrated into the ground water layers, solid and liquid waste disposal into the surface water sources and channels, liquid wastes penetrated into the ground water layers and lack of water retention and restoration are identified as primary causes for water contamination in the site.

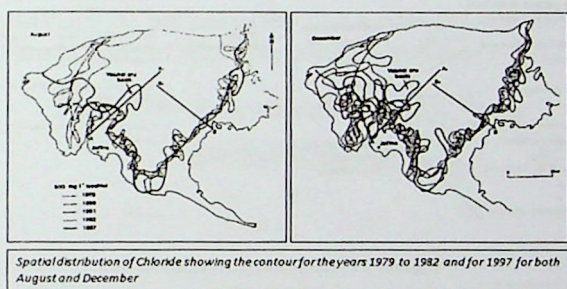
Water contamination was tested and proved by number of scholars and professionals. According to their literatures, major water quality problem, identified in the 1950s, and highlighted in the 1960s, is seawater intrusion into the groundwater system (Balendran et al. 1968).

In the north zone of the Peninsula where the intensive study was carried out during the period 1973 - 1976 in an area of 55 sq. miles, indicates that 39% of the wells became brine (K, Shanmugarajah 1993). 80% of the wells in the Peninsula are affected by high nitrate concentration (Gunasekaram 1983).

The electrical conductivity was  $300 > 22000\text{S cm}^{-1}$ , pH rate was 7.0 reflecting the alkaline nature of the limestone aquifer and coastal region identified as a high salinity area and some built-up areas in coastal zone have higher chloride levels. Nitrate concentration value range is  $< 8$  to  $> 165\text{ mg l}^{-1}\text{ NO}_3^-$  with a mean value of  $25\text{ mg l}^{-1}\text{ NO}_3^-$ . Selected agricultural and urban well, reach value of more than  $100\text{ mg l}^{-1}\text{ NO}_3^-$ . A single well in Jaffna town demonstrated a high nitrate level  $115\text{ mg l}^{-1}\text{ NO}_3^-$  (Rajasooriyar, Mathavan, Dharmaganawardhane & Nandakumar 2002).

A significant contributory factor to the high level of chloride in the cultivated land areas in the extensive extraction of groundwater in support of cultivation that has caused the lowering of groundwater levels and a rise in the saline water body (Figure: 22). (Arumugam 1969, Nandakumar 1983).

**Figure: 22**– Spatial distribution of Chloride



Source: Groundwater Quality in the Valigamam Region of the Jaffna Peninsula, 2002.

Chloride concentrations are very high in the sandy calcareous formation of the coastal regions, increasing from  $500\text{ mg l}^{-1}$  to  $> 4000\text{ mg l}^{-1}$ . But the WHO permissible level for chloride is  $500\text{ mg l}^{-1}\text{ Cl}^{-1}$ . The pattern of chloride concentration is a clear indication of seawater intrusion.

Most of the contamination happens due to improper planning of soak away pits and dug wells (Gunasekaram 1983). Distance between latrine pit and dug well are not maintained as recommended, particularly in highly populated urban areas (Table: 04).

**Table: 04** – Distance between pit latrines and dug wells in Jaffna Municipal Council area

Distances (m)	Percentage of Dug wells
< 1.5	5.7
1.6 – 3.0	8.0
3.1 – 4.5	5.7
4.6 – 6.0	6.8
> 6.1	73.5

Source: Groundwater Quality in the Valigamam Region of the Jaffna Peninsula, 2002.

## Analysis – 1: Root cause analysis

It is conducted to find out the causes for identified four crucial issues in the site (Figures: 23, 24, 25 & 26)

Figure: 23 – Root causes for Issue - 1

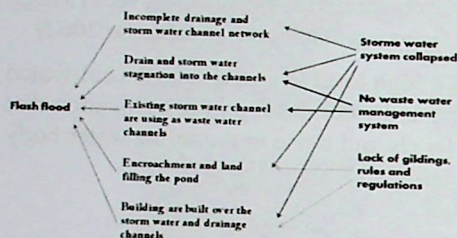


Figure: 25 – Root causes for Issue - 3

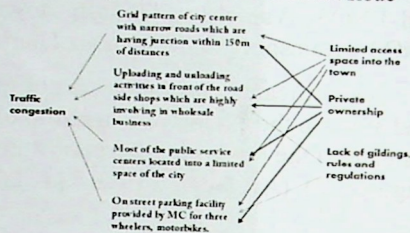


Figure: 24 – Root causes for Issue – 2

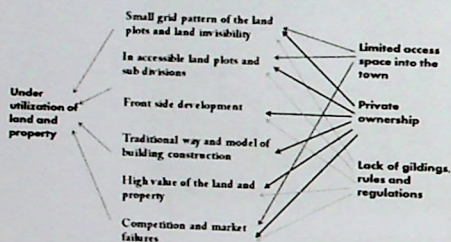


Figure: 26 – Root causes for Issue – 4

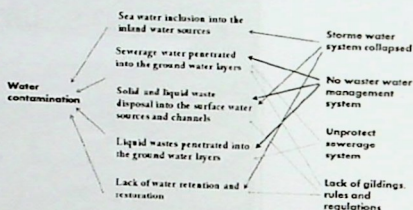
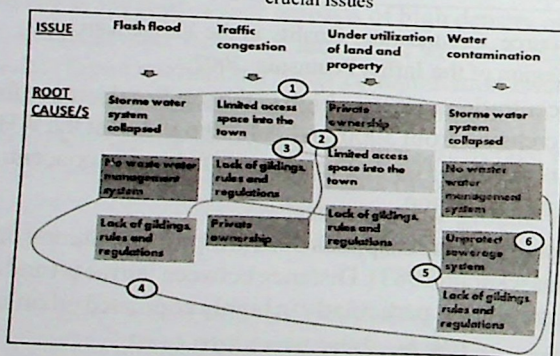


Figure: 27 – Common root causes for four crucial issues



According to the result of root cause analysis, six causes are identified for those major four issues. They are collapses in storm water system, high ratio of private ownership, limited accessible space into the town, no waste water management system, lack of guidelines, rules and regulations, and unprotected sewerage system.



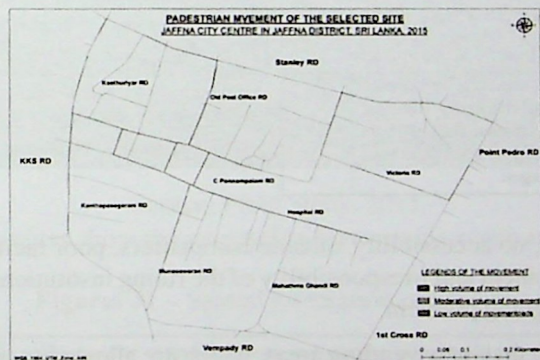
## Analysis – 2: User analysis

Wider range and volume of users utilize the site every day. They are commonly categorized as service providers, commuters, transit, inhabitants, visitors and Investors (local and national). Further, users are defined as pedestrians and public transport dependents, cyclists, motor cycle users and other private vehicle users in terms of mode of transportation of them. Before 1995, during the war, pedestrians and cyclists were highly engaged within the site. Then in 1995, public transport dependents were increased because of the re-interference of government in administration of the Jaffna district. Use of motor cycles has suddenly increased due to the improved connectivity with Indian vehicle market in Sri Lanka since 2000.

**Users:** Pedestrians and Public transport dependents; at present, the private vehicle users are gradually increasing, but not reached the peak but pedestrians and public transport dependents are very much utilizing the site in order to fulfill their health and commercial needs. Especially Pedestrians, who as commuters, workers, visitors and service obtainers, are playing major role to keep the town active.

**Issue:** Pedestrians do not have effective walkways with linkages. They are struggling on route because of the traffic congestion (Figure: 28).

Figure: 28 – Pedestrian movement in the site



Source: Field Study, 2015

**User:** Service providers; the market vendors are playing major role at local level by serving the people who are approaching town for their health, transport and commercial needs. Vegetable, fruit and Palmyra product vendors are the identity of the site.

**Issue:** But, the market vendors are facing issues due to the surrounding development at present. It was identified through cap work shop which was done in the market area with the 48% of the participation of vendors (Table: 05).

**Table: 05** – Results of CAP workshop

Identified Issues on CAP workshop in the Vegetable and fruit market	Users %
The existing vegetable and fruit market area not having visibility to the roads due to the establishment of new cloth payments around to the market premises with the permission of the government authorities.	100
The existing vegetable and fruit market area not having accessible space to the vehicle entrance to upload and unload the vegetable and fruits due to the establishment of payments in the boundaries of the market premises with the permission of the government authorities.	100
Allocated space for every single vegetable and fruit vendors is too small to carry business (5f x10f). Therefore, a vendor rent out minimum two plot area to maximum four plot areas. But they wanted to pay Rs.50/= for a plot of area per day if they do the business or not. If they rent out four plot areas, have to pay Rs.200/= per day.	83
Vending space is insecure. They cannot store things into the market at night or off days due to the reason that, it is an open area with temporary roof. The roof is also already damaged.	90

There are new competitors in the outside of the market premises. The government authorities allowed the new fruit vendors to do their business outside.	100
The existing market area doesn't have the facilities of storing, sanitation, water supply, waste management and parking for workers.	78
The existing area space is not enough to improve the facilities and creating business opportunities to them due to the location and development of the surrounding business areas.	100
The corner areas of the market are used for illegal activities like smoking at the day and night, drinking at the night and urinate at the working time also by the customers of market and surrounding business.	100
Irresponsible decision making of the ruling authorities. They provided the surrounding areas of the market premises to textiles and fancy. There was a long toilet pit located in the east boundary of the market. Authorities allowed building construction on the top of them. Nowadays the function of the toilet is totally stagnated.	100

Source: Field Study, 2015

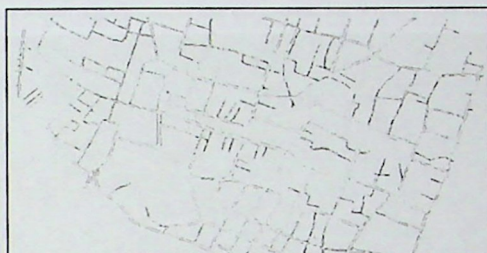
No visibility, no accessibility, outside competitors, poor facilities, no proper space for improvement and irresponsibility of the ruling institutions are the crucial factors for the ongoing problem.

In addition to that, new vending areas, which are allowed to the usage of new vendors within the city center also do not have basic facilities. These are temporarily located along the roads. It is another problem to the city center as well.

### Analysis – 3: Space syntax analysis

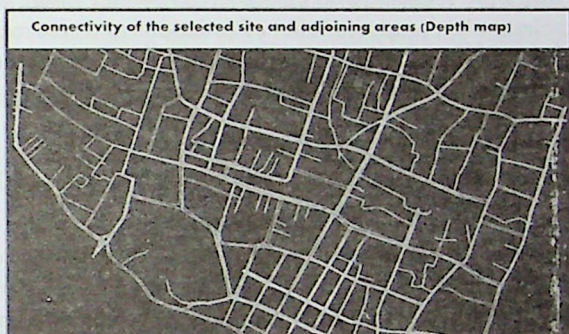
It is conducted to find out the connectivity of the grid pattern of the roads that are located in the site and surrounding areas (Figures: 29 & 30).

**Figure: 29** – Road network with road space of the site.



Source: Field Study, 2015

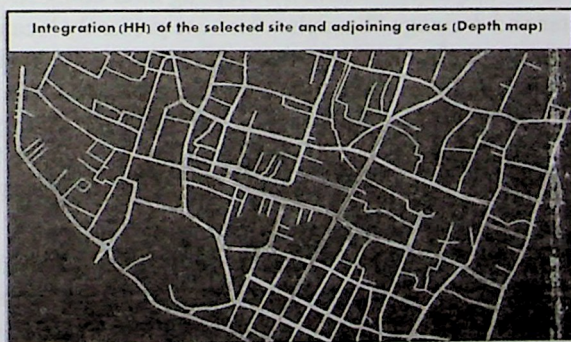
**Figure: 30** – Connectivity of the site.



Source: Field Study, 2015

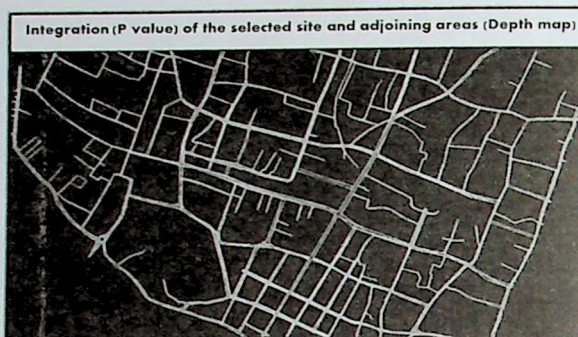
HH and P values show the integration between the roads and nodes (Figures: 31 & 32).

**Figure: 31** – Spatial Integration of the site.



Source: Field Study, 2015

**Figure: 32** – Spatial Integration of the site.



Source: Field Study, 2015

Potentials: Strategic location and connectivity, wider range of vacant land, water bodies and channels, compact model of functions and services, consistently increasing demand for commercial activities, high density of commuters as customers and consumers, and high volume of pedestrian movement.

### Site improvement

Vision to improve the site is 'to be a Green field City of Northern Sri Lanka'. It was formulated based on the network analysis.

The five objectives for site improvement are to re-integrate the existing storm water system to function effectively, to establish a comprehensive model of waste water management system, to revise and introduce the acceptable and accountable rules and regulation for managing private ownership on resources, to create an integration between the green and blue, to construct conducive and loveable environment for users, and to improve the active and multi-functional space for service providers of the city center.

The strategies for site improvement are creating inter connection between the ponds, storm water and drainage channels which are presently located into the site and adjoining area, promoting land owners to landscaping the backside which is underutilized, facilitating to improve the water retention and restoration process, providing suitable and harmful spaces to the users for better delivery services in terms of rules, regulations and good governance principles, and restricting norms with efficient guidance to achieve sustainable development through integrity of natural resources.

There are three projects identified to improve the connectivity of roads to ensure effective and efficient transportation within the site, to improve integrity between green and blue to ensure effective and efficient function of the natural environmental system in the site, and to build user-friendly space to ensure high volume of satisfaction among diverse users within the site.

Constructing new linking roads, widening the existing roads, constructing walk ways, and revising the regulations are four plans proposed to improve connectivity of roads to ensure effective and efficient transportation within the site.

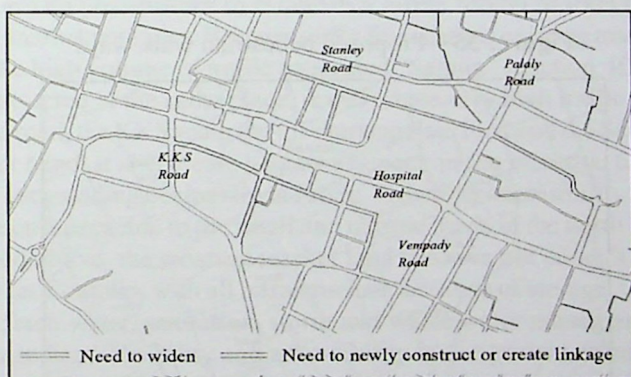
Reconstructing the existing storm water channels, reconstructing the drainage channels and link with every land uses, landscaping for create walk ability, and revising the regulations are another four plans proposed to improve integrity between green and blue to ensure effective and efficient function of the natural environmental system in the site.

Constructing the Jaffna vegetable model market complex, modernizing the bus terminal for public transport system, relocating the vehicle parking, and allocating space for the extension of the hospital are another four plans proposed to build user-friendly space to ensure high volume of satisfaction among diverse users within the site.

### Proposed plans and locations of them in the site

(Plan: 1 and 2) Constructing new roads, creating linking roads and widening the existing roads (Figure: 33) will increase the connectivity and accessibility. On the other hand, it will reduce the traffic congestion within the site.

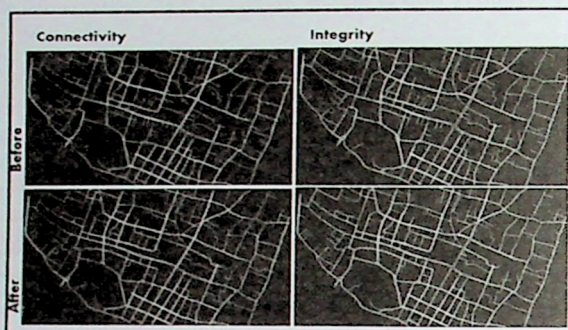
**Figure: 33** – Proposed new roads, linking roads and widening the existing Roads



Source: Field Study, 2015

Connectivity and accessibility improvement after the re-arrangement of roads are tested by space syntax analysis (Figure: 34).

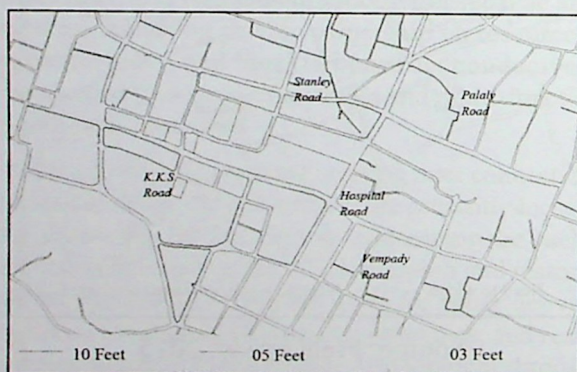
**Figure: 34 – Connectivity improvement in the site**



Source: Field Study, 2015

(Plan: 3) Constructing path ways for pedestrians will create user friendly and livable environment into the site. It will ensure the safety movements of pedestrians who mostly occupy this site in order to receive medical and health services. It will reduce the vehicle movement that causes to decrease traffic congestion within the site and surrounding areas. On the other hand, it will create spaces with walk ability and livability. Safe accessibility will ensure within the site. Pedestrian path ways will construct in 10, 05 and 03 feet according to the volume of pedestrian usages (Figure: 35).

**Figure: 35 – Proposed pedestrian walk ways**

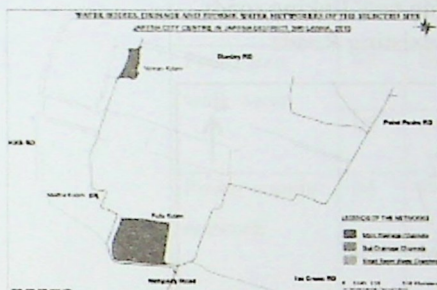


Source: Field Study, 2015

(Plan: 4) Reconstruction of the existing storm water and drainage channels and creation of linkages with every land use will increase the integrity between blue and green environment within the site. It will reduce the water related issues through ensuring water restoration and retention within the site (Figure: 36).

(Plan: 5) Construction of Jaffna vegetable model market complex with all infrastructure facilities according to their different requirements will create effective space for the vegetable and fruit vendors in the site. It will create wider opportunities to small scale business people to improve their livelihood. It will locate at the middle area of the site in order to provide efficient and effective service for all users (Figure: 37).

**Figure: 36** – Constructing new linking roads and widening the existing Roads



Source: Field Study, 2015

**Figure: 37** – Constructing new linking roads and widening the existing Roads



Source: Field Study, 2015

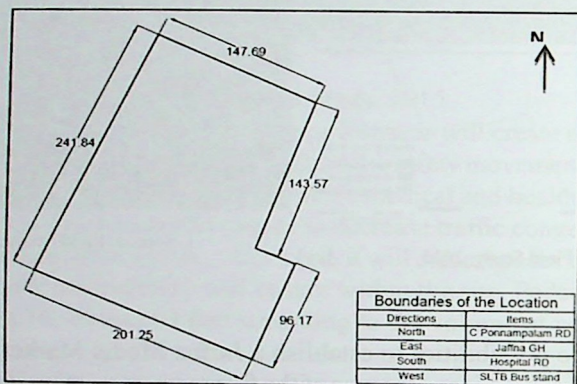
There are no possibilities to establish a Jaffna Model Market Complex into the existing market premises. Because of the five reasons existing market is located up next to the high volume of traffic congested “Sathira” junction. If a new market will be constructed in the same place, it will create very high traffic congestion in the Hospital road, the KKS road, the C Ponnampalam road and the Sathira junction. On the other hand, it will create negative impact on the effective function of the market and surrounding businesses in future. Providing accessibility is too difficult into the present space due to the small and narrow roads in the north and the south. As explained above, the existing market land space is not enough to establish a Model Market Complex with all infrastructure facilities of storage, vehicle access, electricity, fresh water, sanitation, storm and waste water management and solid waste management. Visibility and accessibility are important requirements for a successful function of a market to attract the customers. It cannot be fulfilled by existing market land space at present and future too. Providing equal opportunities and space to all, inside market vendors and outside market vendors, is an important responsibility of the planner. But the existing space is not enough for all vendors, like outside vendors.

Therefore, an ultimate space was found into the Jaffna town center according to the market demand and requirements, requirement of business people and valuable customers, land use suitability, and land value. The new location was found up next to

the Jaffna General Hospital premises. The boundaries of the site are C. Ponnampalam road in the North, Jaffna General Hospital in the East, Hospital road in the South and, Jaffna Central Bus Stand on the West.

Total extent of the site is 1300 Square meters (Figures: 38 & 39). The site is going to have buildings, parking areas, cross roads for vehicle movement and unloading - unloading, pedestrian walk ways, power supply network, water supply network, drainage network, solid waste dustbins and sanitation network (Table: 06).

**Figure: 38** – Constructing new linking roads and widening the existing Roads



Source: Field Study, 2015

**Table: 06** – Constructing new linking roads and widening the existing Roads

Contents	Area of site contents in the site		Size (Sq ft)
Buildings	03	Model Market Blocks	25,200
	02	Public toilets Blocks & water tanks	900
	01	Power unit	100



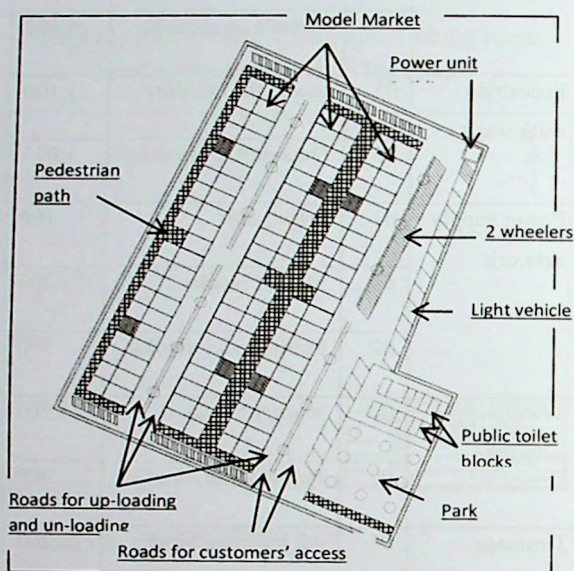
Small parking areas	02	light vehicle parking	1,900
	05	Two wheelers parking	2,680
Cross roads	02	Up-loading & un-loading	7,200
	02	Vehicle movement	9,600
Pedestrian walk ways	03	Inside the building	1,100
	05	Outside the building	1,015
Power supply network	01	Power unit	100
	03	Market blocks	25,200
	02	Public toilet blocks	900
Water supply networks	03	Market blocks	25,200
	02	Public toilet blocks	900
Drainage network	06	All building blocks	26,200
	02	All cross roads	9,600
Solid waste dustbins	03	Market buildings	25,200
Sanitation network	02	Public toilet blocks	900

Source: Field Study, 2015

Three blocks are going to be built within the site. Every single block is going to be built as two stories buildings with floor extent of 8,400Sqft that; ground floor extent of a block is 5,250Sqft and first floor extent of 3150Sqft. Altogether, the market building floor extent is 25,200Sqft.

This building design is something different from common designs of two-storey buildings. This design is highly focused on business requirement and customer's satisfaction. Especially in Jaffna, customers are not like to go to upper floors to buy goods and get services. They like to get every thing in the ground floor level. On the other hand, the visibility and accessibility of those upper floor also do not satisfy the customers and business people.

**Figure: 39** – Blueprint of the Jaffna Vegetable model Market



Source: Field Study, 2015

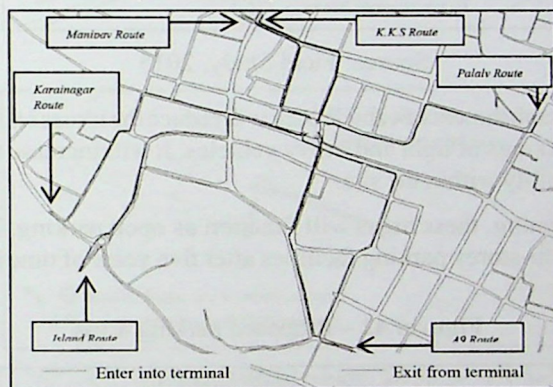
The new design considered the needs of the customers and business people. The ground floor has 18 shops and the first floor has 19 shops. The extent of a single shop in the ground floor is 200Sqft. The extent of a single shop in the first floor is 150Sqft. Every shop has a 50Sqft vacant space in the back side of the ground floor. The solid waste dustbins are going to be built within the space.

Two public toilet building blocks are to be constructed for men and women. It is planned to serve for the business people and customers of the market. Extent of a block is 450Sqft. Total extent of the public toilet building is 900Sqft. Every single block plans to have one washing room (100Sqft), one toilet for differently-abled people (50Sqft), five for abled people (50Sqft x 5). Both blocks have different 10ft and 5ft paths to access.

One power unit building is going to be built on the site. The extent is 100Sqft. It will function as the main electricity receiving and internal supplying unit. This building must be constructed with the all protective layers.

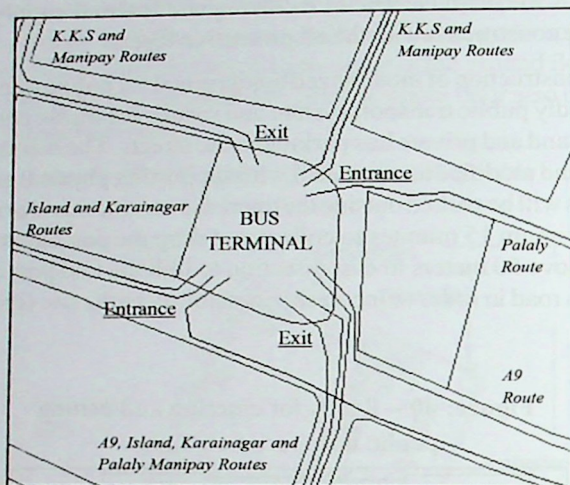
(Plan: 6) Construction of modernized bus terminal for public transportation will create user-friendly public transport system and reduce the traffic congestion that is created by bus stand and private bus parking in the streets. The bus stand is going to be transformed and modified as a terminal with supporting physical and social infrastructures. Buses will be parked outside the town. Government and private buses will just stay for maximum 15 minutes to collect and drop the passengers. The existing bus stand will move 50 meters in east direction to link the Old post office road and the Muneswaran road in order to increase accessibility in the site (Figure: 40 & 41).

**Figure: 40** – Roads for entering and exiting public transportation buses



Source: Field Study, 2015

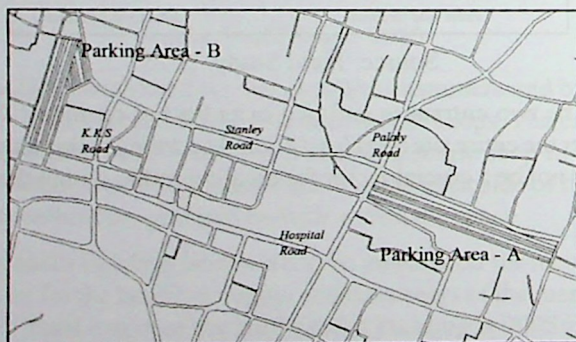
There will be two entrances and two exits for bus terminal. The bus route is designed to cover the entire site by at least once. According to this model, movements of the buses will not be a crucial factor for creating traffic within the site.

**Figure: 41 – Bus terminal and entrance and exit**

Source: Field Study, 2015

(Plan: 7) Establishment of vehicle park will reduce the issues caused by on-street and off-street parkings of light and heavy vehicles. It will increase the walk ability and safe accessibility within the site.

At the beginning, these areas will function as open parking. This space will develop with multi-storey parking facilities after five years of time (Figure: 42).

**Figure: 42 – Proposed parking areas**

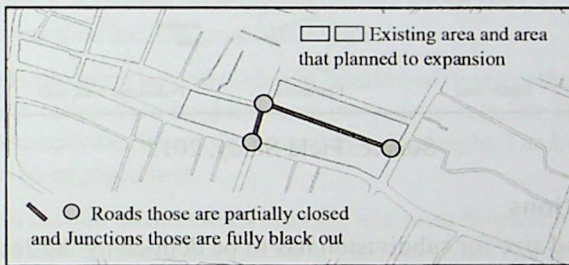
Source: Source: Field Study, 2015

The Jaffna general hospital is known as the heart for the supporting health, commercial, and administrative functions of the Jaffna town. It is a phenomenon that has been determining and influencing the evolution of the site and its function since 1940s. Definitely, the town will decline if this hospital is moved away due to the functional dependency of investments made around hospital.

(Plan: 8) The Hospital expansion is needed to provide improved services to the users who come from all over the places in the Northern Province. The hospital has been expanding on the east – West direction until 2018, which is not appropriate according to the natural location, spatial pattern and functional arrangement of the site. It has been creating spatial issue like traffic congestion in the site since 2000s.

It highly affects the connectivity function within the site. Two roads, C.Ponnampalam and Mahadma Gandhi road, were partially closed and three junctions were fully blackout their functions due to the expansion of the hospital (Figure: 43).

**Figure: 43 – Hospital premises and connectivity issues**



Source: Field Study, 2015

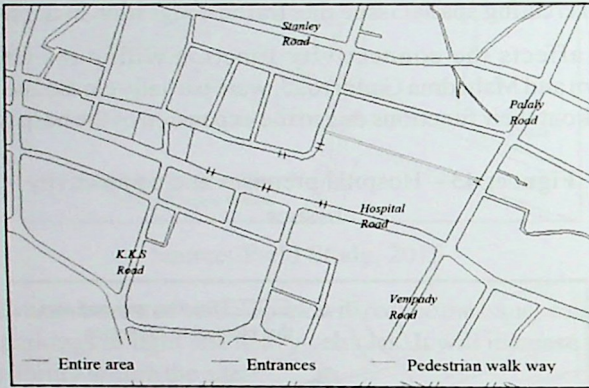
Commercial functions of the site are highly developed along the Hospital road and Stanley road. The hospital expansion is also happening between and parallel to these two roads. Only three cross roads, the Old post office road, the Kasthuriyar Road and the Clock tower Road, link these major two roads. The Old post office road and the Kasthuriyar Road are allowed to access in one direction. Further, the Kasthuriyar Road only connects both the major roads directly in single direction. Remaining two cross roads start from the Stanley road and joining in the Old power house road and meet the Hospital road by a small cross road.

This pattern of hospital building distribution and road network development highly affect the connectivity. Therefore, the expansion of the hospital in the west – east direction has to be controlled and should be continuing in the south – north direction if needed.

In order to carry out this expansion, private lands which are located in the north side of the Victoria road have to be encroached by paying compensation.

The existing Victoria road space will be occupied by the hospital and modified as walk way in order to serve the people who need to access the railway station and the bus terminal quickly. The New Victoria road will be constructed at the new north boundary of the Hospital. Six entrances will be available to access the hospital at a time. Every single entrance will allocate for accessing different medical and health services. The second main entrance for accessing the Intensive Care Unit has to be established in the west boundary of the hospital via walk way in the site (Figure: 44).

**Figure: 44** – Proposed area for expansion of Jaffna General Hospital



Source: Field Study, 2015

### Recommendations

- Minimum land size for subdivision has to be defined by the Jaffna Municipal Council and the Urban Development Authority.
- The rules, regulations and policies on land use must be formulated by the Jaffna Municipal Council and the Urban Development Authority to control arbitrary development that has been highly occurring within the site without honoring the sensitiveness of the natural environment.
- Land and property values have to be controlled by authorities in order to make space available and possible for any level of investor.
- Taxation policy has to be revised by paying attention on type, level and scope of investment. A common taxation is not appropriate for a diverse investment on space.
- The Jaffna town development should be directed to the east direction than the north and the west.
- The Jaffna Hospital has to be expanded in the north direction rather than east direction.

- If only possible in future, the Mahatma Gandhi road and Clock Tower road, which are separated by the hospital, should be linked again to increase high level of connectivity by using advanced engineering technology (Over head bridge) without affecting the function of the hospital.
- Construction over the channels must be avoided in future. In order to make sure of effective function of channels it should be modified as the location where the construction is already made. It does not mean to maintain all channels open. It should have accessibility to clean and monitor.
- Linking roads have to be constructed in order to reduce underutilization of land due to inaccessibility.
- Improve the visibility of ponds and channels to reduce the pollution. The spaces for pedestrian movement could be created along these ponds and channels to reduce the pollution.
- Charges for light and heavy vehicles on streets should be increased in double to encourage them to properly utilize the parking space. At the same time, reasonable fee has to be collected from motorbike parkers. Fees collectors should be employed in Hospital road, K.K.S road, Stanly road, Power house road, C. Ponnambalam road, Kasthuriyar road and Old post office road.
- Uploading and unloading activities should be allowed doing in the newly created back side roads rather than hospital road in order to regulate the traffic flow. Otherwise, these activities have to be permitted to do at night. The Jaffna Municipal Council has to be engaged in it.
- Temporary and mobile businesses within the site must be prohibited in order to support and protect registered businesses and investments. The Jaffna Municipal Council has to monitor this.
- People participation should be increased in flood management. The Jaffna Municipal Council has to organize awareness programmes about flood management. It will empower and mobilize the people to act on it.
- People participation should be increased in waste management. The Jaffna Municipal Council has to organize awareness programmes about solid and liquid waste management. Especially about separation and disposal of degradable solid and liquid waste at domestic level. It will empower and mobilize the people to act on it. Increasing the charge for waste collection will motivate the people to participate in this process.
- The Jaffna Municipal Council must pay individual attention on the waste produced in the hospital. Sewerage and medical waste that are produced by hospital is hazardous. It will quickly affect the people due to the high density of them within the site as a town. It affects the natural environment too.

## Conclusion

The Jaffna General Hospital and the Bus Stand are the core elements that have been determining the successful function of this site since 1940s. The total function of site will decline if these two elements are moved. These are the two elements that cause major issues within the site too. Therefore, the improvement of the hospital should be carried out on the north direction and the bus stand has to be transformed as a well structured terminal.

In addition to that, there are lack of rules, regulations and policies regarding land subdivision, land value, land use and natural resource management. Therefore, Jaffna Municipal Council and Urban Development Authorities have to pay high attention on formulating and implementing by laws and controlling and managing the spatial and functional development properly in the site.

Further, flooding, waste management and natural resource integration issues could be solved by people participation. The Jaffna Municipal Council is a responsible institution to empower and mobilize the communities and societies for the successful function of the site.

There were no much centralized planned development occurred since the Jaffna town center site evolved from colonization period. Most of the developments are happening arbitrarily due to the private ownership. Three decades of war is also a major factor for delaying in formulating rules, regulations and policies relevant to spatial and functional development. This is the time for an action that should be taken by responsible authorities like the Jaffna Municipal Council and the Urban Development Authority to design, control and manage the site improvement properly. Here, the eight plans that are proposed through a comprehensive research will be implementable to improve the Jaffna town site to be a Green Field City of Northern Sri Lanka.

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