CHAPTER I: INTRODUCTION

Due to environmental change, land use changes, climatic change and loss of biodiversity; sustainable land use has become an important analytical and policy issue (Finco and Nijkamp, 1997). Therefore, the demand on land as a space and as a natural resource has increased. With time the natural resource per capita will decrease implying further stress on land, land-use, and resources management.

As stated by Darin (1977) "That is, existing resources are being utilized to such a degree that, if the rate of growth continues in the future as in the past, the natural resource base will not be able to supply growing needs created by technological progress. The solution to the problem, as proposed, is a slower growth rate." What should be referred to here is that the natural land resource is a source of income and the most important element in food production, and is thus a source of living, that has to be preserved, and utilized efficiently to satisfy the future generation's needs. Therefore, sustainable urban growth and land resources management are significant issues to be considered in planning.

(1.1) Relevance of the Study:

This research focus on how land resources management should be introduced in planning for rural areas and towns to satisfy urban expansion and population growth needs in a systematic and planned manner, by addressing the most related issues, which contribute to the subject of land resources sustainability.

It aims at setting an approach for environmental land use planning at the local level, in rural areas and towns, within a sustainable manner, by managing the environment and the land resources, and defining the urban growth boundaries, which satisfy the urban needs for these localities, and fulfill the environmental issues. Besides, it intends to outline a managerial process for monitoring the land use change with time, for resource management, attaining sustainability, and to achieve an efficient design.

Furthermore, this study is important for setting a sustainable framework for land resource management and sustainable urban growth planning. This was achieved by classifying areas according to the available land resources and environmental value, then identifying the most suitable areas for urban development and estimating the design period upon which the available areas will satisfy the projected urban growth needs.

It has introduced new definitions for the concept of sustainability, in order to promote a sustainable framework, for which some indicators and measures were developed and identified for assessing sustainability.

The study has also defined some indicators for measuring the efficiency of the design, to ensure that the urbanization process conforms to the design standards. Whereas, a managerial process for land resources sustainability was developed, by monitoring and managing the system urban growth to perform in a sustainable manner within the available areas suitable for urban development.

Finally, an environmental land use plan was developed for the area of concern, Halhul, which considers a sustainable framework for urban development plan under two geo-political scenarios.

(1.2) Study Objectives and Goals:

- To identify the most sustainable model for urban growth in Halhul area, under two geo-political scenarios.
- To define and find appropriate measures for sustainability.
- To set a managerial approach for sustainable land resources management, and sustainable urban growth.
- To prepare an environmental land use plan for Halhul area.

(1.3) Problem Identification:

Rural areas in Palestine have witnessed random and sometimes illegal urban expansion in the absence of local authorities, effective laws and enforcement. Therefore, urban expansion has taken place in an unplanned manner, as a result of an increase in population growth, urban growth and needs, higher standards of living and an increase in service provision. Besides the geo-political situation in the Palestinian territory which adds many constraints, and restricts the urbanization process under certain circumstances, by limiting the opportunities of urban expansion and enforcing obligatory directions, on areas that may be highly environmentally sensitive, such as high value agricultural lands or water sensitive areas.

Therefore, there is a need to set an approach for classifying the land resources value within a region, by considering the available land resources in order to identify the most suitable urban development boundary in which urban growth will be permitted within a region.

Thus, in these areas a sustainable framework for land resources management and urban growth management should be developed, to satisfy urban growth demands, population growth, and protect environmental sensitive areas, cultural sites, ecologically sensitive areas, agricultural lands, nature reserves and forests (MOPIC,1996).

Taking into consideration that in the Palestinian case, the geo-political situation has its unique influence, and which is a driving force that adds constraints, and determines where urban growth can take place, by limiting urban growth opportunities within the boundaries of each village, town and city. That is why the effect of the geopolitical situation has its own influence on the urbanization process itself and on the land resources sustainability. However, in planning, different scenarios should be accounted for, in order to accommodate any political changes in the future, and to eliminate the political effect and its influence on the resources sustainability as much as possible.

In this research, the case study of Halhul was used to develop a land resources management plan. It was a good example since it has vast agricultural areas; about 65% from the total area is considered as agricultural lands, and is cultivated with permanent crops, as it is well known for vineyards and fruit trees cultivation. In addition to the geopolitical status, which adds constraints on the opportunities of urban expansion, limited to the west on the agricultural lands, leaving no other choice for the future generations to expand, threatening agricultural lands and the farmers' main source of income.

(1.4) <u>Research Questions</u>:

1) What is the sustainable model for Halhul under different scenarios?
2) How could sustainability be measured?
3) How could we manage urban growth within a sustainable framework?
4) What is the systematic approach for land resource management and sustainable urban growth?

5) What is the difference between the designed urban growth (model) and the actual urban growth (system)?

(1.5) Research Methodology:

The research was conducted through a systematic process, which started by identifying the research problem, which is the main subject of research in this study concerning land resources management and development within a sustainable framework. This concern has been raised as a result of an increase in population growth, urban growth, and higher standards of living. Besides the geo-political situation which adds many constraints, and restricts the urbanization process to specific circumstances, by limiting the opportunities of urban expansion and enforcing defined directions that may have valuable land resources.

Therefore, there was a need to identify the available land resources within a region and understand all the threats, opportunities, and study all the available related factors. This was conducted through the data collection phase, which was carried out in different manners, in order to understand and study the area of concern through interviews, literature review, and maps prepared and analyzed by using Geographical Information System (GIS) software.

Then the main objectives were developed to include; developing a sustainable framework for land resources management, sustainable development model for Halhul, and define an approach for environmental land use planning (land resources management).

After that, two alternatives were considered to be analyzed and studied which were developed according to the two assumed geo-political scenarios, as they are the major factors, which could curb the development process and influence the resources sustainability, in order to study how they interact in the area and realize their effect.

Hence, the two geopolitical scenarios were introduced and analyzed by integrating spatial data to the socio-economic, environmental and physical factors, using the land suitability analysis method to develop a land suitability model for land resources value, classified into highly sensitive areas (HSA), , moderately sensitive areas (MSA), low sensitivity areas (LSA), and not sensitive (NS). Then obtaining the sustainable models for both scenarios, by using the GIS spatial analysis, Statistical Package for Social Sciences (SPSS) for the questionnaire analysis, and setting a sustainable framework upon which the models will be evaluated, in order to select the most sustainable alternative model. See Figure (1.1) for a schematic outline of the research methodology.

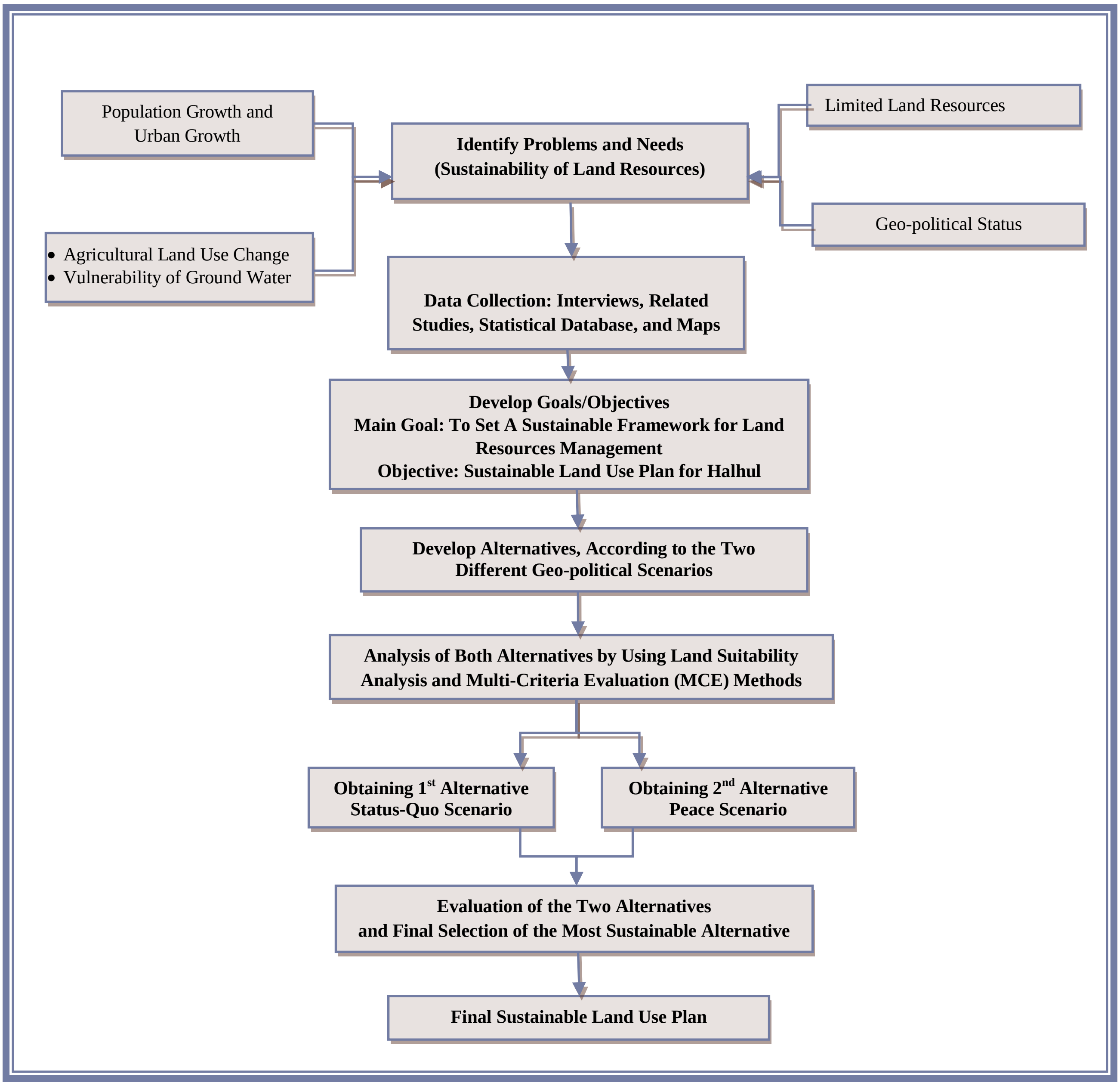


Figure (1.1): Research Methodological Framework

Source: Ruiter et. al., 1998

CHAPTER II: LITERATURE REVIEW:

In order to understand the issue of planning for land resources management through a sustainable approach, one should understand what these resources are and how they are managed. In addition to the land-use impact, which has influence on the sustainability of land resources, to ensure that a sustainable design can be attained, furthermore the methods and approaches for land analysis and management should also be considered. This has been studied, whereas the most significant relevant issues will be displayed in this Chapter.

(2.1) Land Resources and Management:

Land is classified as natural resources, which comprise agricultural lands, water sensitivity lands and other land cover classifications (Levy, 2003).

"Given that land is a finite resource which must satisfy a multitude of needs, it is crucial that its ultimate use be planned wisely" (Darin, 1977).

Platt (1975) has illustrated the one land parcel as shown in Figure (2.1) which includes all the material, biological, and chemical factors which surround human kind and constitutes the complex ecological system called the biosphere and so it is "the air we breathe; the water we drink and use for recreation, the land we cultivate, mine and build on, the cities we flock to in growing numbers; and the wilderness we seek to enjoy today and to preserve for future generations" **(**Dale, 1990).

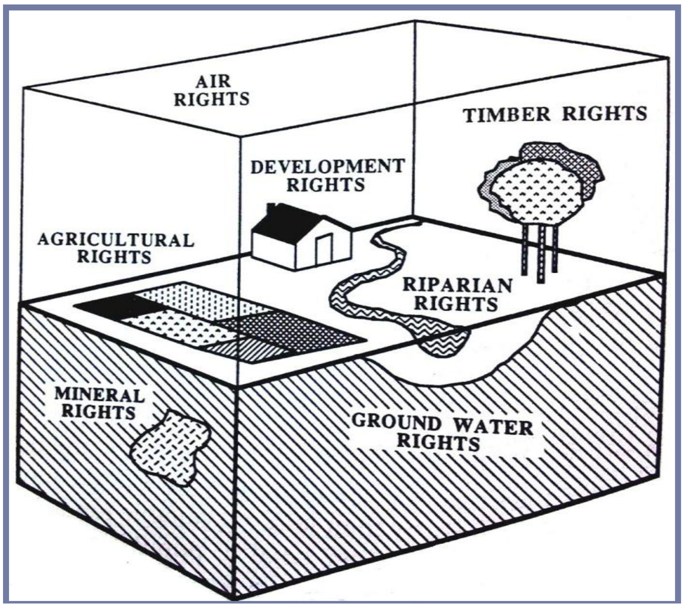


Figure (2.1): The Land Parcel Based on Platt (1975)
Source: Dale, 1990

Land-use "denotes the human employment of land" (Turner and Meyer, 1994). Skole expands further and states that "land use itself is the human employment of a land cover type, the means by which human activity appropriates the results of net primary production as determined by a complex of socio-economic factors" (Skole, 1994); where land use and land cover are not equivalent although they may overlap. "Land cover is the biophysical state of the earth's surface and immediate subsurface" (Turner et. al., 1995).

The natural land resources and managed natural systems are critical for human subsistence, livelihood and quality of life. Nonrenewable resources such as fossil energy, minerals, and land are subject to depletion. Sustainable management of water resources and productive "working landscapes", like agriculture and forestry is necessary for continued development of renewable resources, water, food and fiber (Randolph, 2004).

Human activities impose pressure on the environment, that impact essential natural systems and ecosystems by resource exploitation and pollution, such as groundwater recharge (Levy, 2003).

Land-use influences hydrologic systems, and pollutes surface and groundwater. Through the impervious surfaces (roads parking lots, rooftops) associated with urban development, which increase and speed runoff from storms increasing downstream flooding, reducing infiltration into the ground, reducing groundwater recharge and diminishing stream low- and base flows that are dependent on seepage of subsurface water (Kelly,2000).

Agricultural, urban, forestry and mining uses of the land increase erosion and sedimentation and runoff pollution.

These environmentally sensitive areas have different environmental value, such as important habitats, prime agricultural soils, and scenic areas.

The most successful land development is the one which considers both, the natural environment and the cultural community. "These include preservation of natural features, the efficient use of resources (land, materials, and energy), and enhancement of community features" (Randolph, 2004), such as; water resource protection, environmental resource land protection, ecologically sensitive land preservation and protection against natural hazards.

Rural and small town land use and development are important in environmental land-use management problems, in which the green field areas are home to important ecological, cultural, and agricultural resources. Their value for resource production of agriculture, forestry, and mineral extraction has considerable environmental impact. In addition, they are increasingly attractive, as people grow weary of congestion and lifestyle of the city and suburbs (Randolph, 2004). Rural areas and towns are those areas, which depend on agricultural land use and forestry for their income with low population density, and low settlements density, and thus a high share of free space. Where people have a rural or village lifestyle with tendencies for some of emigration (Bantle, 1998).

They are" characterized by a balance between the natural environment and human uses with low density residential dwellings, farms forests, mining areas, outdoor recreation and other open space activities. Commercial uses will be small in scale and provide lower convenience service to the rural neighborhood. Industrial uses will generally be those that are related to and dependent on natural resources such as agriculture, timber or minerals. Home based occupations and industries will be allowed throughout the rural area provided they do not adversely affect the surrounding residential uses (Douglas, 1999).

Management aims to control the interactions of people and the environment, it involves the interaction of people and institutions, where "planning and management involves people interacting in a competition of ideas and values, shaping the technical, institutional, legal, and policy means of managing the environment" (Randolph,2004).

Several environmental planning approaches specific to rural communities have been developed. Sargent, and Valera (1991) adopted the conventional planning process of rural planning, which focuses on the resource base of natural areas, agricultural lands, lakes and rivers and cultural heritage. Others such as Audirac (1997), Golley and Bellot (1999) in their analysis focus on rural sustainability. "They all agree that, achieving sustainable development in rural areas is different from urban and suburban planning. It emphasizes local self-reliance and natural resource management, watershed and ecosystem management principles are most applicable in these areas, also engagement of local stakeholders in goal setting and alternative formulation, fund raising for local initiatives, and a rapid environmental economic and social assessment".

Therefore, the local level is not enough for achieving sustainable development, there is a need for a regional context and regional policies. For example, urban growth boundary, which is a useful tool to bound development, and promote infill and development within the boundaries, to preserve natural resources and sensitive areas such as "greenfields", and agricultural lands, outside the urban growth boundary. In this way, the government will save extra expenditure for infrastructure and transportation services outside the boundary if urban sprawl would take place there (Levy, 2003). Land resource management, is to evaluate the land value, to make the decision on the appropriate land use, which is the most convenient, beneficial, classifying the resource of land for a specific use of a sustainable beneficial nature (Dale, 1990).

Upon this, the most important thing to be considered in land management is how to define land quality or formulate land classification, and so "Sustainability indicators or land quality indicators are needed to guide land users in their decision on the management of their land" (FAO, 1995).

These "Indicators are used increasingly to provide convenient descriptions of the current state or condition of a resource, as well as to gauge performance, and predict responses. Indicators are statistics or measures that relate to a condition, change of quality, or change in state" (FAO, 1995).

Furthermore, knowing land uses and identifying the most suitable one, is the key issue to management.

A seminal report on land administration prepared for the Food and Agriculture Organization (FAO), in which Binns observed that:" the land is man's most valuable resource it is indeed much more than this; it is the means of life without which he could never have existed and on which his continued existence and progress depend". He also remarked that "accurate knowledge of natural resources and accurate description and record of such knowledge are the first essentials to their rational use and conservation. The value of the information and the effectiveness of the decision making process are directly related to the quality of the information and the manner in which it is made available" (Dale et. al., 1990).

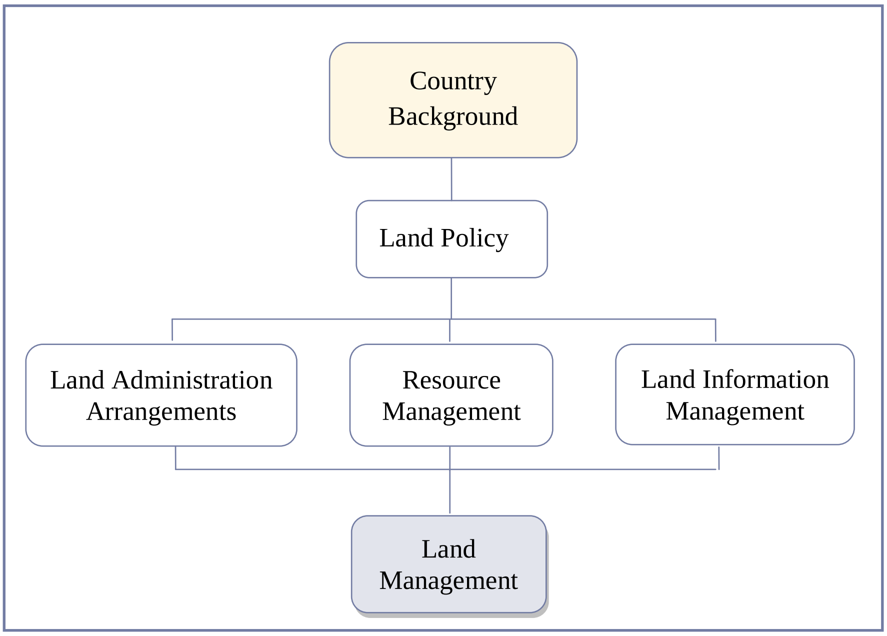


Figure (2.2): Land Management Arrangements

Source: Dale et. al., 1990

Land management "is the process whereby the resources of land are put to good effect. Land management entails decision-making and the implementation of decisions about land. Therefore, land management is developed as shown in Figure (2.2),where according to the country background; there should be a land policy and legislations. This land policy depends on land administration arrangements, resource management, and land information management. Land management includes fundamental policy decisions and routine operational decisions such as property conveyance, including decisions on mortgages and investment:

1. Property assessment and valuation
2. The development and management of utilities and services
3. The management of land resources such as forestry, soils, or agriculture
4. The formation and implementation of land use policies
5. Environmental impact assessments
6. The monitoring of all land based activities in so far as they affect the best use of the land

(2.2) <u>Sustainability:</u>

Sustainable development has been defined, as Brundtland's report, "as the capacity to meet the needs of the present without compromising the needs of the future generations to meet their own needs" (WCED, 1987)

This means managing our present development and needs; considering the future generation needs, by accounting for environmental, economic, social, and cultural factors to enhance long-term livability on this planet.

The International Council for Local Environmental Initiatives (1994) provides a practical and local understanding of sustainable development," sustainable development is development that delivers basic environmental, social, and economic services to all residents of a community without threatening the viability of the natural built and social systems upon which the delivery of these services depends".

Evans (1997) has said, "It has become a common place to assert that one purpose of planning is to secure sustainable cities, or perhaps a sustainable pattern of land use".

"Sustainable land use planning deals with an active planning of land to be used in the near future by people to provide for their needs. These needs are diverse from food products to places to live from industrial production sites to places to relax, and enjoy beautiful landscapes, from human uses to places where natural plants and animals can live and survive and many more" (Van Lier, 1994).

Also Van Lier (1994) illustrated sustainable land use planning as shown in Figure (2.3) which shows the two dimensions of both land use planning (physical planning and improvement plans) and sustainability (environmental and socio/ economic sustainability).

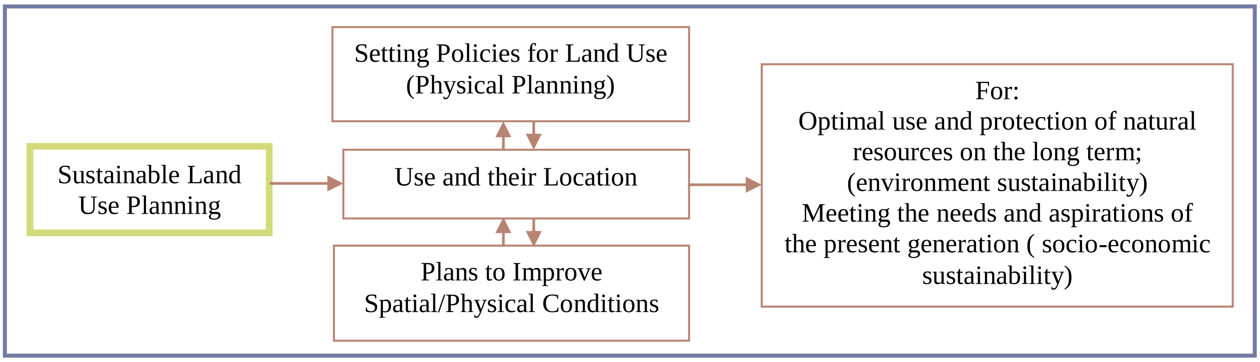


Figure (2.3): Sustainable Land Use Planning and Embracing Aspects

Source: Van Lier, 1994

Sustainability is characterized by the integration of "three E's", the tri objectives of economy, environment and social equity (Randolph, 2004).

Campbell (1996) suggests that planning for sustainability largely involves resolving conflicts among these objectives and interests, between economy and environment is the resource conflict, between economy and social equity is the property conflict and between social equity and environment is the development conflict, he asserts that by resolving these conflicts, sustainability can be achieved.

By studying the relation between the land use issue and the three aspects of sustainability, which are social, economic, and environmental aspects within or through their related indicators, we can assess the system's sustainability.

The process for sustainable land use design: (Randolph, 2004)

1. Land analysis, to understand the lands natural features, development opportunities, and constraints.
2. Creative design that incorporates features of land protection, community aesthetics, and livability.
3. Stakeholders involvement, including community groups, local government, land conservation organizations, perceptions, and cultural context.

(2.3) Environmental Planning and Land Analysis Methods/ Suitability Analysis Methods:

"Environmental planning emerged as a field at the end of the 1960s. Its emergence can be traced to two separate background forces. First, the growth of population and prosperity, humanity had acquired more ability to damage the environment. Second and more important according to some, there were changes in what we produced and the way we produced it" (Levy, 2003).

Environmental planning might involve restriction on building in steep slopes, or other ecologically valuable lands, it might involve preservation of open space, ordinances to control discharges into water bodies, prohibition or limitations on commercial or industrial activities that would degrade air quality. In a broader sense it may be connected to planning for the entire pattern of land use.

By 1960, Mc Harg popularized the concept of conforming development design to the opportunities and constraints provided by the land. Mc Harg's design with nature (1969) had a significant effect on subsequent environmental design and planning. As a first step in his design process, he applied to scales from site to a region. Mc Harg called for an environmental inventory; the process builds on basic environmental information to reveal areas suitable for human activities (Levy, 2003).

Mc Harg's method of overlaying environmental data is the basis for land suitability analysis and overlay techniques used in geographic information systems GIS (Levy, 2003) & (Randolph, 2004).

Therefore, we can use the suitability approach as one of the land management approaches to classify lands according to its potential and value, into lands suitable for urban uses, or unsuitable lands and protected from urban uses because they are natural resources such as highly sensitive areas.

The first routine task in environmental land planning, is preparing the land-use inventory, which is a study that generally begins by mapping the existing land uses. It also characterizes the undeveloped land in the community in terms of suitability for different uses.

The common practice is to prepare a series of maps that show various land characteristics, such as topography, soil, etc. In many cases, the land-use study will also contain some information on landownership, generally distinguishing between public, private, and institutional holdings at a minimum. The study might make further distinctions such as identifying major private or major institutional holders. The study may also identify some legal characteristics such as zoning categories, though these are less permanent characteristics than most of the other items mentioned.

And so," ***the environmental land inventory*** involves gathering and usually mapping a number of natural and often socio-economic factors that have a bearing on land use" (Randolph, 2004), in order to be used for land use planning and through different analysis methods such as in Figure (2.4). After that, it may follow Build-out Analysis, Environmental Impact Assessment (EIA), Carrying Capacity Analysis, or Land Suitability Analysis. This research is concerned with the Land Suitability Analysis

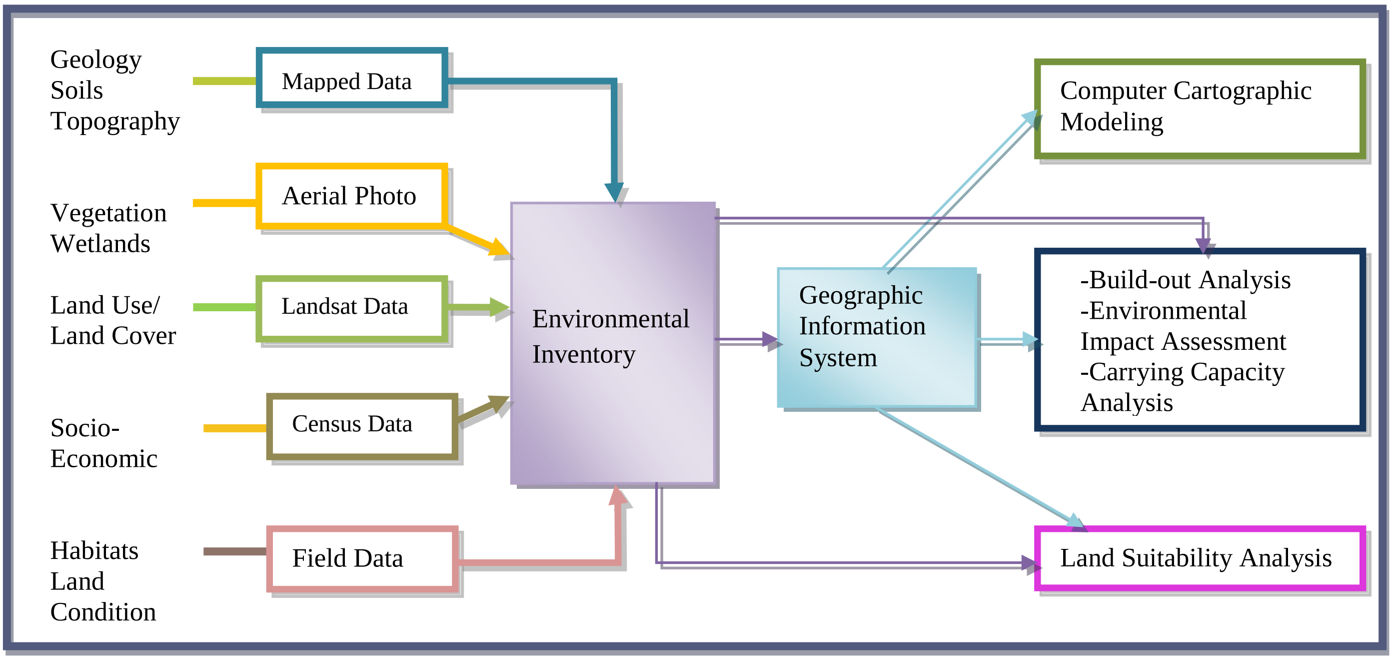


Figure (2.4): Potential Relationship of Environmental Land Analysis Methods

Source: Randolph, 2004

method. As "Land has an intrinsic suitability for particular land uses; that can be determined by combining information on individual factors". And so as to decide on the more suitable land use a method of land suitability analysis is well needed, where "the objective of land suitability analysis is to determine the appropriate location for certain uses based on those intrinsic characteristics". This can be done by identifying the land's natural features; that indicate the vulnerability of certain areas to impact or damage as a result of development (e.g. habitats, resources, aesthetic values, erosion, slope stability), and those features that indicate the attractiveness of certain areas for development (e.g. absence of natural hazards, good soils for foundations, permeable soils for septic systems, road access, etc.)" (Ruiter et. al., 1998).

And so, "land suitability analysis combines inventory information to produce composite maps that display the relative suitability for a specific use (in siting studies) or a number of uses (in comprehensive planning) " (Levy, 2003).

"Land suitability procedures can be applied to siting studies and comprehensive planning. The objective of siting studies is to identify the best location for a specific use". In which a composite map can be produced to show the most suitable alternative location (Ruiter et. al., 1998).

A comprehensive plan can be developed to identify the most suitable location for a variety of land uses, which combines the most important factors for each use, based on public or agency criteria.

"A distinction can be made between land capability and land suitability. Capability refers to the physical capacity of the land to support development whereas suitability refers to the physical capacity plus the social acceptability and economic feasibility of development" (Randolph, 2004).

Land suitability studies involve different approaches, all in which combine information by overlaying maps and produce the composite map, which identifies the most attractive areas for a particular use. However, with some variations that makes the intermediate factor combination method the best one; compared to the Gestalt method, ordinal combination method, or the linear combination method.

Whereas, the intermediate factor combination method has solved the problem of the ordinal combination method, which gives equal importance to all of the factors influencing land suitability adding them together, while one may be more important to a particular use than the other; and so weighting factors according to their relative importance. To obtain weighted factor overlays, where the factor value numbers (factor classes) are multiplied by the factor weight to get corresponding scores to each factor value, and by " overlaying factor maps a composite number can be determined for each distinct area by simply adding the weighted factors scores". This is also valid for the linear combination method (Randolph, 2004) and (Ruiter et. al., 1998).

In addition it solves the problem of the interdependence (that individual factors are completely independent) by combining interactive factors (e.g. slope, soils, and geology) into intermediate interpretive maps (e.g. slope stability), and then these maps are used again as in the factor maps mentioned above.

(2.4) Related Studies:

Many case studies have been reviewed which are related to the subject of research, one conducted by the Applied Research Institute-Jerusalem ARIJ (2002). It took the cases of Hebron and Bethlehem Governorates, in which land suitability analysis was used to develop two-scenario modeling for urban development land suitability in Hebron and Bethlehem Governorates.

The two scenarios are the Peace Scenario (an independent Palestinian state in the West Bank), while the other is the Status-Quo Scenario accompanied by the existing geopolitical situation. Then, another study was conducted by ARIJ later in 2005 for all other West Bank Governorates.

In the first study the criteria set selected for the land suitability analysis is composed of nine factors, which are the soil type, proximity to city center, the master plans, proximity to roads network, water sensitive areas, districts divisions, land cover, slope, and the geopolitical situation (See Appendix (I) for criteria set used by ARIJ, 2002).

While in the second study the criteria set selected was the geopolitical land classification, water sensitive areas, land cover, master plans, soil types, the environmental protected areas, slopes, wall of segregation, and the bypass roads.

In addition to these studies, another two case studies one for Bethlehem district (Rabayah, 2006), and another for the cities of Bethlehem, Beit Jala and Beit Sahour in Bethlehem area (El-Atrash, 2009) were reviewed. The selected criteria included agricultural land sensitivity, water sensitivity, soil types, existing urban areas, climate, cultural places, slope, distance from regional road as used by

(Rabayah, 2006). While El-Atrash (2009) had selected the land-use (land-cover), slope, proximity to city center, and geology as a parameter for water sensitivity.

It worth to say that many of the selected criteria sets are overlapping, and measuring the same effect by different factors. By adding up to the score of the grid cell, affecting the resulted total score of each cell suitability. For example, as in the case of (ARIJ, 2002), proximity to city center, master plans, proximity to roads network, and districts divisions, are all measured in one factor, which is the land value for urban development purposes, that is near to the city center, inside the serviced urban areas and so near the roads networks, and within the districts. Means that there is no need for all of them as they can be measured once, and so adding up the effect of this factor more than one time will lead to overlapping, mistakes and nonsense for judging on land suitability for an area, this can be seen also by (ARIJ, 2005) and by (Rabayah, 2006). However, (El-Atrash, 2009) was successful in selecting criteria for measuring land suitability for urban development.

As for the selected criteria set for the purpose of this research, it was set with care, accounting for the environmental, agricultural value and the urban development potential, many criteria were set at first, and it was hard to decide on the final most important set by eliminating the overlapping factors.

Therefore, the final selected criteria set in this research are soil, precipitation, land cover, water sensitivity, land value (potential for urban development) in addition to the landownership, and slope.

Where the land value and potential for the urban development factor includes the effect of the geopolitical situation, the existing built up areas, the city center, the roads network, the bypass road effect, and the serviced areas according to the master plan boundaries all in one factor, to avoid overlapping.

Land suitability studies involve different approaches, these approaches may vary from ordinal combination method as the one used by (ARIJ, 2002), to the linear combination method which was used by (ARIJ, 2005), (Rabayah, 2006) and (El-Atrash, 2009). While as for the purpose of this study the intermediate factor combination method has been used.

The difference between the three approaches is the process of the analysis levels, and the given weights. For the first, which is the ordinal method, all the factors are analyzed at one stage or level, giving no weights for one factor importance over the other, and just giving ranks within each factor classification adding up all factors together to find the final suitability. This what was exactly used by (ARIJ, 2002), where the ranks for each factor are given according to the suitability analysis then adding up the scores for each layer to obtain the final score for each grid cell and so then to obtain the whole composite map (See Appendix I, for the criteria set of (ARIJ, 2002), and the given scores).

As for the linear combination method, it differs from the ordinal method by giving weights for each factor according to its priority and effect on the aim of the land suitability analysis. This makes it better than the ordinal method, that it does not affect the final score value for the cell upon a certain factor by giving it a higher score value than the real one upon the newly given weight.

However, in both methods, they do not consider the level of analysis, which means all the factors are analyzed at one stage, there even might be intermediate factors, which share the same effect, and should be considered separately by including them into one factor to solve the problem of the interdependence. For example, slope, soils, and geology are shared factor to obtain the slope stability factor.

This was solved by the intermediate factor combination method (Randolph, 2004), which was adopted for the purpose of this study. Environmental, socioeconomic, and physical factors are the major three criteria set, under which the most important factors related to the study area were adopted, from here three levels of analysis were found, as a result of factor interdependence.

This was ignored in the four case studies, which were reviewed (ARIJ, 2002, 2005, Rabayah, 2006 and El-Atrash, 2009).

Besides this, they have ignored to eliminate the areas, which have present land use that cannot be changed or areas for which the future destination is already fixed (Ruiter et al., 1998). Or areas known as having "Veto Values" and should be excluded from the analysis, such as the existing built up areas which already have a land use and thus have no potential for any new kind of land use.

This might be explained, by taking an example from the study of (ARIJ, 2005). In which about 20% of the highly suitable areas for urban development obtained by the model, were found to be existing built up areas. And so, by eliminating these areas from the beginning (by freezing these areas), more accurate results will be obtained, including only the new potential areas. So the new range may include some areas, which should be highly suitable but was moderately suitable first by ignoring this component. In addition, accordingly to the same component, the developed suitability model showed that some of the Israeli settlements were found in highly sensitive areas, which are not suitable for urban development. This is not accurate, as the settlements should be treated in the same manner as the existing built up areas, which has no other potential for urban development or other uses. Even if they were high sensitive areas, but the present land use changed its nature, its effect on the surrounding should be accounted for, or at least should be defined as freeze area.

In this research the Israeli built-up areas, and the Palestinian built up areas effect, is included by freezing these areas in all the layers of the Status-Quo Scenario, as it has no potential for any other use, whether in urban development or for environmental use.

However, in the Peace Scenario, the Israeli built- up areas will be removed according to the peace process, and so they will gain the same land value or potential for the surrounding areas.

Besides, for applying the two scenarios, which are the Status-Quo and the Peace Scenario considering continuation of the peace process back to the 1967 borders, there should be some considerations to be accounted for.

As for the first one, the Status-Quo Scenario, The geopolitical classification, imposes that the political area classified as C zone, has no potential for urban development. However, as for the reviewed case studies, they have considered it as the least suitable area for urban development. That is why for example, the land suitability model obtained by (ARIJ, 2005) of the West Bank cities, showed that some of the moderately suitable areas for development in Nablus, Salfeet, Ramallah and Jerusalem are within an area "C" zone, this results from not freezing these areas as they have no potential for urban use but may have environmental potential or else.

In this research, the "C" zone gain a zero value in the urban development potential analysis, by freezing this area, then by reversing these values as it will gain a higher score for an environmental value as it is not suitable for urban development, to integrate this effect to the environmental factor. As it has other potentials other than urban development.

As for the second scenario, the study of (ARIJ, 2005), eliminated the effect of the geopolitical situation by integrating the Israeli settlement urban fabric into a new development opportunity. However, they ignore the effect of the bypass road, as it will attract more urban development by transferring these areas, which were in C zone to the Palestinians according to the peace process, and so it should be given new urban development potential.

The difference between the reviewed case studies and the one in concern for this research, is that they have suggested three different population growth scenarios, the normal growth, the moderate, and the high growth (ARIJ, 2002, 2005, and El-Atrash, 2009).

For the purpose of this research, there is no need for using the population growth scenarios, as the two major scenarios the Peace Scenario, and the Status-Quo Scenario, will define the total available areas for further development. Therefore, the time of the system balance will be estimated by applying the MOLG standards.

This will be a reference point or guideline for any population growth scenario expected for any time, as the available areas provide us with the maximum limit for the number of people in the area.

As for the scores used for each factor, the soil classification used by ARIJ (2002), and Rabayah (2006), is adopted here for the purpose of this research (see Appendix II, A).

The slope classification, for (ARIJ, 2002, 2005), was successful in considering that the less steep slopes are more suitable for agricultural areas, moderate slopes are considered suitable for urban developments, whereas steep slopes are not economically feasible for urban development suitability, as they require high costs for the infrastructure, roads and services (see Appendix II, B). This classification will be adopted in the same manner.

As for the land-cover classification, it was based on the CORINE definition (see Appendix III), which is the one adopted here, same as in the studies of El-Atrash (2009) and ARIJ (2005) (see Appendix II, C).

Finally, the aim of land suitability in the previous studies was to find the total available areas, whether they are suitable for urban development and they satisfy the needs of the expected population growth or not.

While the main objective of this research is land management and land resource sustainability, the final obtained suitability model for each scenario will be classified into not sensitive (NS), low sensitivity areas (LSA), moderately sensitive areas (MSA), and highly sensitive areas (HSA). Upon this classification, the NS and LS areas will have potential for urban development suitability.

In addition to this classification, the land suitability was a tool for the first step of developing a sustainable model, from which different measures or indicators will be defined to assess the model sustainability.

(2.5) <u>Local Context:</u>

Over the years, political and socio-economic problems have been prioritized over environmental protection. As a result, the natural and human environments have been degraded considerably. The rapid economic development over the past few years has also led to unmonitored deterioration of natural resources.

In Palestine, the main natural resources are generally water reserves, agricultural land, ecologically sensitive areas, cultural heritage sites and the general landscape. There are also the famous minerals of the Dead Sea, along with stone quarries, sand, and other natural mineral deposits. The forest area in the occupied Palestinian territories is about 0.5% of the total land area. Israeli authorities have prohibited wide-scale tree plantations to prevent legal obstacles when confiscating land.

The Palestinian Authority (PA) is aware that the economic well-being of its people is dependent on the quality of the environment. However, the PA’s limited control over environmental issues under the Oslo accords has severely limited its ability to take action. Weak management structures and a lack of tools and expertise have also contributed to the problem (MOPIC, 1996).

Many environmental activities and practices in the occupied West Bank and Gaza are still regulated by laws that existed before 1967; formulated under the Jordanian and Egyptian legislation. Where the environmental responsibilities are distributed among many different institutions resulting in a lack of coordination.

One of the most important official plans was MOP’s 1996 Emergency Natural Resources Protection Plan for the West Bank. This outlined and evaluated the major Palestinian natural resources, identified threats and outlined procedures for protection. It was the first step in creating a policy for protecting natural resources, to make a shift towards sustainable development. However, no legal frameworks or procedures have been drafted by the PA, and it has not been approved by the Palestinian Legislative Council or by the cabinet decision (MOPIC, 1996).

It was just an emergency plan to assess the environment, and recognize the relevant issues, to ensure manifesting the environmental deterioration.

The relevance of this study was in classifying the West Bank region into three zones according to the degree of protection and restrictions on land use and human activities needed on the land. This classification is illustrated in (Appendix IV), which displays the three zones according to the degree of restriction and protection, classification for land value, and the policy for land use and management.

The protected areas are those classified under the category of zone (I), which includes exceptional landscape value, ecologically highly sensitive, selected cultural landscape, the forests and other nature reserves according to Oslo II agreement. As for zone (II) it includes high valuable agricultural lands, extremely and highly sensitive recharge area of groundwater and aquifers, and ecologically moderately sensitive areas.

However, at the local level, this plan does not represent the local scale, as it was elaborated from a rough estimate.

Recently the MOPIC has updated the Natural Resources Protection Plan for the West Bank, which is now in its final phases and stages. These localities will be considered in greater detail. (MOPIC, 2010)

CHAPTER III: STUDY SITE: HALHUL TOWN:

(3.1) Halhul within the Palestinian Territory:

Historical Palestine is the area situated in the western part of Asia. It is bordered by Lebanon in the north, Syria and Jordan in the east, the Mediterranean Sea in the west and Egypt, and the Gulf of Aqaba in the south.

Today, and after the Palestinian- Israeli agreement, the Palestinian territory is about 6,020 km^2 in area, about 5,655 km^2 in the West Bank, and 365 km^2 in Gaza, and is inhabited by 4,048,403 persons, 2,513,283 in the West Bank, and 1,535,120 in Gaza Strip as estimated by PCBS for the end of the year of 2010. Moreover, the population density is 673 person/km^2 for the Palestinian territory; 445 person/km^2 in the West Bank and 4,206 person/km^2 in Gaza Strip (PCBS, 2010), see Table (3.1).

The West Bank is divided into eleven Governorates as in Figure (3.1). Hebron district is one of these governorates, which extended over 2076 km^2 before 1948 and shrinked to 1064 km^2 after 1967 (LRC, 2002) and again to 997 km^2 (PCBS, 2010) due to the Israeli occupation, it is the largest among the Palestinian governorates.

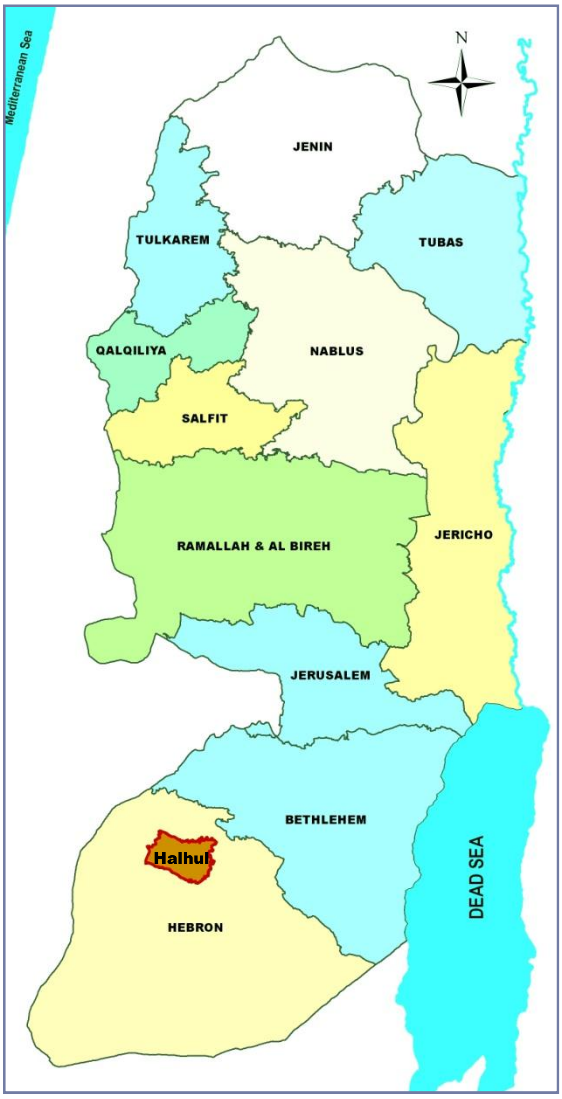


Figure (3.1): The West Bank Governorates
Source: Palestinian Land Authority (PLA), 2010

Moreover, it is the most inhabited Governorate populated by 600,364 persons as estimated by the PCBS at the end of the 2010. It has the third highest population density 603 person/km^2, following Jerusalem 1108 person/km^2 and Tulkarm 674 person/km^2 (PCBS, 2010) (see Table (3.1)).

Table (3.1): Palestinian Territory, Region and Governorates, by Area, Population Estimation at the End of Year 2010, and Population Density

No.	Region And Governorate	Area km^2	Number of Population 31/12/2010	Population Density (Person/km^2)
1	Palestinian Territory	*6020	*4,048,403	673
2	West Bank	*5655	*2,513,283	445
3	Jenin	*583	*274,001	470
4	Tubas	*402	*54,765	137
5	Tulkarm	*246	*165,791	674
6	Nablus	*605	*340,117	563
7	Qalqilya	*166	*97,447	588
8	Salfit	*204	*63,148	310
9	Ramallah And Al Bireh	*855	*301,296	353
10	Jericho And Al Aghwar	*593	*45,433	77
11	Jerusalem	*345	*382,041	1108
12	Bethlehem	*659	*188,880	287
13	Hebron	*997	*600,364	603
14	Halhul	**37.3	*24,060	646
15	Gaza Strip	*365	*1,535,120	4206

Note:

*: Data source from the PCBS, 2010

**: Data source obtained from ARIJ, 2010

Source: Prepared by the Researcher according to PCBS Evaluation Methods

Halhul is one of the localities in Hebron district, extending over (37.3) km^2 (ARIJ, 2009). It was occupied as other Palestinian cities and villages by the British Mandate, until 1948 when it fell under the control of the Jordanian government, till the occupation of the West Bank by Israel in 1967.

Halhul is classified as an urban area, inhabited by 24,060 persons at the end of the year 2010 as estimated by PCBS. It has a higher population density than the average density for the district, which is about 646 person/ km^2.

It lies between 31° 34' 43.99" N 35° 05' 55.69" E and 31.5788861° N 35.0988028° E according to the local Palestinian coordinates. Located about six km to the north of Hebron City; 30 km from Jerusalem, about 25 km to the west of the Dead Sea, and 60 km from the Mediterranean Sea (Halhul Municipality Database, 2009) (see Figure (3.2)).

Halhul lies on the southern part of the central range in Palestine. It is the highest elevation inhabited place in Palestine with a maximum altitude of about 1020 m above sea level (LRC, 2002 & Socio-Economic & Food Security Atlas, 2010).

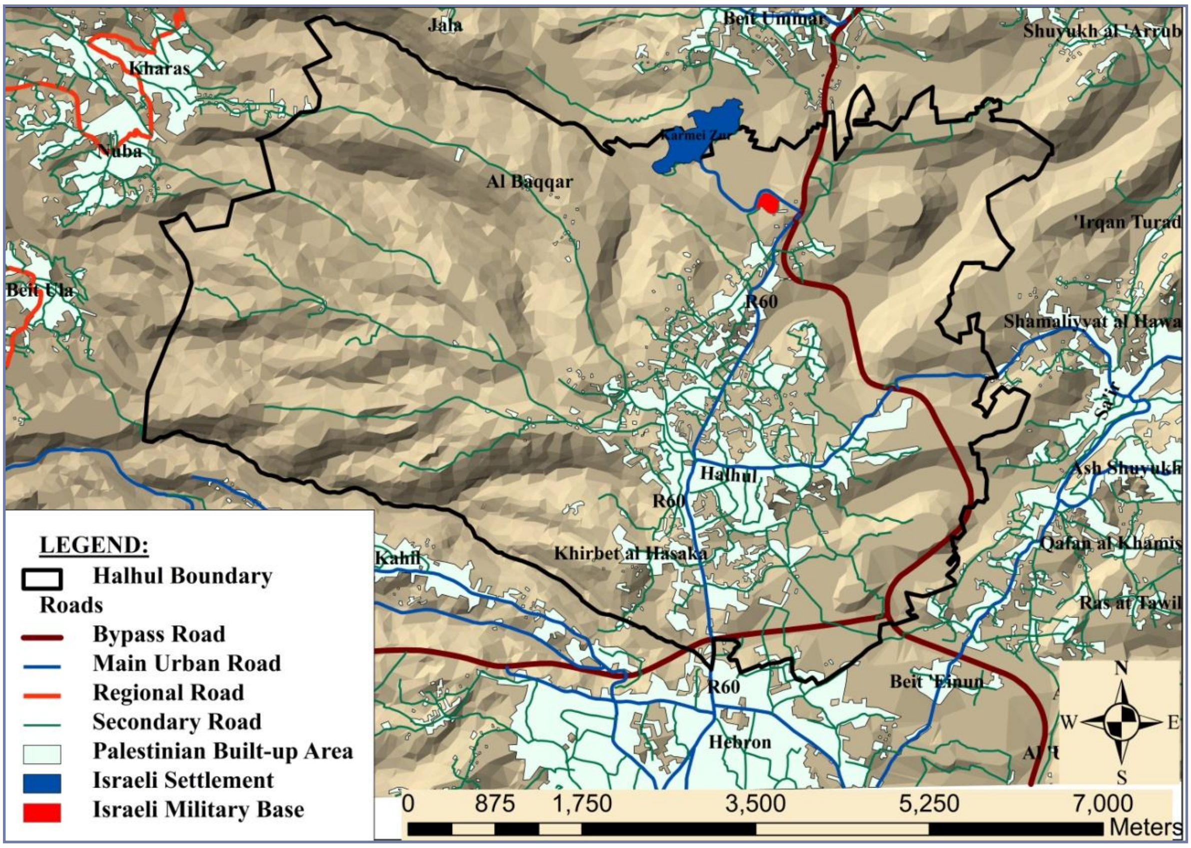


Figure (3.2): Halhul's Location, Borders, and Roads Network.

Source: LRC GIS Database, 2010

Halhul is about 5000 years old in which the oldest engravings in Palestine were discovered, dating back to 3000 years B.C. (ARIJ, 2009).

(3.2) <u>Population Projections:</u>

According to the British mandate census, the total number of residents in Halhul was about 1,927 in the year of 1922, which later became 2,523 inhabitants in 1931, rising in the year of 1945 to 3,380 according to the Land and Population Survey (Hadawi, 1970). In 1961, the population became 5,387 under the Jordanian authority, then after the Israeli occupation according to the 1982 and 1987 census, the total population in Halhul was 6,040 and 9,800 persons respectively. According to the first Palestinian census surveyed by the (PCBS) in 1997, the total population of Halhul was about 15,663 residents from which 1686 (10.8%) were Palestinian refugees (see Table (3.2).

Table (3.2): Population Figures in Halhul Locality between 1922 and 2010.

Year	Population
1922	1,927
1931	2,523
1945	3,380
1961	5,387
1982	6,040
1987	9,800
1997	15,663
2007	21,797
2008	22,528
2009	23,282
2010	24,060

Source: Halhul Municipality (2010) & the Palestinian Central Bureau of Statistics (PCBS, 2010)

According to the latest census in 2007 conducted by PCBS, the total population of Halhul was about 21,797 inhabitants, and the estimated population for the year 2010 is 24,060 persons (see Figure (3.3)).

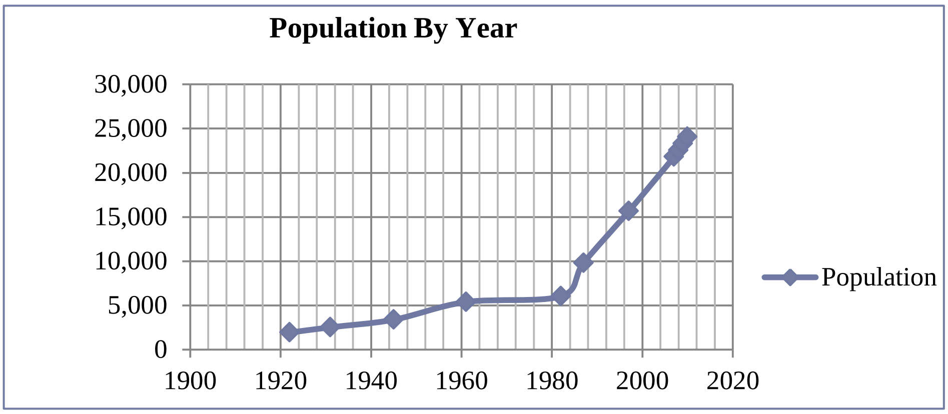


Figure (3.3): Number of Population in Halhul between (1922 – 2010)

Source: Data Obtained from PCBS (2010) and Halhul Municipality (2010)

(3.3) <u>Urban Areas, Town Center, Religious, and Archeological Sites</u>:

Halhul is well connected with Hebron City, through the regional road, having a total jurisdiction area of about 37.3 km^2, where the urban fabric is distributed on mountainous areas. The town is also surrounded by a number of small urban areas known as Khirab such as in Baqqar.

The Ministry of Local Government (MOLG) classifies Halhul to include three villages: Halhul, Baqqar, and Khirbet Al-Haska.

The total built up area within the boundary of Halhul village is about 3,462 dunums, from which 3,364.3 dunums comprise Halhul's town center, 70.3 dunums in Haska, and only 27.38 dunums in Baqqar.

Halhul is classified as an urban area where there are about 3961 households and 4550 housing units, 3555 buildings, and 638 establishments.

It is an ancient city inhabited since 3000 B.C, with many religious and touristic locations, which are of a historical religious or archeological value.

These locations are Al-Nabi Younes Mosque, established in 623 Hijri (1226 A.D) by King Issa Al-Ayoubi, Maqam Al-Sahabi Abdallah Bin Masoud Mosque in the center of the old city to the east of Al-Nabi Younes Mosque, Al-Zawya Al-Bobarya, which is an old mosque in the old town. Al-Saha or Al-Diwan in the old town with an area about 100 m^2, which was the main location where the villagers met, Ein Ayoub which is a water spring with holy value related to Prophet Ayoub, the Omary Mosque established when Omar Bin Al-Khatab visited Jerusalem in the Islamic openings, and Burj Al-Soor (Halhul Municipality, 2010 & ARIJ, 2009).

In addition to other locations of cultural or touristic value such as the old town, Al-Tahona, Al-Qala'a, the old Islamic cemetery, Al-Saha, and Mar'aya park.

The historic center of Halhul city has 360 historic buildings according to RIWAQ (RIWAQ, 2006), some of which have been renovated by RIWAQ including the Cultural Forum of Halhul, and Al-Yarmouk Girls School.

The Town center is dynamic, as the main regional road, which connects the north, south and western villages of Hebron district, passes through the main center of Halhul, giving it a social, cultural, and most of all an economic value. It is vital for life dynamics in the town, by connecting people to the main urban areas that constitute Halhul, creating social cohesion, and a kind of mixed land use in the surrounding areas, where many people could take a walk or bicycle to collect their needs.

(3.4) <u>Land Ownership</u>:

According to the British Mandate divisions, Halhul is classified as one of the communities in the northern Hebron cluster with a total jurisdiction area of about 37,292 dunums (37.3 km^2), from which only 15,000 dunums are inside municipal boundaries, whereas the area of the old town of Halhul village is 165 dunums.

Land ownership in Halhul is divided between the four main families under private land ownership, who own about 97.44% (36,337 dunums) from the total area, in addition; to the public land ownership, which includes state domain ownership, Waqf and Miri land, where there is only 2.56 % (955 dunums) are of state domain (Halhul Municipality, 2010).

This factor has an important influence on the urbanization process and the form it develops.

(3.5) <u>The Economic Sector and Activity in Halhul:</u>

Most of the inhabitants are engaged in the agricultural sector, as Halhul is an agricultural area with about 19,000 dunums considered as fertile agricultural land for planting fruit trees, vineyards and vegetables.

According to a survey conducted by ARIJ in 2007 (ARIJ,2009), the agricultural sector contributes to about 50% of the economic activities in Halhul, while %25 from the employee sector, %15 from the Israeli labor market, 2% the service sector, 3% from the industrial sector, and 5% from the trade sector. See Figure (3.4) for the percentage of Halhul's population according to their economic activities.

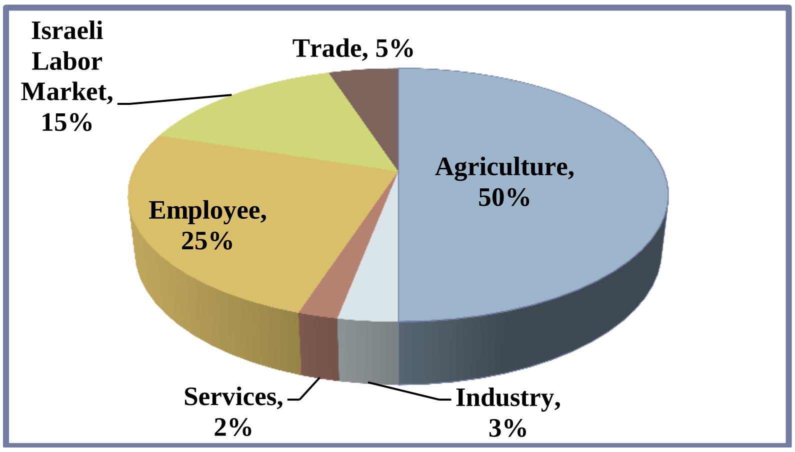


Figure (3.4): Percentage of Economic Activity in Halhul

Source: ARIJ, 2009

Hebron is well known for its handicraft industries, especially the hand-blown glass, and Hebron ceramics known as "Al-Khazaf Al-Khalili", there are about three factories in Halhul area for glass and ceramics.

In addition, there are many other economic activities, institutions and small industries, such as the stone-cutting industry, aluminum industry, iron industry, 30 blacksmith workshops, 20 carpentry workshops, 22 services shops and more than 198 shops. In addition, there is a vegetables market society, which distributes the town's agricultural products.

During the years 2000-2004 after al-Aqsa Intifada, the hard economic blockade imposed by the Israeli occupation policy on all Palestinian territories, had adversely affected the economy. Halhul had suffered from closures; to a certain degree more than other villages and neighboring towns in Hebron district, because of its location, as it is considered the only point, which connects the north of the West Bank to the south of Hebron district (meeting junction). Therefore, the closures had devastated the economic situation in the town, as it is the only link or linking point. But this had created an economic movement inside the town along the regional road, where there had been a public service cars stop which offers transportation services from the passenger gathering point at Halhul blockaded entrance to the main villages, towns, and the center of Hebron city itself. As it is the only way, at which people could end their journey from the north to the south of the West Bank.

This remained to be the situation until the end of al-Aqsa Intifada when the blockade was eased and al-Nabi Younes road, the main road in the old town was rehabilitated. Thereafter the public service transportation was allowed to pass from Halhul to other different destination points in the south.

This created an economic movement inside the town along al-Nabi Younes road and part of the regional road as it is the major collecting point, with no other competitor.

There is little data collected about the main economic indicators for Halhul, which reveals that the total number of establishments, which are in operation, are 632 establishments, including the private sector, non-governmental organization sector, and governmental institutions. These enterprises are classified according to the economic activity (see Table (3.3)).

From Table (3.3), the wholesale, retail trade, and repair of motor vehicles & personal goods are the most common economic activity, which contributes to about 58.54% of the total economic activities in Halhul. At the second level, there is the manufacturing activity at 12.66 %, then the community social, and personal services activity, at 7.75%, and finally health and social work at

6.49%.Therefore, the economic activity in Halhul highly depends on wholesale and retail trade, besides repair of motor vehicles and personal goods, in addition to manufacturing.

Table (3.3): Number of Enterprises in Public and Private Sector Classified by the Economic Activity in Halhul

Economic Activity	No. of Enterprise	% of Total
Agriculture Hunting, Forestry and Fishing (Raising of Cattle and Other Animals)	18	2.85
Mining and Quarrying	4	0.63
Manufacturing	80	12.66
Construction	1	0.16
Wholesale and Retail Trade ,and Repair of Motor Vehicles and Personal Goods	370	58.54
Hotels and Restaurants	17	2.7
Transport, Storage and Communications Activities	7	1.11
Financial Intermediation	3	0.47
Real Estate and Business Services	26	4.11
Education	16	2.53
Health and Social Work	41	6.49
Other Community Social, and Personal Services	49	7.75
Total	**632**	**100**

Source: PCBS, 2010

In addition, an impression can be made from the existing buildings in Halhul town and their current use, as obtained from the PCBS, most of the buildings are used for habitation, 80%, while only 14% are used for work and the rest are left vacant or closed (see Table (3.4)).

Table (3.4): Completed Buildings by Locality and Current Utilization, 2007

Locality		Halhul
Total		**3,286**
Current Utilization	Not Stated	-
	Deserted	19
	Vacant	76
	Closed	116
	Work	183
	Habitation & Work	262
	Habitation	2,630

Source: PCBS, 2009

(3.6) Roads Network:

The transportation network in Halhul is made up of 92 km of roads, where 15 km are paved and in good condition, 12 km are paved but need maintenance, and 65 km are not paved (ARIJ, 2009).

The main road in Halhul is the Hebron-Jerusalem road which connects the northern Palestinian territory to the south, known as al- Hawawer Road (Road 60), and used to be the main road, which connected the governorates of Bethlehem and Jerusalem to Hebron governorate. In addition, it is used to link the cities of Hebron and Halhul to the rest of the villages and towns in the north, west and east of the governorates (see Figure (3.2), p.24).

In the year of 1996, the Israeli occupation forces constructed a bypass road to connect the Israeli colonies in Bethlehem governorate with the colonies in Hebron governorate (LRC, 2008).

The bypass road, which passes through Halhul, has divided it into three parts: the north-eastern, the southern part, and what remains to the west. The total length of the bypass road section which crosses Halhul is about 9 km (LRC GIS database, 2010).

(3.7) Agricultural Areas:

Halhul is an agricultural area known for its vineyards and fruit trees, with vast agricultural areas estimated at about 19,000 dunums of fertile land suitable for planting fruit trees and vegetables (ARIJ, 2009).

According to the country report prepared for FAO's international conference on plant genetic resources, Hebron governorate was classified into three main categories, which are highly sensitive areas (HSA), agricultural sensitive areas (ASA), and moderately sensitive areas (MSA), in order to determine the degree of restrictions on human activities needed on the land (PIALES, 1996). As for Halhul, it was classified as agricultural sensitive areas (ASA), where the criteria set, indicate suitability for grazing, field crops, vineyards, orchards and vegetables.

Therefore, "the area leading from Halhul to Sa'ir is an important terraced agricultural area, especially for the production of grapes, fruit trees and some field crops. The southernmost Quericus Boisseri in the world exists in this area as well." (PIALES, 1996), in addition another ASA, "between Halhul and Hebron are important terraced grape vineyards and some orchards. Not only is their production important, but the terracing is important in the biological maintenance of the area."(PIALES, 1996), which emphasizes the agricultural value and sensitivity of Halhul area, that should be conserved. The most important elements in agricultural datasets will be discussed below:

A) Land Use in Halhul:

The land use for Halhul was estimated in 1945 by Hadawi (1957) as in Table (3.5). The total area for Halhul was estimated to be about 37,334 dunums, and the total cultivable land was estimated to be about 19,185 dunums while the non-cultivable land area was estimated at about 17,984 dunums, most of the areas were planted with cereal.

Table (3.5): Land-Use for Halhul in 1945

Land Usage in 1945 for Halhul	Land Usage Type	Area in (Dunums)
	Irrigated & Plantation	5,529
	Planted with Cereal	13,656
	Built up	165
Total Cultivable Land Area		19,185
Total Non-Cultivable Land Area		17,984
Total Area		37334

Source: Hadawi, 1957

Lately, the land use/ land cover for Halhul was analyzed by ARIJ using the 2006 aerial photo (see Figure (3.5)); prepared according to the CORINE classification code (see Appendix III). The total area of each land-use category is displayed in Table (3.6), also Figure (3.6) shows the percentage of each land use category.

Table (3.6): Land Use/Land Cover in Halhul by Area in Dunums

Land Use/Land Cover, 2006 for Halhul	Area in dunums
Arable Land	4,938
Forest	806
Industrial, Commercial and Transport Unit	56
Heterogeneous Agricultural Areas	193
Mine, Dump and Construction	217
Open Spaces with Little or no Vegetation	3,995
Permanent Crops	19,040
Plastic House	19
Shrub and/or Herbaceous Vegetation Associations	4,401
Palestinian Built-up Area	3,475
Israeli Settlement	105
Israeli Military Base	34
Cemetery	13
Total Area	37,292

Source: ARIJ Database, 2010 (Unpublished Data)

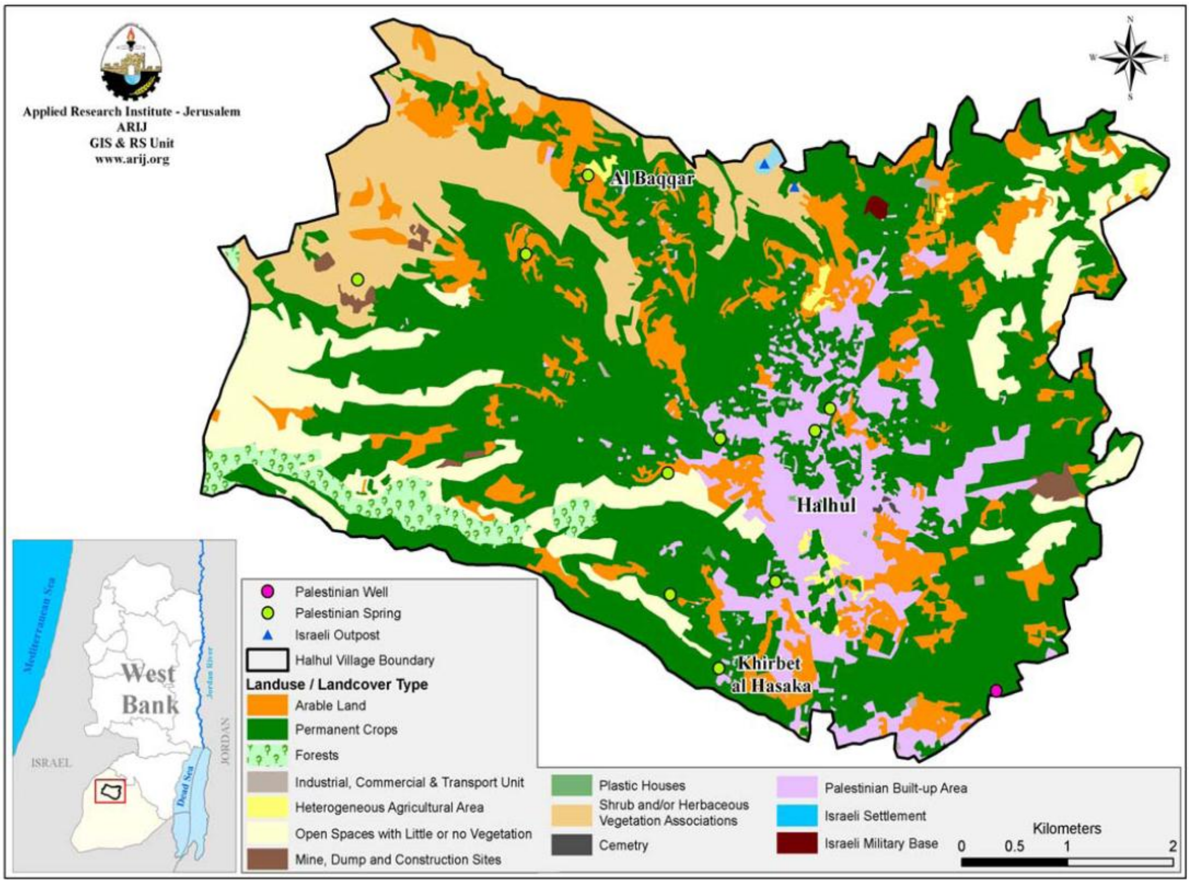


Figure (3.5): Land Use /Land Cover in Halhul

Source: ARIJ, 2009

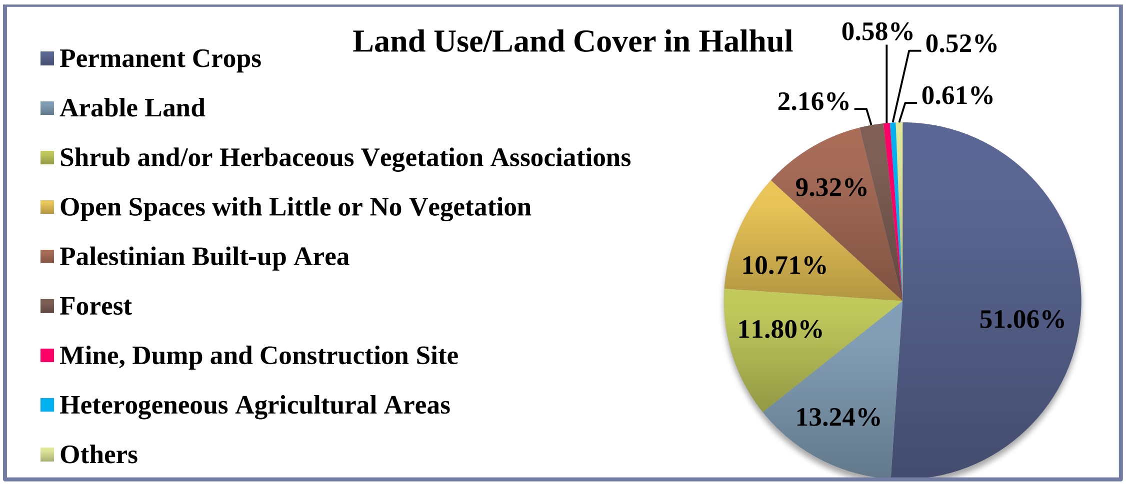


Figure (3.6): Land Use/Land Cover in Halhul by Percentage, According to Aerial Photo 2006

Source: ARIJ, 2009

B) <u>Vineyards and Grapes</u>:

"Throughout the West Bank, fruits dominate the agricultural output, with Hebron Governorate ranking second among the West Bank Governorates for total fruit production. Grape vine cultivation comprises the greatest amount of the output, with 68% of total West Bank grape cultivation found in the Hebron District" (ARIJ,2000). Halhul is well known for its varieties of the best grapes in the West Bank.

In Halhul the total cultivated areas of vines are 7,705 dunums (58% from the total cultivated area of fruit trees, 52% from the total cultivated area in Halhul), from which 5,705 dunums are considered as bearing (PCBS, 2009). The total production quantities of grapes in Halhul is about 4,650 tons which contribute to 31% of the total grape production in the Hebron Governorate, about 14,946 tons for the same year of 2007 (ARIJ,2009) , and 63% of the total agricultural production in Halhul. According to Table (3.7) the total income (US$) from the total plant production (tons) in Halhul, the estimations show that the total value of agricultural revenues from grape production is about (3,542,370.00) US$ by using the average price of fruit trees production in US$/tons (as in Table (3.7)).

Hence, it is the main source of income for the farmers in Halhul, as 52% of the total cultivated land area is vineyards, which depends on grape yields and production.

Table (3.7): The Total Income (US$) from the Total Plant Production (tons) in Halhul, by Type of Crop, Production in (tons), and Price (US$/ton).

Type of Crop	*Production (tons)	**Price (US $/ton)	Total Value
vegetables	1,353.00	661.50	895,009.50
Field Crops	54.00	403.70	21,799.80
Fruit Trees	5,941.00	761.80	4,525,853.80
Total	7,348.00	1,827.00	5,442,663.10

Source: Prepared by the Researcher

* Source: Palestinian Central Bureau of Statistics, 2009, Agricultural Statistics, 2007/2008, Ramallah –Palestine (Un-Published Data)
** Source: Estimated by the researcher upon the total values of US$ for plant production in Hebron Governorate according to the agricultural year of 2007 prepared by ARIJ, 2009

(3.8) Climate:

In general, the climate of Hebron Governorate ranges between dry and semi-dry, it is a Mediterranean climate, which is characterized by long hot summers and short cool rainy winters. Whereas dry climate becomes harsher as we move to the east towards the Jordan Valley and to the south towards the Neqeb desert. As for Halhul it is considered as sub-humid according to the De Martonne Aridity Index (MAI), which ranges between (20-30) (LRC, 2002); and the average annual humidity is 61% (ARIJ GIS, 2009).

Halhul has the lowest temperatures degrees within Hebron district, as it has a mountainous area with elevations exceeding 1000 m above sea level; the average annual temperature is 16 °C (ARIJ, 2009). Moreover, it reaches the lowest temperature in January -4 °C, and snow and hail may occur over the highlands (Records of the Palestinian Meteorological Department, 2002), while the average temperature in summer is 21 °C (LRC, 2002).

The average number of precipitation days is 50 rainy days, whereas the average annual precipitation varies from 500 to 600 mm (see Figure (3.7)), and the mean annual precipitation is 583 mm (ARIJ, 2009) (LRC, 2002). This rate is considered more than the mean precipitation rate in those countries producing grains. However, the reason of the limited yield and inadequate plant growth is due to the improper and unbalanced distribution of precipitation among the months of the year, as the long arid summer, in addition to the great variations in precipitation quantities in most of the years from the annual average precipitation (LRC, 2002). Moreover, this range of precipitation is suitable for growing rain-fed crops.

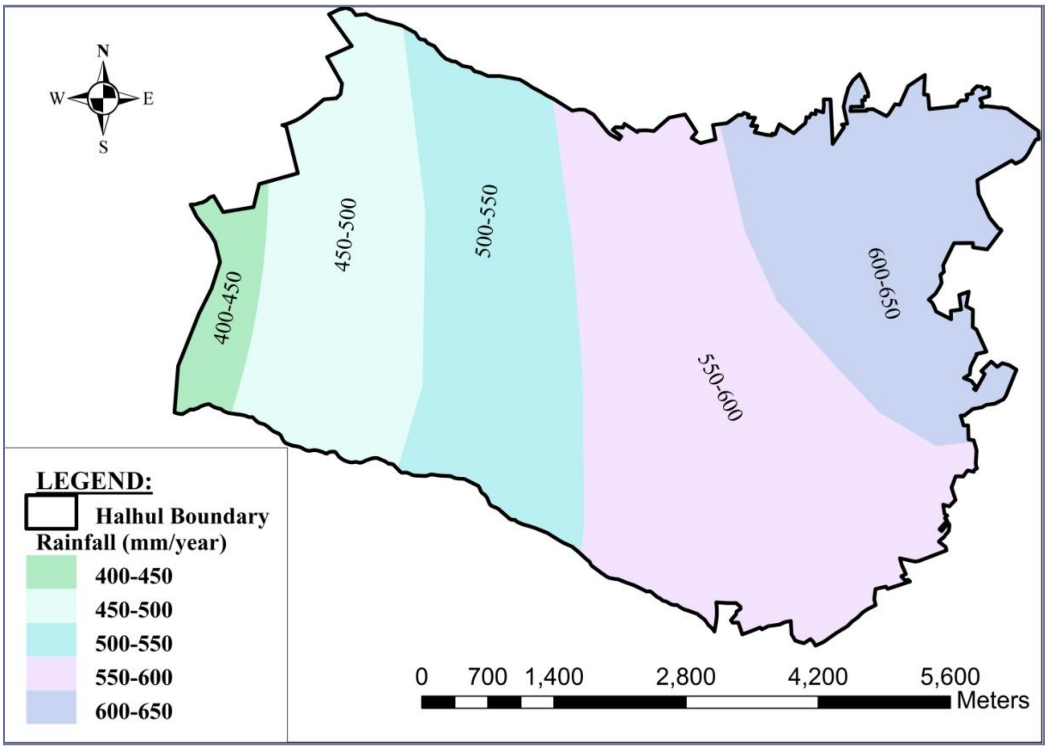


Figure (3.7): Mean Annual Precipitation in (mm) for Halhul

Source: LRC GIS Database, 2010

(3.9) Soil and Fertility:

The dominating soil types in Halhul are Terra Rossa Brown Rendzinas and Pale Rendzinas, in addition to Brown Rendzinas and Pale Rendzinas, as shown in Figure (3.8).

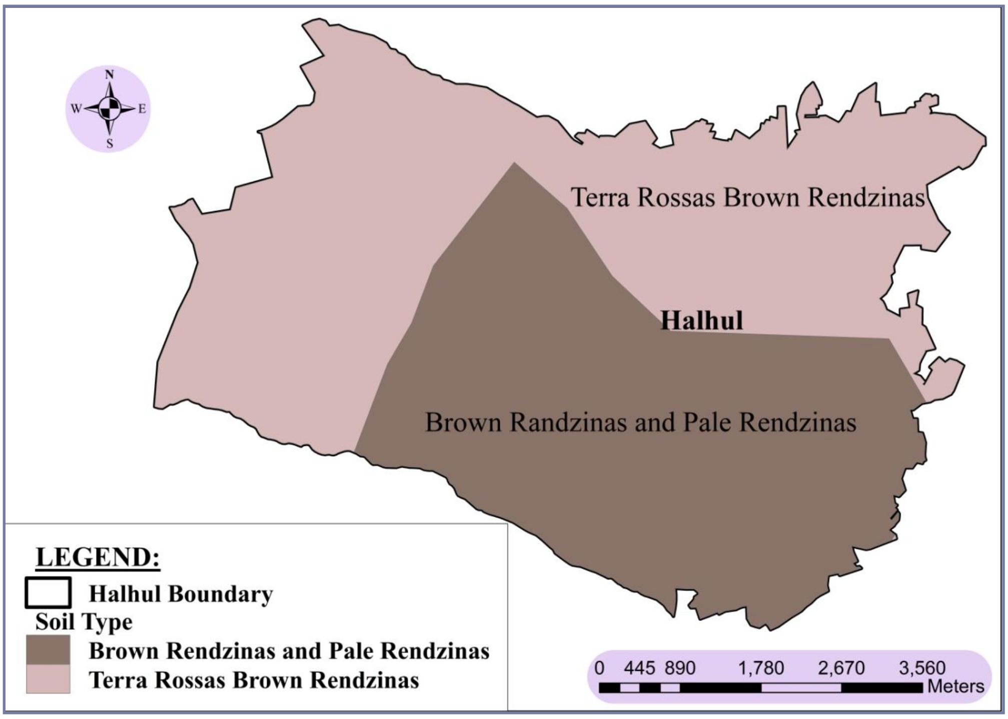


Figure (3.8): Soil Map of Halhul

Source: (ARIJ GIS Database, 2010)

Terra Rossa Brown Rendzinas and Pale Rendzinas is the most common vineyard soil, which is fertile and suitable for growing vines, as it is a mixture of clay and sand, which lies over hard limestone. The clay component holds sufficient water keeping the vines root moist and active throughout the summer. The sand components help in removing clotting between soil particles allowing for adequate drainage (LRC, 2002), as for Brown Rendzinas and Pale Rendzinas, they are considered less fertile than the Terra Rossa.

(3.10) Water Sensitive Areas:

According to MOPIC, an emergency natural resources protection plan was prepared for the West Bank in 1996.

In regards to the water sensitive areas, they were classified based upon different criteria set to determine the degree of sensitivity (vulnerability) of ground-water including: the Geological

Formations, Precipitation Distribution, Evaporation and Transpiration, Land Cover, the Hydrology of Aquifers, the Water Quality, the Depth to Water, Topography and Slopes (MOPIC, 1996).

Sensitivity refers to the degree of vulnerability of the groundwater system from being contaminated, which is mainly defined by the hydro-geological characteristics of the aquifer systems. It describes the ease of which water (and pollutants) may enter and flow through the aquifer. Some areas and aquifers are more vulnerable than others, depending on the characteristics of the physical system. Therefore, water sensitivity maps are useful for regulatory, managerial, and decision-making purposes, which are related to land use and groundwater protection.

The obtained water sensitivity map for the West Bank region was classified into five classes depending upon ground water vulnerability, which are extreme, high, moderate, low, and not sensitive (MOPIC, 1996 and PWA, 2010).

As for Halhul, the eastern edge is classified as extremely sensitive, while the remaining areas are not sensitive, see Figure (3.9) (MOPIC, 2010 and PWA, 2010).

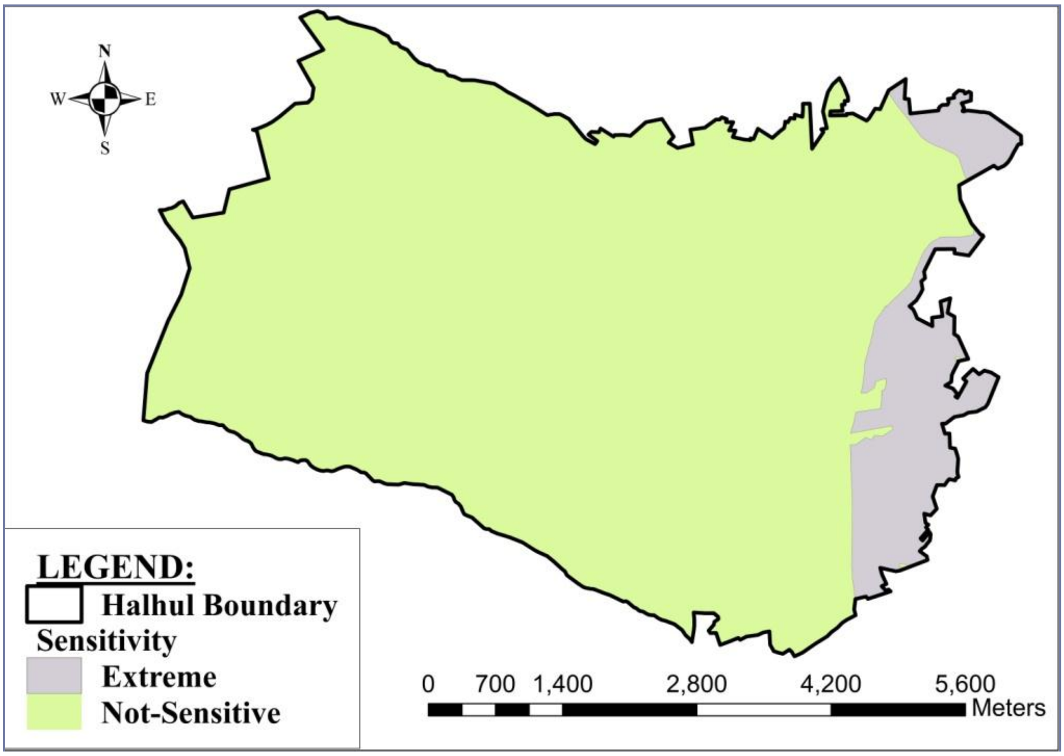


Figure (3.9): Ground-water Sensitivity (Vulnerability) in Halhul

Source: MOPIC, 2010

(3.11) Physical Datasets (Slope):

Halhul is characterized by great variations in its topography and altitude, where it ranges between 550 m above sea level to reach a maximum of 1014 m above sea level, the highest peak in the West Bank. Where the eastern parts have higher altitudes compared to the western parts (see Figure (3.10)).

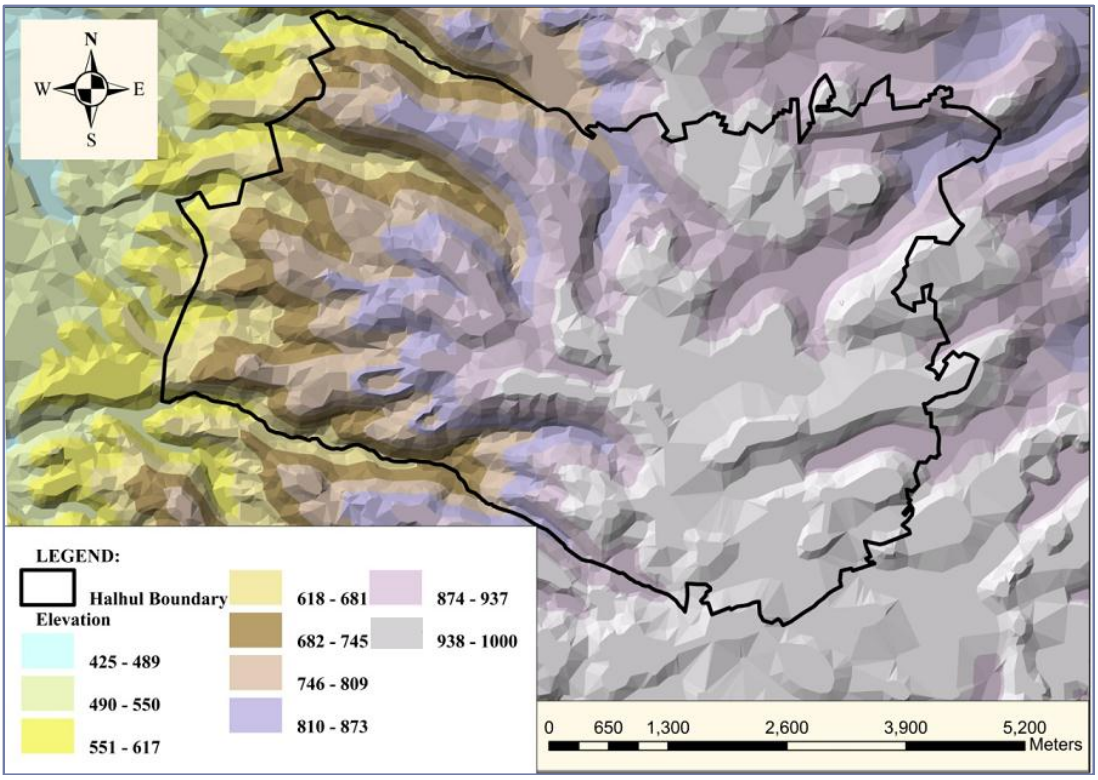


Figure (3.10): Topographic Map/Halhul

Source: Prepared by the Researcher, (Contour Lines obtained from LRC, GIS Database, 2010)

(3.12) Geopolitical Status:

(A) Israeli Settlement:

There are about 28 Israeli settlements in Hebron Governorate, which have a total master-plan area of about 59.2 km^2, 5.5% of Hebron governorate, the largest of which are Karyat Arbaa and Kharsina. Karmi-Tsur is situated to the north of Halhul, established on the lands of Beit-Ummar and Halhul in 1984, extending over 289 dunums, of which about 105 dunums lie on the lands of Halhul (within the boundary of Halhul) (LRC, GIS database,2010 and ARIJ,2009).

(B) <u>Bypass Roads</u>: The total bypass roads network constructed, following the signing of the Oslo agreement, in Hebron governorate is about 150 km in length dividing the governorate into six separate entities (ARIJ, 2009)

As for Halhul the bypass road, divides it into three parts with total length of about 9 km from the northern part of Halhul passing east to the southern part (LRC, 2010). A new planned section will be established and opened through Halhul, as announced by the Israelis on August 10 of the year 2006 in Al-Quds daily newspaper, it will confiscate an additional areas, with a total length of 3.5 km and width of about 160 m (Halhul Municipality,2010).

(C) <u>Political Zones</u>:

According to the Oslo agreement signed in 1995, the Hebron Governorate was fragmented into areas "A","B", and "C". Zone "A" constitutes about 24%, zone "B" 22%, and zone "C" 48%, in addition to 6% which have been classified as nature reserve areas (ARIJ, 2005). In Halhul the total area of "A" zone is about (5,191dunums) 14% from the total area of Halhul, while area "B" includes (21,082 dunums) 56.5%, and area C (10,869) dunums 29.1%, and only 150 dunums classified as "H1" (0.4%) according to the Hebron Protocol signed in (1997) (ARIJ, 2002) see Table (3.8) and Figure (3.11).

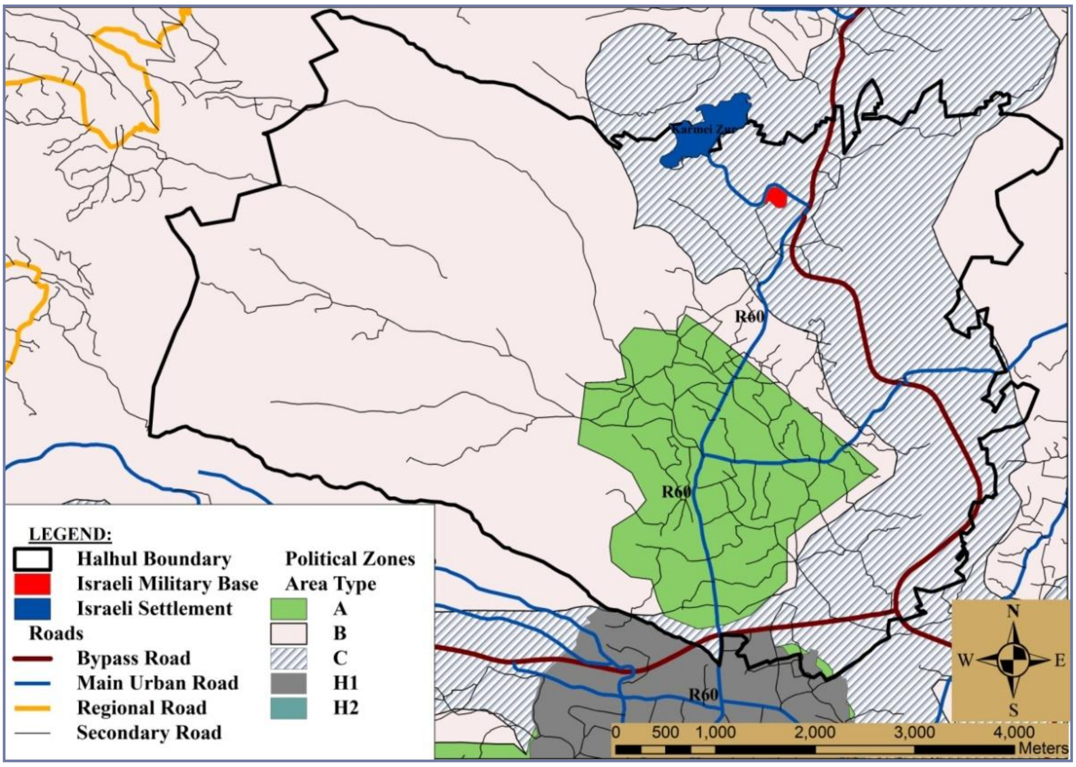


Figure (3.11): The Geopolitical Status in Halhul

Source: LRC, GIS Database, 2010

Table (3.8): The Political Zones in Halhul According to Oslo Agreement (1995), and Hebron Protocol

Political Zone	Area (Dunums)	% From Total Area
A	5,191	14%
B	21,082	56.5%
C	10,869	29.1%
H1	150	0.40%
Total	37,292	100%

Source: LRC GIS Database, 2010

(3.13) The Local Context:

The planning system in the West Bank was subjected to a number of different authorities and occupation powers. However, after the second Oslo agreement in the year 1995, the Palestinian National Authority was granted the right and power on the populated areas in both of the political zones, A, and B.

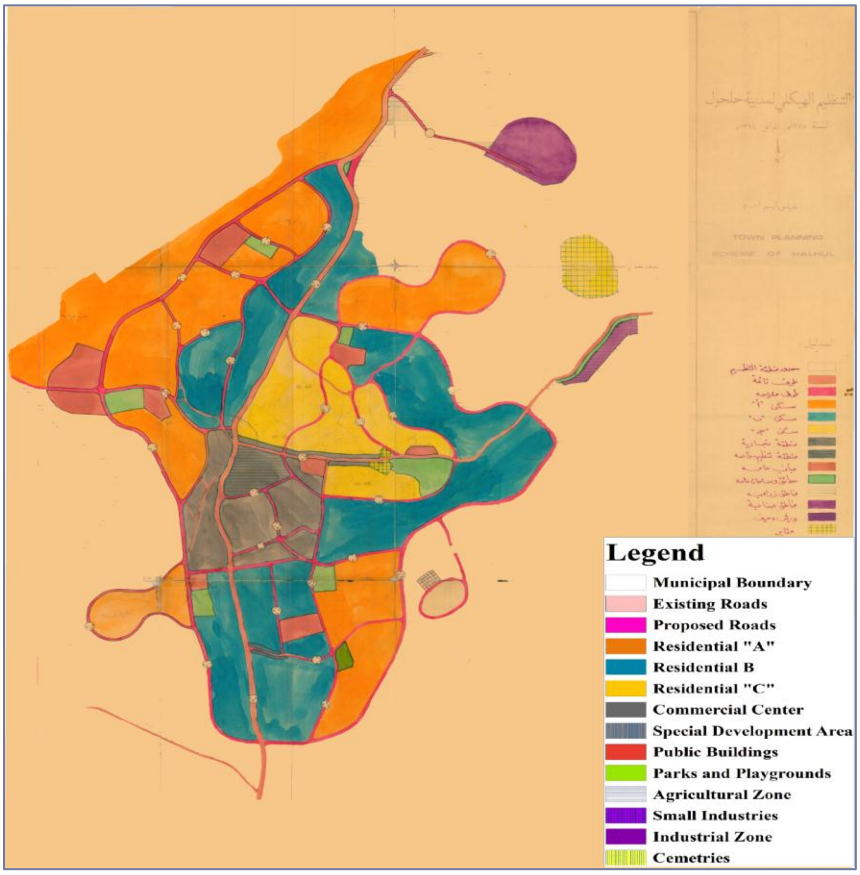


Figure (3.12): The First Master Plan for Halhul in 1975

Source: Halhul Municipality, 2010

The first master plan for Halhul was prepared in 1975, comprised of 9,198 dunums (see Figure (3.12)) (Halhul Municipality, 2010). Even though it was not applied on ground, it can be considered as an outline plan. In 1982, the municipal boundaries were reduced by 4,980 dunums, until the year of 2006 under the PNA governance, where a new expansion was approved by the Israeli occupation for the western part of the municipal boundaries increasing the municipal boundaries area to approximately 14,743.7 dunums in total (Halhul Municipality GIS Database, 2010).

The new expansion of the municipal boundary lacks any kind of land-use planning, or zoning, and doesn't consider any environmental conservation or development plans (see Figure (3.13)).

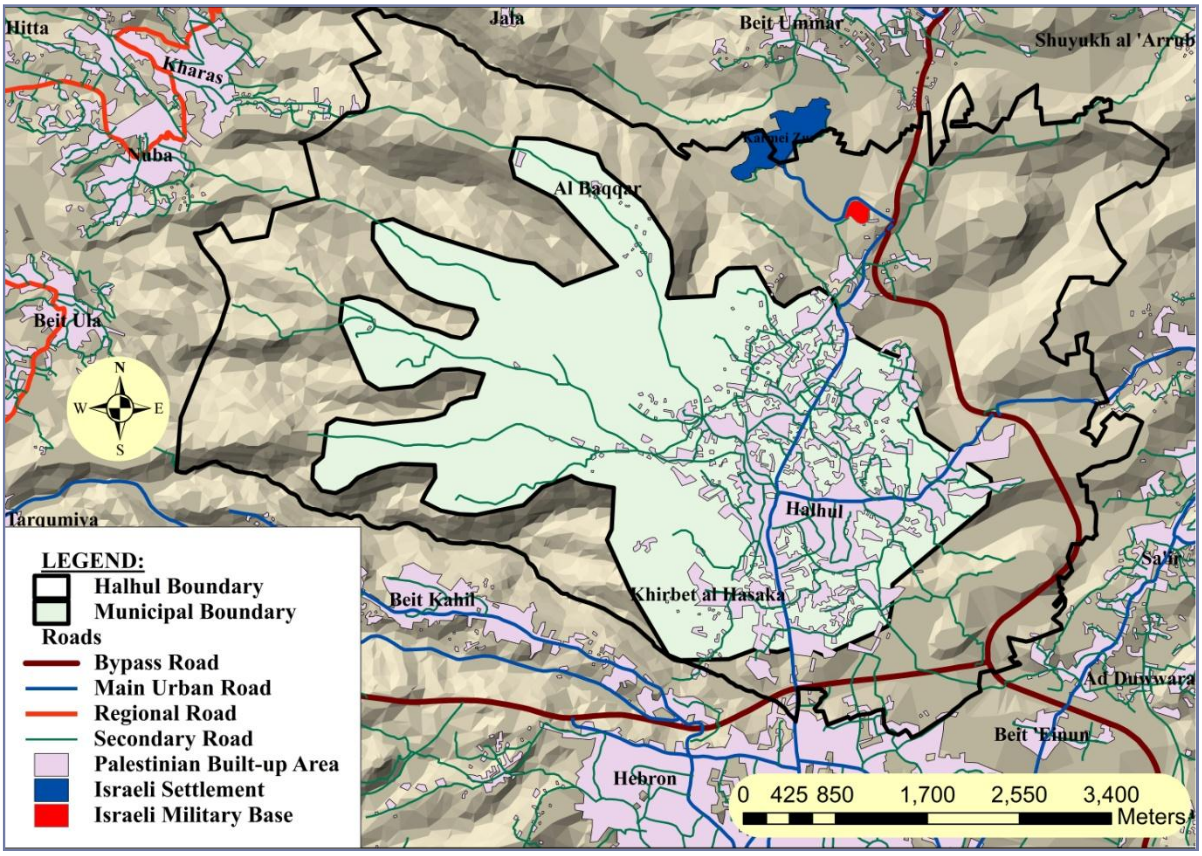


Figure (3.13): Municipal Boundary According to the Expansion Boundaries Approved in 2006 by the MOLG

Source: LRC, GIS Database, 2010

CHAPTER IV: RESEARCH METHODOLOGY

The research structure is constructed in phases to achieve a land management plan, and a model for Halhul.

The main goals of the land management modeling are:

1. Land suitability modeling for Halhul, under two suggested geo-political scenarios which will be defined later. Several social, cultural, economic, physical and environmental factors (criteria set) were considered to classify land according to its suitability for urban development in respect to land resource sustainability. Lands were then classified into highly sensitive areas (HSA), moderately sensitive areas (MSA), low sensitivity areas (LSA), and not sensitive areas (NS).
2. To promote a sustainable framework, for a sustainable model.
3. To define measures and indicators for the assessment of the sustainability of the model.

The research framework must be constructed upon a defined approach, thus the rationale planning approach has been applied as mentioned in Chapter (1), P. (5) (Figure (1.1)).

The research is divided into four main phases, which are the problem identification and literature review as the first phase, the data collection phase related to the study area including social, economic, environmental, political, and physical data, after that comes the analysis phase, in which the social, economic, physical and environmental data, is analyzed using the intermediate factor combination, and the multi criteria evaluation method as an approach for creating a land suitability model (for Halhul) using GIS spatial analysis, to determine the available urban areas suitable for urban development, then discussing the results obtained by the analysis, and defining the sustainable limit for the final model, and the appropriate measures to assess the sustainability of the models.

Finally comes the last phase to set an approach for the models evaluation and monitoring the system.

(4.1) <u>The Research Structure and Framework</u>:

The research methodology is divided into four phases as in the following Figure (4.1).

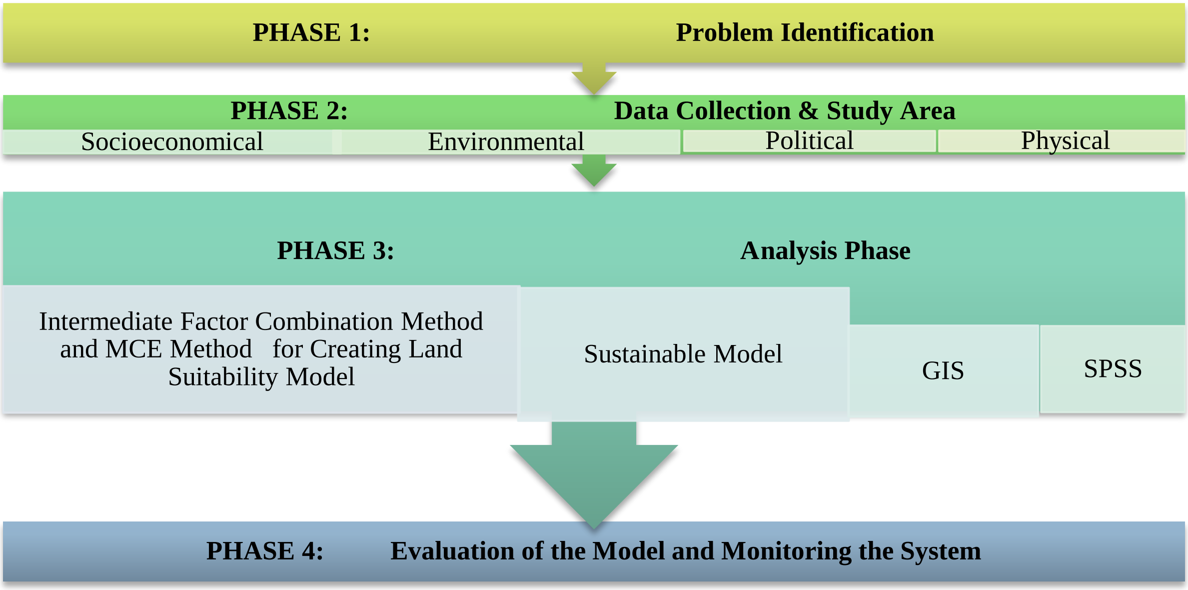


Figure (4.1): The Research Methodology Phases

This was mentioned by (Ruiter et al., 1998), who stated that "the need for information during the planning process is concentrated in four phases, problem identification, data collection, analysis of alternatives, and evaluation".

Therefore, each phase contains different information and data types, which means different techniques in data collection.

(4.1.1) <u>Phase One: Problem Identification</u>:

The main features and ideas, and the main principles related to the subject of research must be considered, explained, and discussed, and the main concepts which are relevant to the study, as mentioned in Chapter I. They include the main goals and objectives, and the relevance of the study.

(4.1.2) <u>Phase Two: Data Collection</u>:

The second phase, the ***data collection phase***, concerning the data needed for the study area, it includes;

A) Spatial and Non-Spatial Data, which include: "the area, facts, Figures, existing land use, and government policy" (Ruiter et. al., 1998)

The most important data used in this study related to this classification can be summarized in the following:

The study area data should include "a description of the main (physical) features, location, and short history" (Ruiter et. al., 1998). Land use; agricultural land, nature, environment, open areas, water sensitive areas, and archeological sites.

Government policy including local scale, existing plans, decision making processes, laws and regulations."

For physical planning, it is important to focus on relevant geographical data. To the extent possible, the data should be known at the beginning of the planning process (Ruiter et al., 1998).

These include three major data categories or types, which are classified under socio-economic, environmental, physical and political data. They were illustrated in more detailing in Chapter (III).

As for the maps and data layers, which have been used in this study, they include: Halhul village boundary (Jurisdiction Area) (LRC, 2010), the master-plan for the year 1975 (Halhul Municipality), the political zones (Geopolitical status in Halhul GIS Database) (LRC, 2010), the land-use land cover map (ARIJ GIS Database, 2010), water sensitive areas from (MOPIC), soil data map (ARIJ,2010), Halhul administrative and municipal boundaries according to the expanded boundaries 2006 (LRC, 2010), contour map of 25 m interval (LRC,2010), existing Palestinian built-up areas and Israeli settlements based on an aerial photo taken in 2006 (ARIJ,2010), land ownership (Halhul Municipality), mean annual precipitation map (LRC, 2010), and mean annual temperature (C°) (LRC, 2010).

B) The Criteria Set Evaluation Form/ Questionnaire:

In addition to the spatial and non-spatial data obtained previously, an evaluation form or a questionnaire was prepared to evaluate the weights of the selected criteria set for the proposed land suitability model of Halhul. This evaluation form is illustrated in Appendix (V). The targeted groups were planners, and other governmental and non- governmental organizations (NGO s). About 23 evaluation forms were distributed, from which 15 were responded, to each included different views according to the field of work. These organizations include the Land Research Center (LRC), ARIJ, MoPIC, MoA, the Palestinian Hydrology Group (PHG), Hebron Municipality, Halhul Municipality, MoLG, the Palestinian Water Authority (PWA), in addition to a group of planners.

The form was distributed by the researcher to the designated organizations, who met their representatives to discuss their views, as for the selected group of planners, they received their evaluation forms through the e-mail, as it is more convenient and easier to collect.

The collected forms were analyzed using SPSS, where the main criteria set weights were found by evaluating the average mean of the answers.

(4.1.3) Phase Three: The Analysis Phase:

In this phase, the collected data was used in projecting the social, economic, physical and environmental data layers, spatially. All the analysis tools, techniques and the different modeling approaches, used for analyzing the research problem, will be discussed and mentioned.

And so; the analysis phase was structured in different stages, in the first stage the local profiling including population projections was analyzed, As for stage 2: the land suitability analysis was first conducted for the agricultural sensitive areas, to define and find the highly sensitive agricultural areas (most suitable for agriculture), by using the intermediate factor combination method. Then in the second analysis level land use suitability analysis was conducted to find the most suitable areas for urban development taking in consideration the importance of socio-economic factors, in addition to the land suitability analysis for the environmental value, which includes agricultural sensitivity and water sensitive areas. As for the third level of analysis, the land suitability analysis model will be developed by integrating the socio-economic suitability to the physical and environmental suitability, to obtain the final land suitability model for land resource management.

Therefore, based upon the defined criteria set, by conducting sieve analysis, then by the multi-criteria evaluation approach and the intermediate factor combination method, using GIS spatial analysis, the land suitability map was obtained with the HSA, MSA, LSA, and NS classifications.

In stage 3 the sustainable model for Halhul was considered, the urban growth projection were estimated at which the time balance of the system occurs, moreover the sustainable limit for the model, and the two indices of the degree of sustainability and the degree of saturation, were defined.

Each stage will be illustrated and displayed below:

(4.1.3.1) <u>Stage 1: Population Projections</u>:

Population projections are needed for future planning, where the need is to find the expected no. of people for the planned year. There are many forecasting methods used to estimate population projections, such as linear trend extrapolation, non-linear trend extrapolation, moving average, and forecasting using simple equation which was used for estimating future population growth for the purpose of this thesis (Ruiter et. al., 1998).

$B(t) = B(t_0)(1+GR)^t$ …………..equ. (4.1)

Where:
$B(t)$ = population size at time t, $B(t_0)$ = population size at time zero,
GR = growth rate, and t = projected period

Therefore, population estimation can be made by using the above equation, considering the normal growth rate for Hebron to be 3.34, (PCBS, 2010), which is the same as estimated for Halhul.

(4.1.3.2) <u>Stage 2: Land Suitability Analysis</u>:

In this stage the land suitability analysis were conducted by developing the most significant criteria set, which are related to the sustainability criteria (socio-economic, and environmental). The two scenarios were analyzed based upon the obtained criteria weights and scores using the intermediate factor combination method to obtain the final suitability. The land suitability process is illustrated in Figure (4.2).

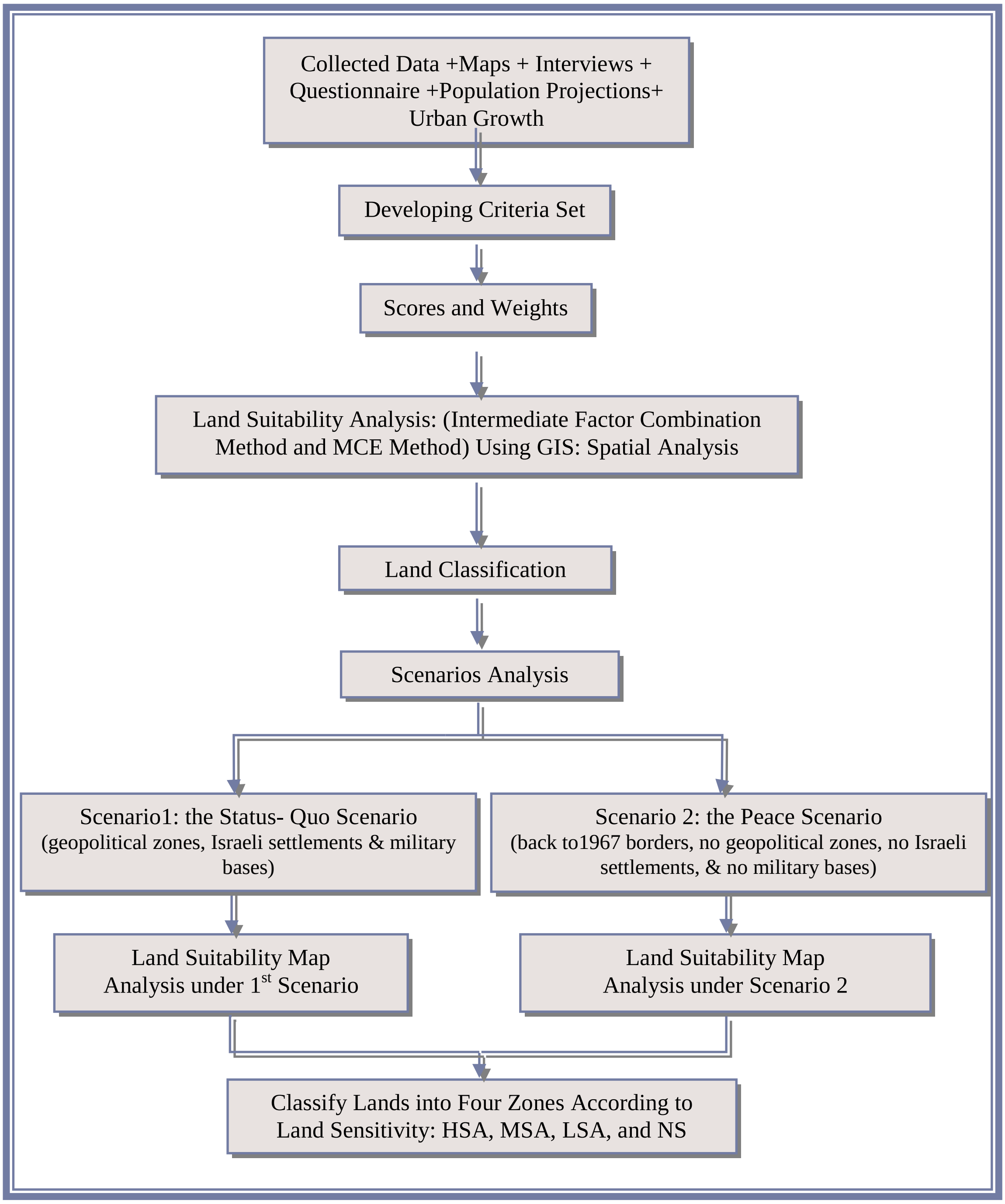


Figure (4.2): Land Suitability Analysis Process

The most significant steps to consider in the research methodology are derived from the previously illustrated process, and are summarized in the following:

1) <u>Maps and Layers</u>:

They include soil map, precipitation, land-cover, water sensitive areas, built up areas, geopolitical ABC zones, master plan (municipal boundary), village boundary, land ownership, and the slope.

2) <u>Criteria Set and Data Layers</u>:

The three major selected criteria categories are related to the sustainability criteria set, which include environmental social and economic aspects in addition to the physical factors. Under the major category the most important priorities for the study area considered are the agricultural land value, and water sensitive areas as for the environmental aspects.

For the social aspect, the land ownership, and the land potential for new urban areas (including the effect of distance from existing built up area, geo-political zones, master-plan boundary (municipal boundary) where the major social and economic activities are both around and within the serviced areas (roads, and water networks, etc.), and the distance from the bypass road. As for the economic aspect, it shares the previous social priorities in addition to the land value.

Therefore, as to avoid overlapping and duplication, the social & economic factors are used once in the analysis, achieving the same results (See Table (4.1)).

The social and economic aspects are joined under the socio-economic criteria set, and include land ownership, and land value for urban development.

As for the factor of distance from the bypass road, it is correlated with the land value thus the land value is used to reflect both effects. Therefore this factor can be eliminated, as there is another factor, which measures its effect.

1. <u>Environmental Factors</u>:

- Agricultural land
- Water sensitive areas

2. <u>Social and Cultural Factors</u>:

- Distance from CBD
- Land ownership
- Distance from bypass road

3. <u>Economic Factors</u>:

- Distance from CBD
- Land value

- Land ownership

4. Physical Factor:

- Slope

Table (4.1): The Final Selected Criteria Set for the Purpose of Land Suitability Analysis in Halhul

Environmental Factors	**Social & Cultural Factors**	**Economic Factors**	**Physical Factors**
	Socio-Economic Factors		
1. Water Sensitivity Areas	3. Land Ownership		5. Slope
2. Agricultural Sensitive Areas	4. Land value (land potential for new urban areas including the effect of distance from existing built–up areas, geo-political zones ABC, and the master plan)		

3) The Analysis Levels:

The agricultural land suitability analysis was conducted first, to classify the agricultural lands value into high to low agricultural sensitive areas, according to a number of criteria set which are: precipitation distribution, soil types, and land cover/ land use. The map layer resulting from this analysis was used in the second level of the land suitability analysis for the environmental suitability. In addition, to obtain the layer of the land potential for socio-economic needs, in the second stage, for the second level of analysis, the two factors or criteria had to be analyzed first, which are land value (the land potential for new urban areas including the effect of distance from existing built up area, ABC political zones, and the master plan), in addition to the land ownership.

In the third level of analysis, the layers obtained from stage two, which are the land potential for socio-economic needs suitability and the environmental suitability analysis were integrated to the slope layer (physical factor), and analyzed to obtain the final land-resource management plan. The levels of criteria set analysis are illustrated in the following Table (4.2) and Figure (4.3).

Table (4.2): Criteria Analysis Levels

Analysis Level (Stage)	First Level	Second Level	Third Level	Fourth Level
Environmental	1.1) Land Cover 1.2) Soil Type 1.3) Precipitation Distribution	1. Agricultural Sensitivity	Environmental Sensitive Areas	Land Suitability Analysis Model
		2. Ground-water Sensitivity		
Physical			Slope	
Socio-Economic		3. Land value (land potential for new urban areas (distance from existing built-up areas ,ABC political zones, master plan))	Land Potential for Socio-economic Needs	
		4. Land Ownership		

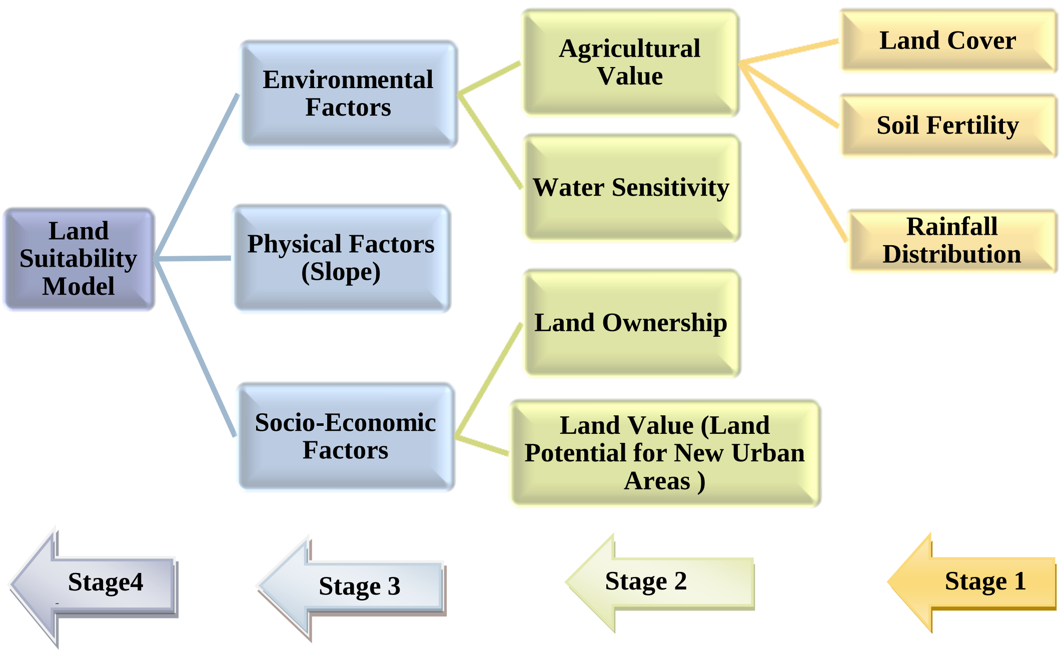


Figure (4.3): Criteria Analysis Phases

4) <u>Scenario Analysis/ Geopolitical Scenarios Assumptions</u>:

The analysis of land suitability was conducted for two different geo-political scenarios, the Status-Quo Scenario (de facto), and the Peace Scenario assuming peace continuation. For both scenarios, planning for urban land development will be influenced by several factors.

(I) <u>Scenario (I): Status-Quo Scenario:</u>

This scenario implies continuation of the Israeli occupation and segmentation of the West Bank into geopolitical zones. Therefore, the current situation imposes geopolitical zoning into areas "A", "B", and "C". Where area "A" means: the Palestinian Authority controls internal security and civil functions (full Palestinian civil and security control), area "B" means: populated villages, camps and other Palestinian built-up areas, where the Palestinian Authority controls civil functions only (Palestinian civil control and Israeli security control), and area "C" includes all other areas where Israel still have full authority (full Israeli civil and security control). (Hosh et. al., 2000)

In this scenario, the following assumptions are valid:

The current situation will be applied, assuming the continuation of the geopolitical situation, "ABC" political zones, Israeli settlement, and Israeli military bases. The population growth rate will follow the natural annual growth rate.

In the current situation, the total urban fabric is made up of the Israeli military base and settlements, in addition to the Palestinian built up areas. Therefore, in these lands there is no potential for any land use other than the existing, so freezing these areas must be done for all the layers. In addition, for the socio-economic factors which are the land ownership and the land value layer (the land potential for new urban areas), in which area "C" zone is a restricted area for urban development; it has no value for urban development.

(II) Scenario II: Peace Scenario:

In the second scenario, assuming an independent Palestinian state in the West Bank, and back to the 1967-Borders. This implies several assumptions to be made and used in the analysis, to include:

All lands are available for further urban expansion, no settlement, no military bases, and the political zones "ABC" will be invalid.

In the land value for urban development layer: lands around the town center will maintain their high price rates and value in addition to the lands which are within the master-plan boundaries, as they are within the serviced areas. In addition, the land value and price rates will rise for the lands along the bypass road, as "C" zone no longer exists, higher demand on these lands will be generated for social and economic reasons. This means that these areas won’t be referred to as a freeze area as in the first scenario and will have new development potential. That is why the "C" zone boundaries will be considered in this layer as a buffer zone within which a new potential will be gained. As for the areas outside the master-plan, they will be less attractive.

From all of the other layers, the Palestinian built up areas will be excluded by freezing these areas. As they still exist, and so these lands have no potential for any use other than the existing. Whereas the Israeli settlements and military bases will be removed and so, the score value will be gained according to the actual cell (grid) value.

5) <u>Multi-Criteria Evaluation Method</u>:

"The multi-criteria evaluation method was used to classify, analyze and arrange available information concerning alternative solutions in physical planning" by using criteria set where the relative importance of the criteria can vary according to the weight given for each. It accounts for impact on the environment (Ruiter et. al., 1998). These weights are determined according to the plan, and policy makers on local, regional or national level (Ruiter et. al., 1998).

The selected criteria set, for the purpose of this study was given weights based on the policy makers' opinions and feedback from stakeholders, such as MOPIC, MOLG, Halhul Municipality, Hebron Municipality, MOA, in addition to other NGO s such as LRC, ARIJ, PHG, in addition to a number of planners.

The multi-criteria method should pass through three stages or steps (Ruiter et. al., 1998):

1. Classification of criteria
2. Scaling of criteria
3. Standardization of different criteria.

In any project or study that will be evaluated by using (MCE) method, there is a need to develop criteria set. The criteria set can be obtained by considering the possibility of choices to be realistic, and that the selected criteria can describe the means and constraints of the desired choice possibilities, also it should consider the social desirability of such a project.

There are three types of criteria (Ruiter et. al., 1998):

1) Spatially influenced criteria related to the situation around the cell and not the grid cell itself.
2) Suitability criteria related to the grid cell itself (as in this research).
3) Surrounding criteria related to how nearby the grid cell is to a certain object.

As for, the criteria set, which was selected in this research, it was given weights as mentioned above, where each cell is assigned with scores according to each criteria. And because the factors are measured in different units they have to be weighed before by giving a weight factor for each criteria based on its relative importance, the scores are then multiplied with their corresponding factor weights, and finally; the product scores are added up to obtain the final total score and suitability analysis for the project.

Then by applying, the following equation the final standardized and weighted scores for the suitability map are found: (Ruiter et. al., 1998)

$S_j = (\Sigma S_{ij} \times w_j) / \Sigma w_j$ ……equ. (4.2) where:

S_j=the total score of the sub-area
$S_{i,j}$= score for the sub-area i for factor j
W_j=Factor Weight

The result of this phase is a map or a matrix, which shows the total quality of every sub-area. This map contains the total quality in terms of a certain set of objectives, factors, indicators, and a certain set of factor weights. This will be a database for the future, for any new objectives, when the criteria are changed, any new classification is applied, or when new factors and indicators are added, omitted or changed, new plans can then be applied easily.

(4.1.3.3) <u>Stage 3: Measuring Sustainability</u>:

From the previous sections land suitability analysis has been conducted to obtain the final composite map of land suitability analysis, where the final low score values are the most suitable areas for urban development and the high scores values are not suitable for urban development. In other words, the high score values are those areas, which are highly sensitive; they include agricultural areas, and water sensitive areas. From this, the composite map will be reclassified into four categories according to land sensitivity (HSA, MSA, LSA, and NS).

However, how can we judge on the actual system sustainability, as the previous reclassification is not the actual reality (It is the ideal condition (designed) but not the real world)? There should therefore be indicators to measure how much the real world is related to the ideal model.

From the previous reclassification, Halhul area is divided into four major areas which are HSA, MSA, LSA, and NS.

This means:

- Halhul's total area (TA) = existing urban area (U) + available area (HSA+MSA+LSA+NS)

  → TA = U + HSA+ MSA+LSA+ NS

It should be referred to that the existing urban area considered is according to the time reference of the model, here the U (t0) is at time zero (which is the model year of classification) obtained from the land cover of 2006, according to ARI J (ARIJ, GIS Database, 2010).

Now, (by substituting for HSA, MSA, LSA, NS by H, M, L, and N respectively)

- TA= U + H+M+L+N … equ. (4.3)

With time, the available area will decrease, as the existing urban area will increase at the same time reference.

- ΔU= U (t)-U (t0) ...… equ. (4.4)

Where:
ΔU= incremental increase in the existing urban area by time from the original constant value of existed urban area
U (t0) =U= existing urban area (At the model time reference 2006)
U (t) = urban area at time t

However, the incremental increase in urban area and decrease in the available area is from different sources, in other words, the decrease is from HSA, MSA, LSA or NS (see Appendix (VI), equations (VI-1, VI-2, VI-3, VI-4))

Therefore, with time, the change in urban area is due to the change in ΔH, ΔM, ΔL, and or ΔN

- ΔU= ΔH+ ΔM+ ΔL+ ΔN ..... equ. (4.5)

Where:
ΔU= incremental increase in the existing urban area by time from the original constant value of existed urban area
ΔH= is the decrease in HSA by time from the original constant value obtained by the model.
ΔM= is the decrease in MSA by time from the original constant value obtained by the model.
ΔL= is the decrease in LSA by time from the original constant value obtained by the model.
ΔN= is the decrease in NS by time from the original constant value obtained by the model.

From this, the balance limit can be determined, at which the system will reach two defined referenced points, defined as the sustainable reference and the saturation point.

The saturation limit is reached when the total available area suitable for urban development is used completely which includes only the LSA and the NS area, this can be translated in the following equation:

$\rightarrow \Delta H=0$, $\Delta M=0$, $\Delta L= L$, $\Delta N = N$ by substitution in equ. (4.5)

$\Delta U= L+ N$	…… equ (4.6)	(Saturation Limit and Sustainable Limit)

According to this equation:

$\Delta H=0$ and $\Delta M=0 \rightarrow$ which means that the HSA and the MSA are conserved and not used for urban development. This is considered the sustainable reference limit for the model, at which any more values will move the system from a sustainable state gradually to an unsustainable condition until $\Delta H=H$ and $\Delta M=M$ (the worst case).

According to equation (4.5), and with time, the system may follow different trends and a number of possibilities (change in existing urban areas), (see Appendix (VI), Table (VI-1)) which illustrate each case.

Therefore, the expression of:

- $(\Delta H+\Delta M)$ is the expression of un-sustainability (which determines and reveals the un-sustainability of the system)
- While $(\Delta L+\Delta N)$ = is the expression of saturation.

As the model reaches:

- $(\Delta H+\Delta M)=0 \rightarrow \Delta U= L+ N$ ….. equ (4.6) → thus it reaches the sustainable limit and the saturation limit which is the balance of the system. After this point, the model will be un-sustainable as $(\Delta H+\Delta M)>0$

Before this limit the model is sustainable and below saturation as $(\Delta H+\Delta M) =0$ (Sustainable) & $\Delta U< L+ N$ (un-saturated) (or) in other words → $\Delta U= (\Delta L+\Delta N)$

From this and according to Table (VI-1) in Appendix (VI), the cases from (1-4) in Table (VI-1) are considered the most common cases which should be available and shouldn't be exceeded to the following cases (5-16) in Table (VI-1).

That is because in these cases the model is sustainable as $(\Delta H+\Delta M)=0$, (except in the highlighted ones (see Table (VI-2), Appendix (VI)), where $(\Delta H+\Delta M)>0\rightarrow$

1. $0<\Delta H<H$ (and) $0<\Delta M<M$ (or)
2. $\Delta H=0$ (and) $0<\Delta M<M$ (or)
3. $0<\Delta H<H$ (and) $\Delta M=0$

But even though, there should be a reliable indicator for measuring sustainability accurately, in order to have a good tool that can be used for comparing two alternative cases, or even measure the degree of sustainability or un-sustainability of any stand-alone case, to indicate how much the case is worsening with time.

Therefore, there is a need to define a sustainability index in order to measure the degree of sustainability or un-sustainability in a system. This can be done by using the term of sustainability, which was defined. Then, the rates of change in M and H imply changing from sustainability to un-sustainability as this change of ΔH and/or ΔM increase, the degree of un-sustainability will increase and vice versa. And so;

- $HSA_{index}=\Delta H/H\rightarrow \Delta H=H-H(t)$ … equ (4.7)

Where:
HSA_{index}: is the highly sensitive area index
H=HSA according to land suitability model (constant)
H (t) =HSA which remains and measured at time t

- $MSA_{index}=\Delta M/M\rightarrow \Delta M=M-M(t)$ … equ (4.8)

Where:
MSA_{index}: Moderately sensitive area index.
M=MSA according to land suitability model (constant)
M (t) =MSA which remains and measured at time t

However, what is more sustainable, is it the change due to HSA, or the MSA, which means that there should be weight for each in relation to their importance.

For the purpose of this research, this weight was given by the researcher, only for illustrating the case of this study, meaning that for other similar or different cases, it can vary according to the case itself, the planners, the decision makers, and the plan. Therefore, the HSA weight will be given 0.6 (60%), and 0.4 (40%) remains for the MSA.

Therefore, the Un-sustainability Index (as it measures the increase in change of HSA and MSA) is:

- Un-sustainability index= $(HSA_{index} * W_{HSA} + MSA_{index} * W_{MSA})*100\%/(W_{HSA} + W_{MSA})$...equ (4.9)

Where:
W_{HSA} =the weight of highly sensitive areas
W_{MSA} = the weight of moderately sensitive areas
* Note: $(W_{HSA} + W_{MSA}) = 1$

In order to find the Sustainability Index:

- Sustainability Index= 100%- Un-sustainability Index ….. equ (4.10)

In the same manner, the degree of saturation can be measured, by using the term ($\Delta L+\Delta N$), which refers to that there is still a change in land utilization of the LSA and NS areas, meaning that the saturation limit (L+N) has not yet been reached. Thus, as the rate of change in L and N increase, the degree of saturation will increase until reaching the saturation limit.

From this:

- $LSA_{index} = \Delta L/L \rightarrow \Delta L = L - L(t)$ (at saturation limit $L(t) = 0$) $\rightarrow (\Delta L = L)$ …. equ (4.11)

Where:
LSA_{index}: low sensitive area index
L=LSA according to land suitability model (constant)
L (t) =LSA which remains and measured at time t

- $NS_{index} = \Delta N/N \rightarrow \Delta N = N - N(t)$ ….. equ (4.12)

Where:
NS_{index}: is the no particular sensitivity area index
N=NS according to land suitability model (constant)
N (t) =NS which remains and measured at time t

Here, it should be referred to that the "not sensitive" areas have the priority to be used and saturated before the low sensitivity areas, as they have no particular land sensitivity value. Therefore, it should take the higher weight factor (for example: ($W_{LSA} = 0.4$, $W_{NS} = 0.6$))

- Saturation index= $(LSA_{index} * W_{LSA} + NS_{index} * W_{NS})*100\%/(W_{LSA} + W_{NS})$ … equ (4.13)

Where:
W_{LSA} =the weight of low sensitive areas
W_{NS} = the weight of no particular sensitivity areas
* Note: $(W_{LSA} + W_{NS}) = 1$

In this manner, any case can be measured for both of the indices to understand the state of sustainability or un-sustainability besides the degree of saturation.

Where the need first is to evaluate the area of the HSA, MSA, LSA, and NS from the land suitability model, denoted by the constants of H, M, L, and N respectively, with the time reference of the designed model.

Then at any time the H (t), M (t), L (t), and N (t) areas which remain at time t, should be determined by having the new land built-up area, in order to find ΔH, ΔM, ΔL and ΔN.

The two indices can then be defined for the time t.

And so at any time:

TA=(U(t0)+ ΔU)+ (H-ΔH)+(M-ΔM)+(L-ΔL)+(N-ΔN)

TA=(U(t0)+(U(t)-U(t0))+ (H-(H(t0)-H(t))+(M-(M(t0)-M(t))+(L-(L(t0)-L(t))+(N-(N(t0)-N(t))

By substitution of H (t0) =H, M (t0) =M, L (t0) =L, and N (t0) =N

TA=U (t) + H (t) +M (t) +L (t) +N (t)

By substitution of the total area of Halhul TA=37,292 dunums

37,292= U (t) + H (t) +M (t) +L (t) +N (t)

- U (t) = 37,292-(H (t) +M (t) +L (t) +N (t)) … equ (4.14)

Whereas, to maintain the system's sustainability H (t) & M (t) should be H (t) =H (0), & M (t)=M (0)

From the above, we have obtained the sustainability of the model.

- **The Urban Development Boundary:**

Now an urban development boundary can be suggested (designed), in which the development is allowed, this boundary will be designed according to the minimum requirements and standards adopted by (MOLG) (280m^2/person). Therefore, the targeted year for the design is known.

However, the urban growth may follow different trends, and so the actual urban area with time, might be equal, less or more than the designed urban area. In order to distinguish between the designed and the actual ones, the design will be denoted by the model (static) and the actual is the system (dynamic).

If they are equal then the system is sustainable (ΔU =0) as the system has achieved the designed standards. If the system is below sustainability (-) , this means that the system is below the designed standards, and finally if the system exceeds the model, this means that the system has exceeded the design standards and the development boundary will be utilized in a higher rate than the (expected) designed period, there is then a need to consider this for the next phase, as a new expansion of the boundary will be necessary, this has also accelerated the land use change (transformation) from agricultural to urban. In other words:

$\Delta U_{sustainability} = U(t) - U^*(t)$ ……equ (4.15)

If:
$\Delta U_{sustainability} = 0 \rightarrow$ the system is totally sustainable
$\Delta U_{sustainability} = (-) \rightarrow$ un-sustainable socio- economic
$\Delta U_{sustainability} = (+) \rightarrow$ environmentally un-sustainable

Where:

$\Delta U_{sustainability}$=the difference in system sustainability.

U (t) = Actual urban area at time (t). (Obtained from Aerial photos at the designated time)

$U^*(t)$ =estimated urban area according to the designed model at time (t), (using the MOLG minimum standards)

This is important in monitoring the efficiency of the design with time, and that the plan is implemented perfectly on ground, and to assure that the design standards are achieved. This can be used as a guideline to assess the performance of the system and the plan.

From here, the efficiency of the system can be estimated by:

Efficiency%= $[U(t)/U^*(t)]*100\%$ ……equ (4.16)

A question may arise here, in terms of, why the system is not performing as the model? And how could it be adjusted to comply with the model (conform to the standards)?

The answer is that there are some factors, which may have influence the rate of urban growth, which should be studied by modeling the actual urban area (system). Then this might reveal which factors are more significant and related to the system performance, in order to decide on the possibility of adjusting the system to increase its efficiency. However, this is out of the scope of this research.

(4.1.4) <u>Phase Four: Evaluation of the Models and Monitoring the System</u>:

This includes the final selected land suitability analysis models for Halhul (both scenarios), to be evaluated for their sustainability, and the selection of the most sustainable model, from which the urban development boundary will be designed and suggested. The monitoring phase will be then conducted. This will be discussed in further details in the following chapter.

In this manner, land resources management can be achieved through two sequential phases: the evaluation phase and the system-monitoring phase.

As a result, the planning process for land resources management has been distinguished and can be used for any other case, this process (approach) can be summarized in a schematic outline for evaluating and monitoring the system. It includes two sequential phases: the planning process and evaluation phase for the sustainable model of land resources, and the monitoring phase for the system sustainability and efficiency. The two phases are illustrated as in the following Figures (see Figure (4.4) and Figure (4.5)).

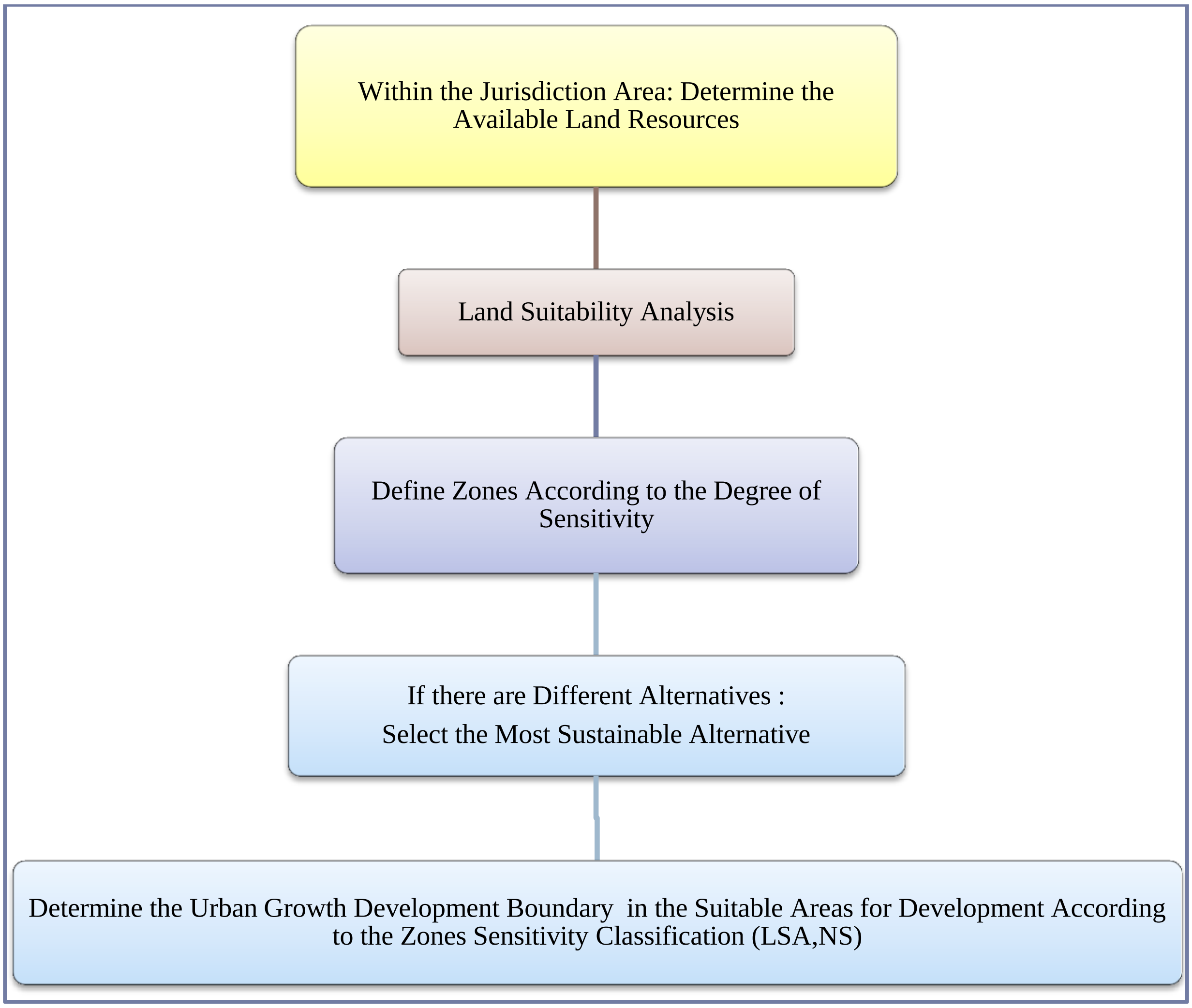


Figure (4.4): Land Management Process as Obtained from the Study, Phase (I)

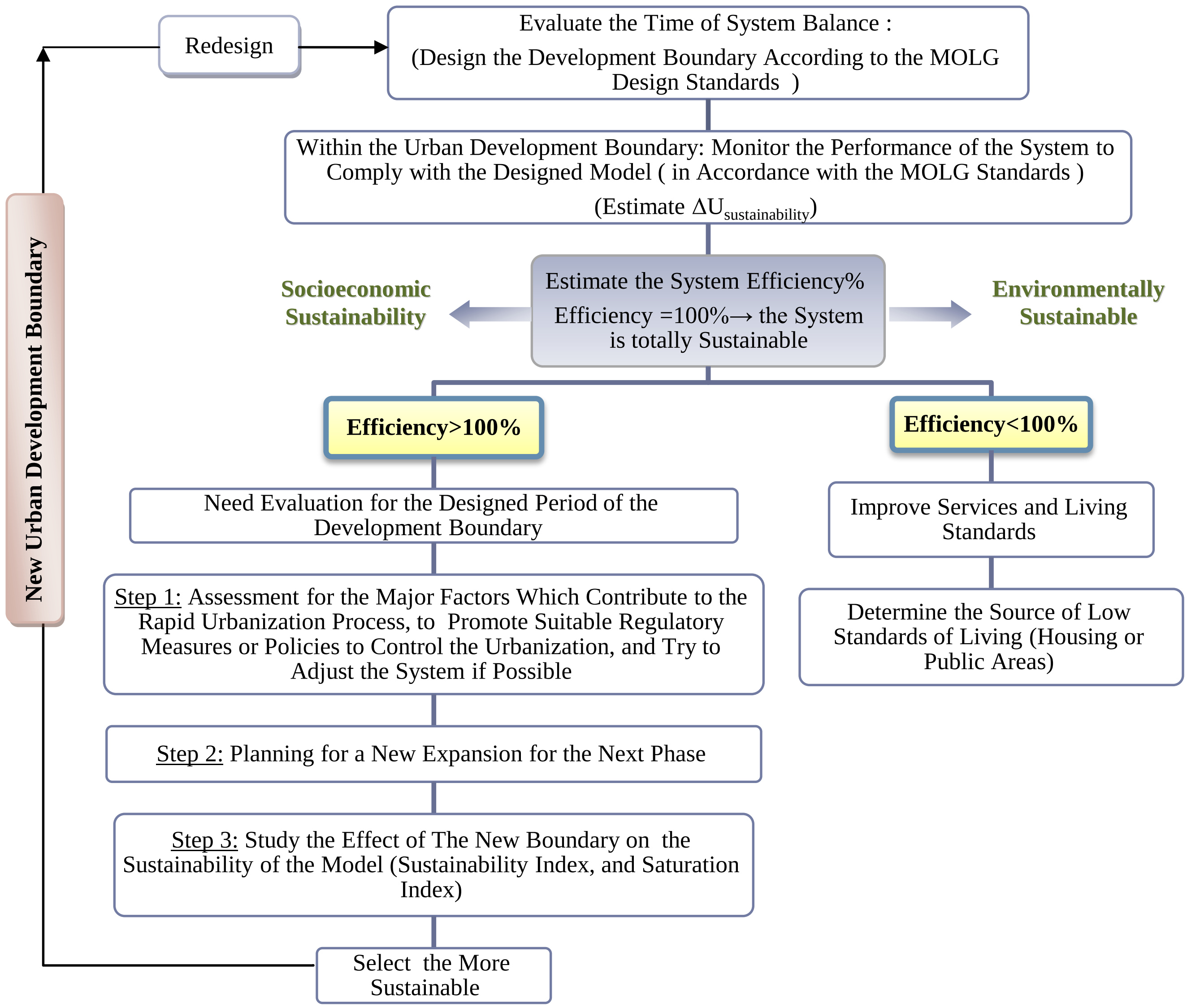


Figure (4.5): The Schematic Approach for the Monitoring Phase of the System Sustainability (Managerial Process), Phase (II)

CHAPTER V: ANALYSIS AND DISCUSSION:

(5.1) Population Growth Analysis:

Population growth is a driving force for future urban growth, and so population projections for the desired year of planning should be estimated, in order to predict the required urban growth areas necessary for the planned year. For this purpose, the population growth rate for the last years should be calculated.

The growth rate for Halhul was analyzed by both linear interpolation and non-linear interpolation according to the following equation as illustrated in Chapter IV:

1. $B(t) = B(t_0)*(1+GR)^{t}$ (non-linear interpolation) ...equ.(4.1)

Where: $GR = ((B(t)/B(t_0)) \wedge (1/(t-t_0)))-1$ ... equ. (5.1)

2. $GR = [(B(t)-B(t_0))/(t-t_0)]/B(t_0)$ (linear interpolation) .... equ.(5.2)

Where:
B (t) = population size at time t, $B(t_0)$ = population size at time zero, GR = Growth rate, and t = projected period

The Equation (4.1) will be used for future population growth estimation $B(t) = B(t0)*(1+GR)^{t}$.

By analyzing the available data on Excel, the estimated growth rates are as follows:

Table (5.1): Population Growth Rate between 1922 and 2010 by Linear and Non-Linear Interpolation

Number of Population between 1922 & 2010, and the Growth Rate Using Linear and Non Linear Interpolation			
Year	Population	Growth Rate Linear Interpolation	Growth Rate Non-Linear Interpolation
1922	1,927	-	-
1931	2,523	3.44%	3.04%
1945	3,380	2.43%	2.11%
1961	5,387	3.71%	2.96%
1982	6,040	0.58%	0.55%
1987	9,800	12.45%	10.16%
1997	15,663	5.98%	4.80%
2007	21,797	3.92%	3.36%
2008	22,528	3.35%	3.35%
2009	23,282	3.35%	3.35%
2010	24,060	3.34%	3.34%

Source: Estimated by the Researcher, Data Obtained from PCBS and Halhul Municipality, 2010

It is clear from the population growth trends that the growth rate is about 3.34% in recent years; while there are un-natural growth breaks noted, possibly related to the political situation in those years, such as the years of 1945, and after 1967, where many left the country, followed by the first

Intifada then by a sudden flow back to the country after 1982, and later in 1997 , when the PLO signed the Oslo agreement in 1994, and the Palestinian Authority allow large numbers of returnees back to the country.

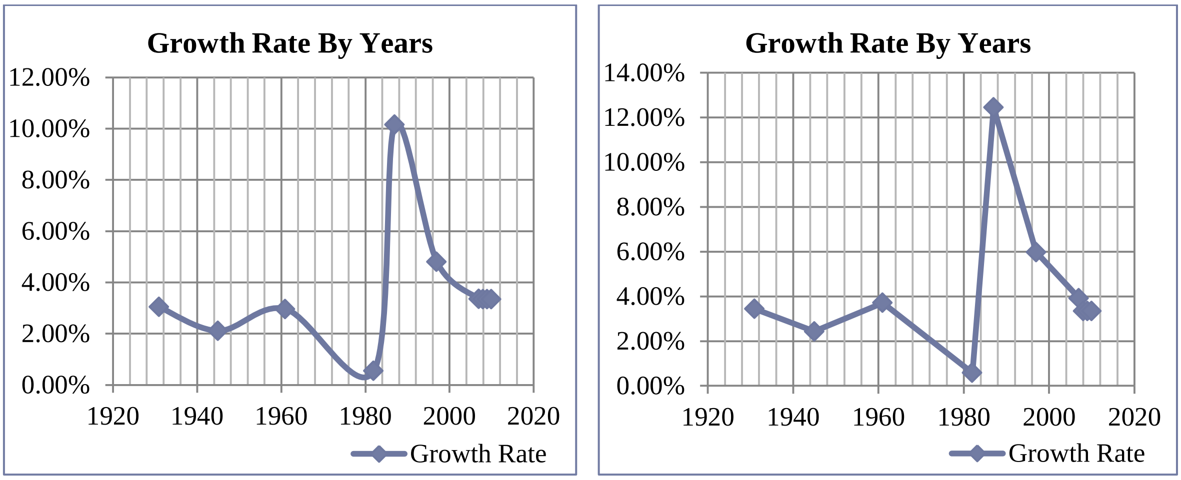


Figure (5.1): Population Growth Rates from 1922 to 2010 Using Non-Linear and Linear Interpolation

Source: Estimated by the Researcher, Data Obtained from PCBS and Halhul Municipality, 2010

Also obvious from the graph the sudden flows are concentrated between the years (1945-1960) and the years (1980-1987), while a sudden drop is noticed between (1960-1980), as for the period 1987-1997 the graph shows how the un-natural sudden rise gradually drops and again in 1997 higher flows than normal then after back to the natural growth rates (see Figure (5.1)).

The growth rate for Halhul was found to be 3.35% according to the final census of 2007 (see Table (5.1) above, population growth rate) and upon which the population projection will be estimated using equation (4.1).

(5.2) Urban Area and Urban Growth:

The total built-up areas were obtained for the years of 1997 and 2006 (ARIJ, 2010). Using 2007 census, the population estimation and density was estimated for 2006, in addition to the urban density as in Table (5.2).

Table (5.2): Population, Built-up Area, Estimation of Population Density and Urban Density

Year	*Population	**Built-Up Area (dunums)	Population Density(person /km^2)	Urban Density (m^2/person)
1997	15,663	2,688	5827	171
2006	21,090	3,487	6048	165

Source: *Data Obtained from PCBS, 2010, ** Data Obtained from ARIJ, GIS Database, 2010

According to the obtained urban density, the urban density for the year 2006 was used for estimating the required urban areas for the targeted years.

(5.3) The Criteria Set Weights:

SPSS was used to analyze the evaluation form of the selected criteria set for the purpose of this study. This evaluation form was prepared in order to examine and evaluate the selected criteria set weights according to the main stakeholders, decision makers and a group of planners.

This evaluation form (or questionnaire) considers the three levels of criteria set analysis, whereas each analysis stage has criteria weights totaling 100%.

The related information and data relevant to the study area were attached into the evaluation form.

There were about 23 evaluation forms which were distributed, 15 responds were obtained, most of the decision makers, and stakeholders views related to the area of concern were considered. All responds were analyzed using SPSS software, from the analysis the average mean values for each criteria weight was obtained as in Table (5.3), but they were approximated by the researcher for flexibility, and to facilitate their use in the analysis.

Table (5.3): Evaluation Form Analysis for the Criteria Set Obtained Weights.

Level of Analysis	Criteria	Criteria Weight as Obtained from SPSS Analysis	Approximated Criteria Weight as Used in the Suitability Analysis	Total
3rd Level	Environmental	39.82%	40%	100%
	Physical (Slope)	21.48%	20%	
	Socio – Economic	38.70%	40%	
2nd Level Stage Two	Land Value	67.78%	70%	100%
	Land Ownership	32.22%	30%	
2nd Level Stage One	Agricultural Sensitivity	61.11%	60%	100%
	Water Sensitivity	38.89%	40%	
1st Level	Precipitation distribution	23.89%	25%	100%
	Land Cover	45%	45%	
	Soil	31.11%	30%	

(5.4) Scenarios Analysis:

In order to analyze the two suggested scenarios, which are the Peace Scenario, and the continuation of the existing situation, the Status-Quo Scenario, two different groups of ranking, or geo-coding based on each criteria will be defined for each scenario. A land suitability model was then developed for each scenario using ranked layers.

(5.4.1) Ranking Scores for Each Scenario:

(5.4.1.1) Land Cover:

The land cover is an important factor; it represents the present land classification according to its actual land use (plant cover) as defined by the CORINE system (see Appendix III), the second level of CORINE Classification will be used for the purpose of this study.

The given scores or ranks are as shown in Table (5.4):

Table (5.4): Land Cover Ranks and Scores According to each Scenario

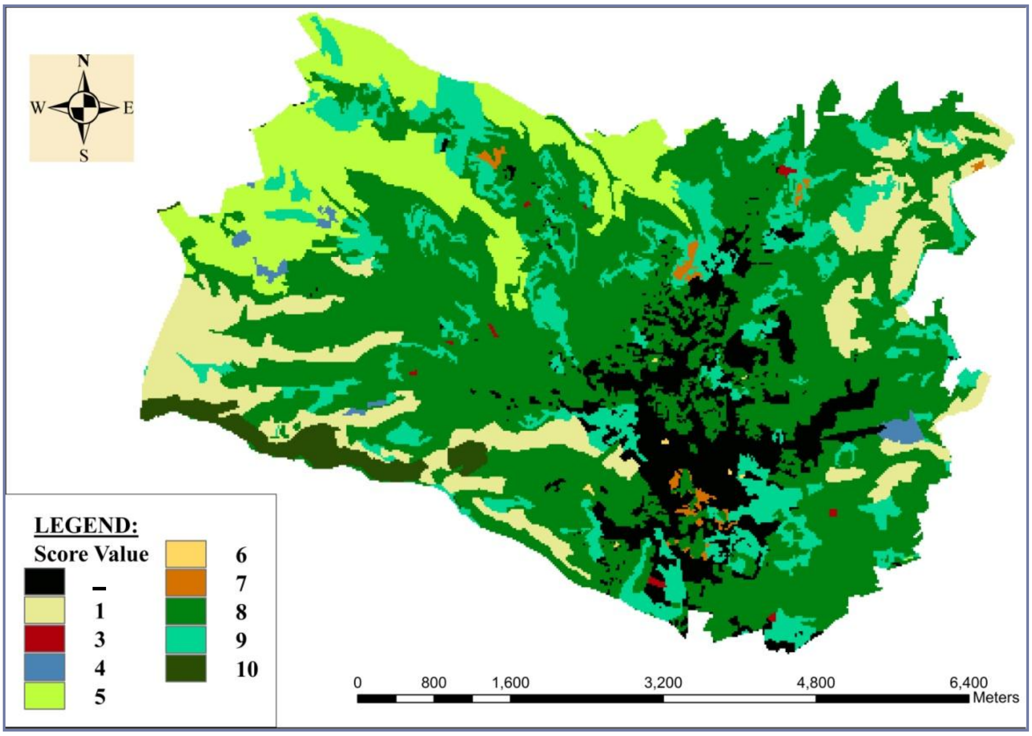
No.	Land Cover	Score Rank for the Status-Quo Scenario	Score Rank for the Peace Scenario
1	Israeli Settlement	-	*
2	Israeli Military Base	-	*
3	Forests	10	10
4	Arable Land	9	9
5	Permanent Crops	8	8
6	Heterogeneous Agricultural Areas	7	7
7	Plastic House	6	6
8	Shrub & Herbaceous Vegetation Associations	5	5
9	Mine, Dump & Construction	4	4
10	Industrial, Commercial Transport Unit	3	3
11	Open Spaces with Little or no Vegetation	1	1
12	Palestinian Urban Fabric	-	-

Note:
(-): Freeze area
(*): Removed and do not exist under this scenario

Source: Prepared by the Researcher, According to the CORINE Code Classification.

From this Table, it can be noticed that the open spaces with little or no vegetation, the shrub and herbaceous vegetation associations and other non-sensitive areas for agricultural use were assigned the lowest factor grading, while the agriculture sensitive areas such as the forests arable land and permanent crops, were assigned the highest score values, and the urban areas of Palestinian built-up areas and Israeli settlements and military bases will be denoted as freeze area, as there is no potential for any land use in these areas for the Status-Quo Scenario, while the Israeli built-up will be removed (do not exist), and will be assigned a score value based on the surrounding areas in the Peace Scenario.

The scores rating for land cover based on (ARIJ, 2002) scoring method (see Appendix II-C). According to this classification the land cover ranks were given, and shown in Figure (5.2).



Note:
(-): Freeze area

Figure (5.2): Land Cover in Halhul /Peace Scenario

Source: ARIJ, 2010

(5.4.1.2) Soil Layer:

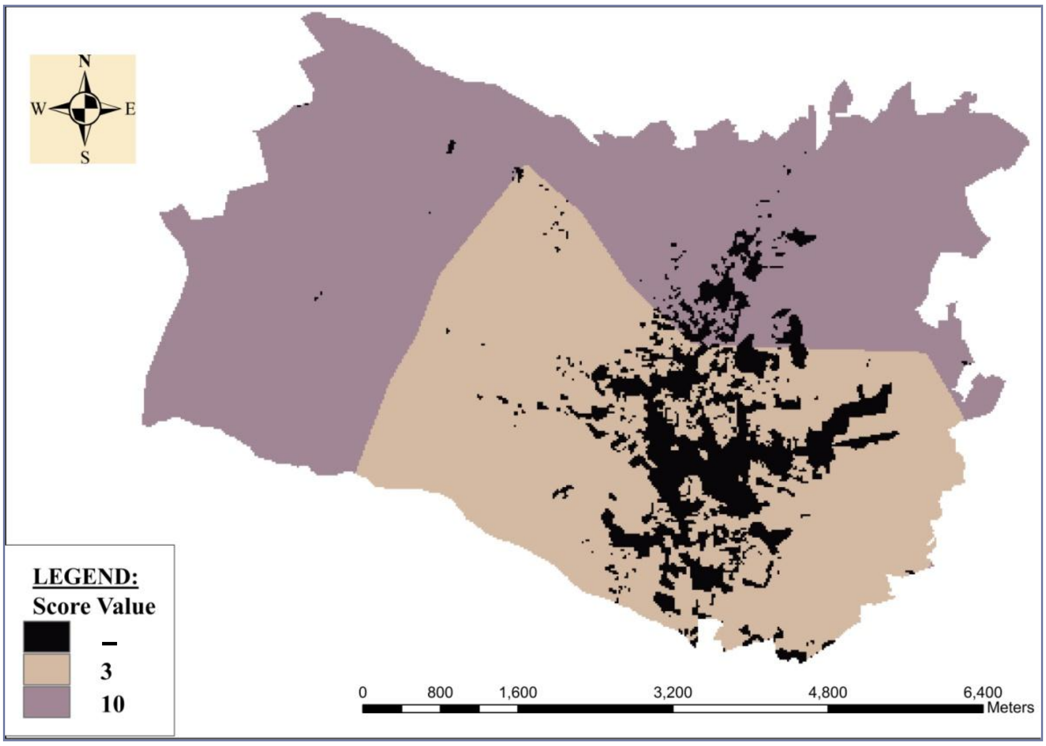
According to the soil classification there are mainly two types of soils: Terra Rossa and Brown Rendzinas, and Brown Rendzinas and Pale Rendzinas, where Terra Rossa is the most fertile soil, suitable for the cultivation of vines, and is thus given the highest score value (10) as for the Brown Rendzinas it was assigned a score value of (3) as it is less fertile (see Appendix II-A), for the scores given by (ARIJ, 2002), and the classification of soils in Hebron Governorate and ranks according to their fertility (see Table (5.5) for soil ranks and Figure (5.3)).

Table (5.5): Soil Type Ranks and Scores According to each Scenario

No.	Soil Type	Score Rank for the Status-Quo Scenario	Score Rank for the Peace Scenario
1	Terra Rossa Brown Rendzinas	10	10
2	Brown Rendzinas & Pale Rendzinas	3	3
3	Palestinian Built-Up Areas	-	-
4	Israeli Settlements	-	*
5	Cemetery	-	-
6	Israeli Military Base	-	*

Note:
(*): Removed and do not exist under this scenario
(-): Freeze area

Source: ARIJ, 2002



Note:
(-): Freeze area

Figure (5.3): Soil Map for Halhul /Peace Scenario

Source: ARIJ, 2002

(5.4.1.3) Annual Precipitation:

The climate in Halhul is classified as sub-humid with a de Martonne Aridity Index (MAI) ranging from 20 to 30. The northeastern parts receive a mean annual precipitation of about 600 – 650 mm, with a decrease in this average towards the western parts until it reaches its lowest mean annual precipitation of about 400 – 450 mm, this is due to the decrease in elevations in the western parts compared to the mountains highlands in the eastern parts.

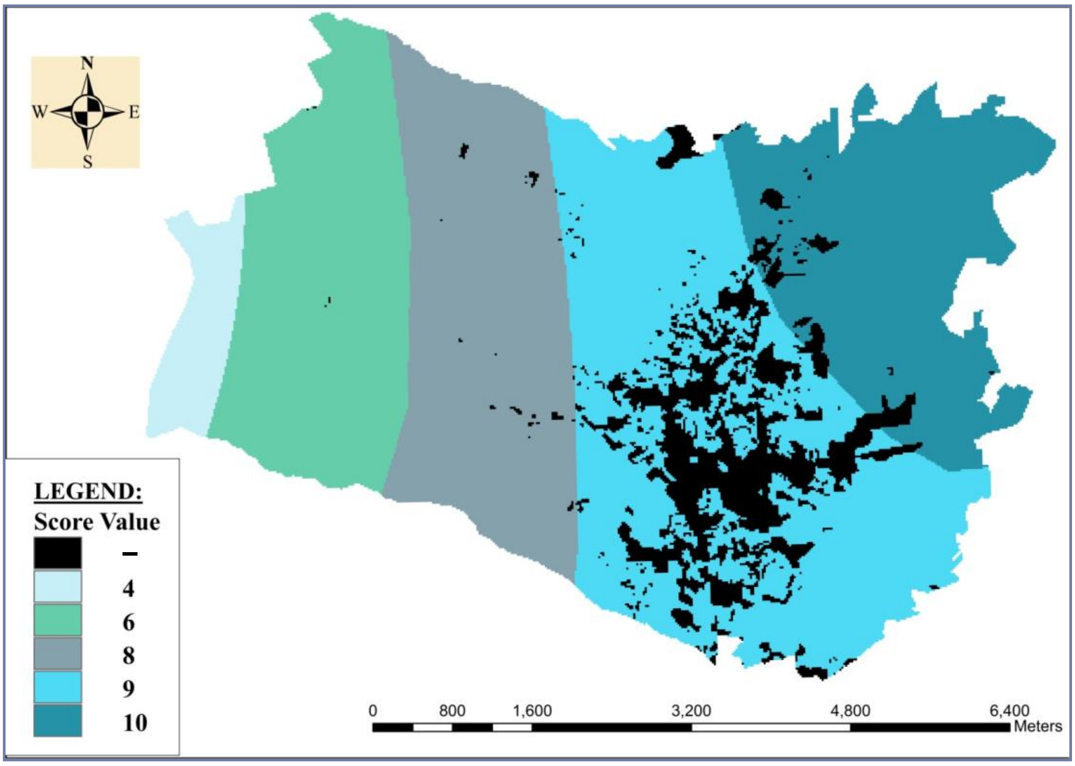
Therefore the precipitation distribution is an important factor here, as it guarantees adequate plant growth and maximum crop production by satisfying the plants requirements, and so the areas of higher mean annual precipitation will be more suitable for plant growth, and will thus be given a higher score value (10), while the lowest precipitation ranges will take the least score value. Table (5.6) shows the scores given for the two scenarios.

Table (5.6): Precipitation Ranks and Scores for each Scenario

No.	Precipitation Distribution	Score Rank for the Status-Quo Scenario	Score Rank for the Peace Scenario
1	> 650	10	10
2	550 - 600	9	9
3	500 - 550	8	8
4	450 - 500	6	6
5	< 450	4	4
6	Israeli Military Base	-	*
7	Israeli Settlement	-	*
8	Palestinian Built-Up Areas	-	-
9	Cemetery	-	-

Note:
(-): Freeze area
(*): Removed and do not exist under this scenario

By applying these scores on the precipitation layer, each scenario will be as in Figure (5.4).



Note:
(-): Freeze area

Figure (5.4): Annual Precipitation in (mm) for Halhul /Status-Quo Scenario

Source: LRC, 2010

(5.4.1.4) Water Sensitivity:

The water sensitivity layer, is the one prepared by the MOPIC and PWA, it was classified using different criteria set to determine the degree of sensitivity for ground-water recharge areas.

As for the case of Halhul the water sensitive areas lie to the east of Halhul, according to this classification the remaining area is not-sensitive.

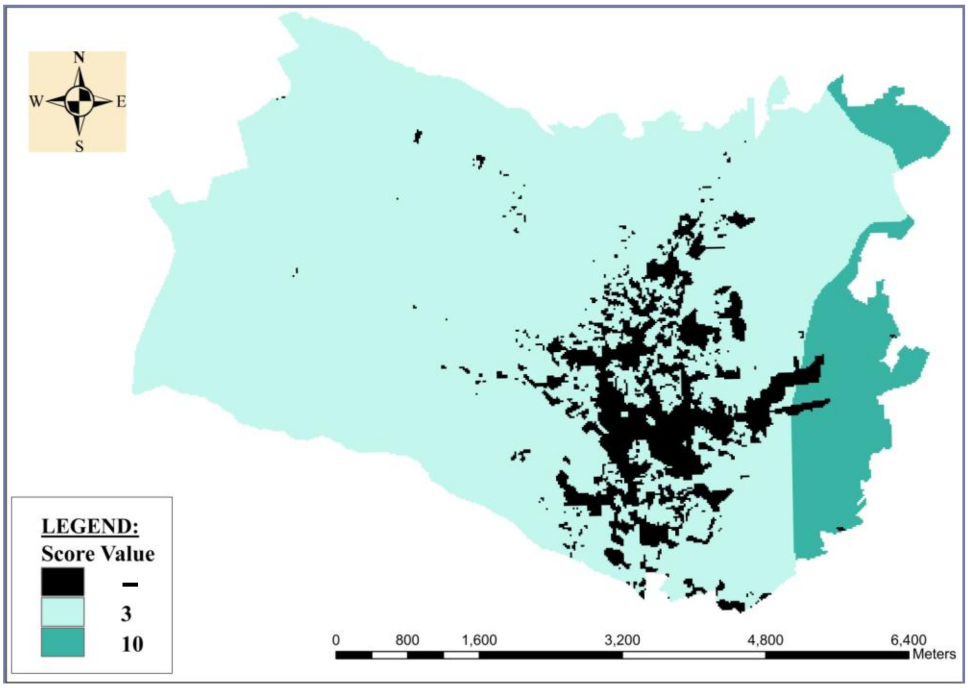
From this the sensitive area will take the highest score value (10) while the not sensitive area will be given a (3). This classification may ignore the western areas, and water springs which are used for drinking or agricultural uses which were not considered in the vulnerability study conducted by the MOP for the groundwater vulnerability assessment in the West Bank, and so the western parts should be considered, for this reason the non-sensitive areas will be given a score value (3). See Table (5.7) for Geo-coding scores of both scenarios.

Table (5.7): Water Sensitivity Ranks and Scores for each Scenario

No.	Water Sensitivity	Score Rank for the Status-Quo Scenario	Score Rank for the Peace Scenario
1	Highly Sensitive Areas	10	10
2	Not Sensitive	3	3
3	Palestinian Built-Up Areas	-	-
4	Israeli Settlement	-	*
5	Cemetery	-	-
6	Israeli Military Base	-	*

Note:
(-): Freeze area
(*): Removed and do not exist under this scenario

According to these score values, the water sensitivity layer will be as in Figure (5.5).



Note:
(-): Freeze area

Figure (5.5): Water Sensitivity for Halhul /Peace Scenario, **Source:** MOPIC, 2010

(5.4.1.5) Land Value:

This factor evolved from the effect of more than one factor; it considers the geopolitical situation, in addition to the master plan boundaries, and the town center (existing built-up area old town (CBD)).

The influence of the three factors is correlated into one factor which is the land value, as they are all major factors which highly influence the land value. However, the difference here, is that these factors are dependent and there is an inter and intra-relation between them, thus there was no other way to represent it except by combining all of them in one layer, which is the land value. It was very difficult to decide how to measure this factor, or how to combine the effect of the three dependent factors, so as to avoid overlapping, as it couldn't be analyzed in the same manner as for the agricultural sensitivity suitability analysis (by taking the influence of the three independent factors which are soil, precipitation, and land cover). Because here the existing built-up area or the town center is on the border line of the geopolitical zone "C" and so as to assume a buffer zone around the existing town center, this will then not be indicative for the suitability of new urban areas and land suitability for urban development as it will coincide with the "C" zone which has no potential for urban development.

Also, as for the master plan effect, it is within Area "B" and goes further away from the built-up area in addition to the boundaries of the geopolitical zone "A", and so there should be an indicator to measure those parts of the master plan which lie in the existing built-up area from those in Area "A", or Area "B". Thus the inter and intra relation should be measured at once to avoid overlapping. Therefore, upon the previously mentioned outlines, the proximity analysis couldn't be applied in this case.

That's why, the buffer zones which will be used instead are the geopolitical zones and the master plan, as they are the major and main factors which influence land value, upon which the land value for urban development and the prices change, rise or decrease (see Figure (5.6)). whereas for the Status-Quo Scenario, area "A" is preferred as it is near the urban center in geopolitical zone "A", within the public services boundaries, around the regional road, cultural centers, schools (CBD), and so it was given the score value (1), as it has the highest price rate, and refer to the NS areas (highly suitable for development). After that the master plan, which lies out of area "A" and in area "B", will take a score value of (2) as it lies within the serviced area, and municipal boundary. As for area "H1", it constitutes about 0.4 % only of the total area of Halhul which is insignificant and lies on the boundaries of Halhul, which borders Hebron City (as the classification of "H1" is the geopolitical divisions of Hebron City according to the Hebron Protocol). It is a fragmented area as there is no continuity between the town center and the built-up area in "H1" zone as a result of the bypass road which divides them and passes through. However it will take a score value of (3) as area "H1" has the same measures as area "A" but to a lesser extent, because it has no influence on Halhul's built-up areas or development potential but may have potential on the Hebron City part. As for area “B” outside the municipal boundaries, that are still un-serviced, with rural unpaved roads, far from the CBD, schools and others, have been assigned a lower potential for development which is (5) as there will be no other choice for additional development because this is the final area remaining from the geopolitical divisions which can be used for development.

As for the "C" zone it has no potential for any urban development, people who already live within this area are threatened by frequent Israeli activities of demolition, thus it will be considered as a freeze area according to the current situation, in addition to the existing built-up areas as they already have an existing land use, and have no potential for any other development, see Figure (5.7) and Table (5.8) for the scores of both scenarios.

Table (5.8): Land Value and Potential for Urban Development Scores According to each Scenario

No.	Land Value and Potential for Urban Development	Score Rank for the Status-Quo Scenario	Score Rank for the Peace Scenario
1	A-Zone	1	1
2	Master Plan	2	2
3	H1-Zone	3	5
4	B-Zone	5	7
5	C-Zone	-	3
6	Palestinian Built-Up Areas	-	-
7	Israeli Settlements	-	*
8	Israeli Military Base	-	*
9	Cemetery	-	-

Note:
(-): Freeze area
(*): Removed and do not exist under this scenario

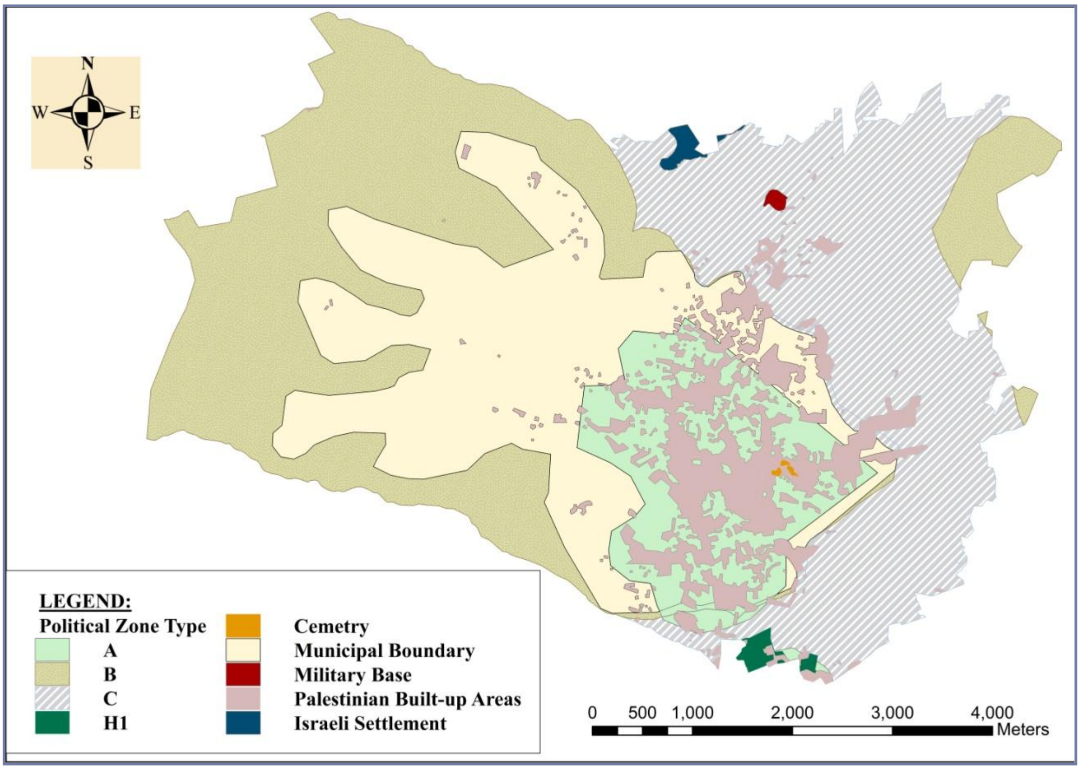
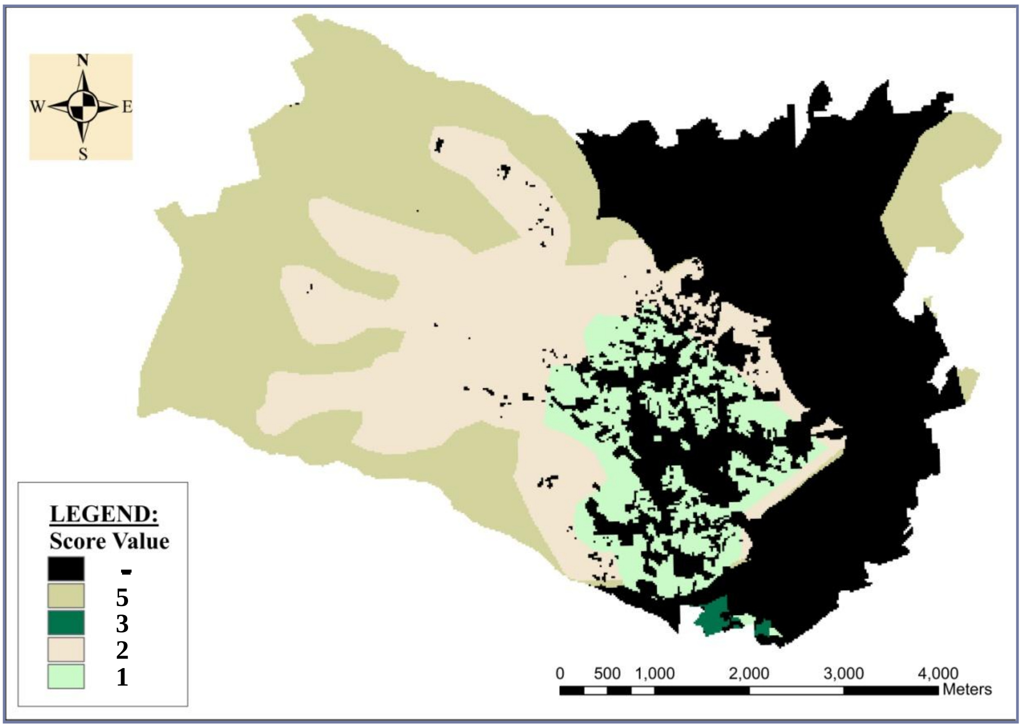
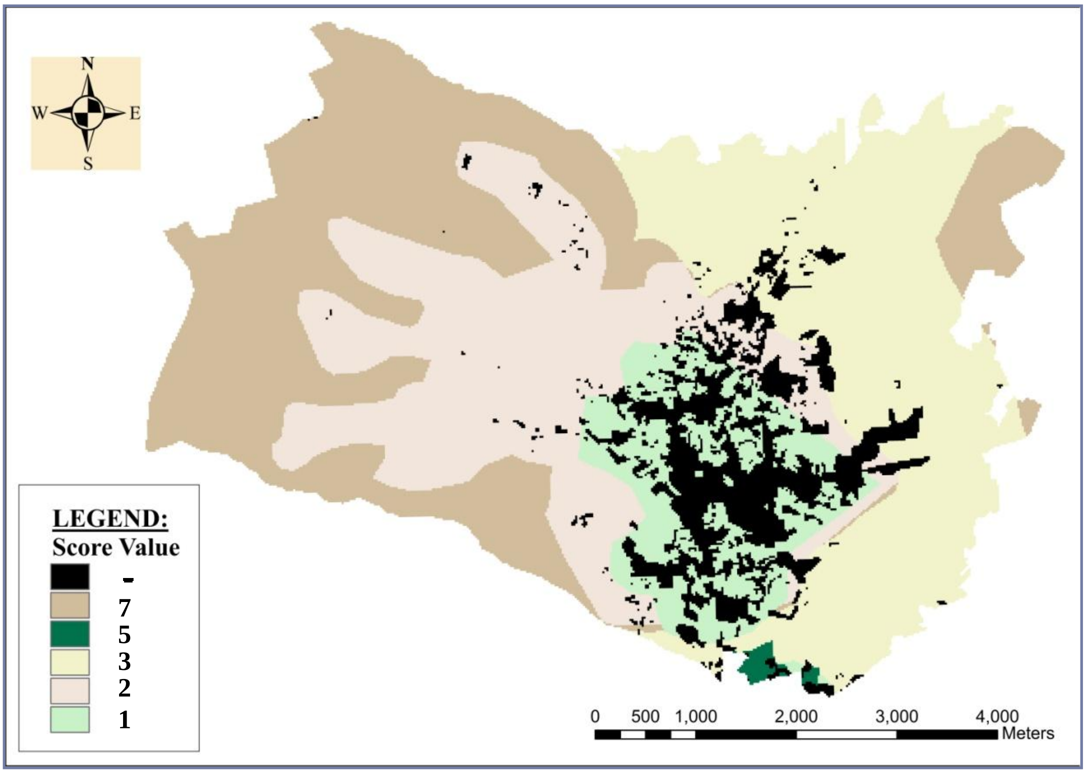


Figure (5.6): The Main Socio-economic Factors Including the Geo-political Zoning, the Urban Center and the Municipal Boundary which Influence Land Value



Note:
(-): Freeze area

Figure (5.7): Ranking Scores for Land Value Factor/Halhul Area /Status-Quo Scenario



Note:
(-): Freeze area

Figure (5.8): Ranking Scores for Land Value Factor/Halhul Area /Peace Scenario

As for the Peace Scenario (see Figure (5.8)), it will be obvious how the geopolitical status will influence the land value. As there will be no more Geopolitical divisions or zoning, and so the land value will take different track or path. Area “C” will attract more people for urban development around the Jerusalem-Hebron road, as it is the major regional road, with an economic importance, as well as the northern parts of the town are also preferred for further development. To summarize zone "A" was given the score value (1), the master plan within the serviced municipal boundaries a score value of (2), the "C" zone a score value of (3), however "H1" area was given a lower importance as new opportunities will be available for further development within the new scenario in the "C" zone and so it gained a score of (5). As for zone "B" it will for sure lose its attractiveness as there are other opportunities, which will be found in the ex-geopolitical zone "C" and was thus given a score value of (7). As for the Israeli settlement of Karmi-Tsur and the military base, they will be removed as they do not exist anymore.

What should be referred to here is that in the Peace Scenario the geopolitical divisions will become invalid and will cease to exist. Nevertheless, they are the most appropriate tools to measure this influence on the land value, that is why they will be used virtually to indicate how the land value will be influenced within each boundary, but in reality they do not exist.

What should be noticed here that the grading system of score values were given in this layer, with a lower score value for the highly suitable areas for urban development which is classified as NS, and the higher scores value for the least suitable areas for urban development which is HSA.

(5.4.1.6) Land Ownership:

This factor has an important influence on urban development, on the rate of urban growth, in addition to the form and location or where it takes place.

Land ownership in Halhul is mainly divided between four families, who own about 97.44% (36,332 dunums) of the total area of Halhul (according to the British Mandate Divisions) while only 2.56 % are of state domain (GIS Database, Halhul Municipality, 2010).

It is thus obvious that, the private land ownership contributes to the driving force for urban expansion, and the way in which it develops, as the traditions, control the land market, where land vendors are only found under certain conditions, since it’s not easy to purchase a land lot in a suitable area for development within the municipal boundaries private land ownership is a constraint. Upon this, it was decided to give the private land ownership a score value of (6) for land suitability, as it depends on the land owner's intent of using it for agricultural activities, for development, to put it for sale, or leave it abandoned. As for the state domain land ownership, it has no potential for urban development and will take a score value of (10) as most of these lands are highly sensitive areas such as the forests, water springs, etc. with an ownership that can’t be transferred, and thus considered as least suitable for development (or protected areas) .

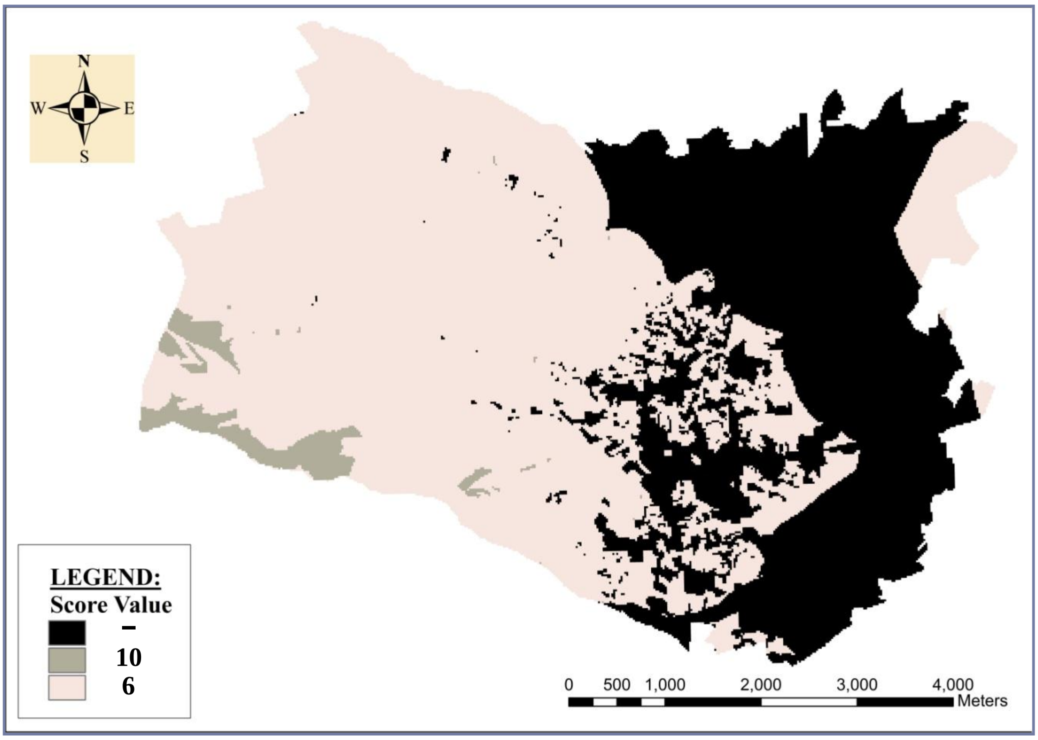
In addition, the land ownership has no influence on urban development in Area "C", so the landowner's intention doesn’t influence its suitability for development as in this scenario Area "C" has no potential for urban development and will be freeze Area. As for the Peace Scenario, this land classification ("C" zone) will be removed, as it doesn’t exist anymore, while other values will remain as in the Status-Quo Scenario. See the score values in Table (5.9).

Table (5.9): Land Ownership Ranking Scores for each Scenario

No.	Land Ownership Type Score Rank	Score Rank for the Status-Quo Scenario	Score Rank for the Peace Scenario
1	Private Ownership	6	6
2	Public Ownership	10	10
3	Urban Fabric	-	-
4	C-Zone	-	*

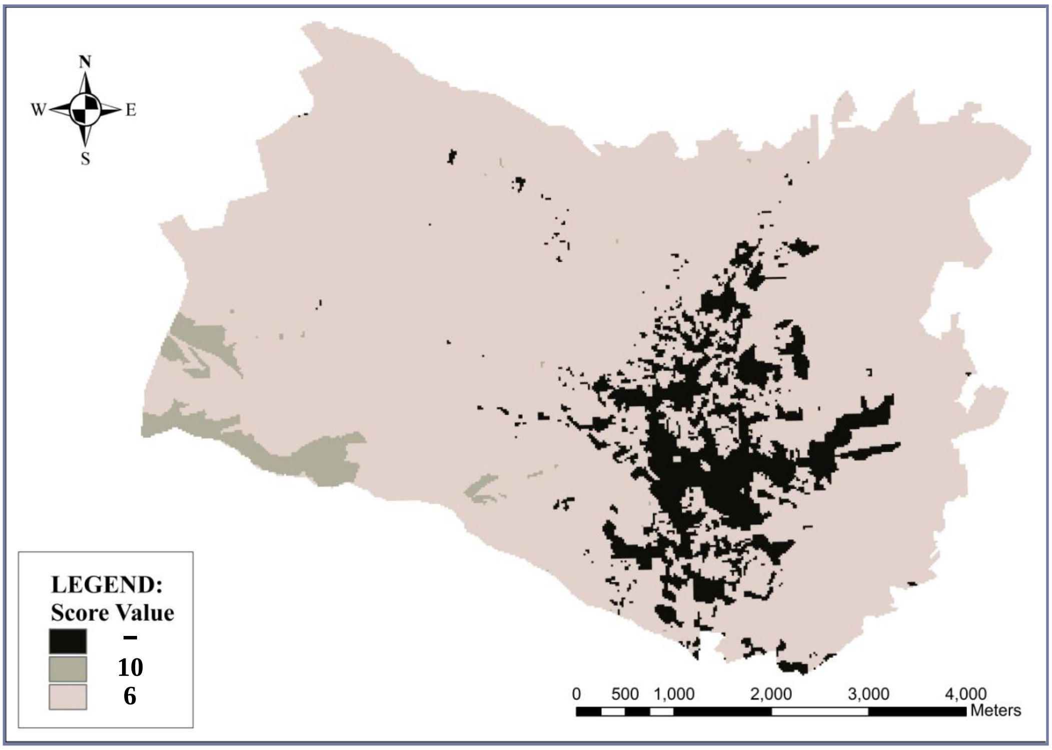
Note:
(-): Freeze area
(*): Removed and do not exist under this scenario

By applying these values on the land ownership layer, the two scenarios will be as shown in Figures (5.9) and (5.10).



Note:
(-): Freeze area

Figure (5.9): Ranks for Land Ownership Type/ Status-Quo Scenario



Note:
(-): Freeze area

Figure (5.10): Ranks for Land Ownership Type/ Peace Scenario

(5.4.1.7) Slope:

The slope is the most common physical factor, which may affect the land suitability for agricultural activities or for urban development. The study area of concern for the purpose of this research is well characterized by great variation in its topography where it is considered as the highest peak in the West Bank.

The contour map was analyzed to obtain the slope, where the slopes obtained in degrees ranged from (0.57 – 64.29) (see Table (5.10)).

Table (5.10): Slope Measured in Degrees by the Total Area in Dunums for each Slope Category, GIS Analysis

No.	Slope (Degrees)°	Area (dunums)	%
1	0 - 0.57°	10560.3	28.32
2	1.43° - 2.66°	12.1	0.03
3	2.66° - 5.71°	2409	6.46
4	5.71 °- 12.13°	8231.1	22.07
5	12.13 °- 24.89°	13763.6	36.91
6	24.89 °- 45.00°	2301.1	6.17
7	45.00° - 64.29°	15.2	0.04
Total		37292.4	100.00

The classification and ranking of scores for the slope values here will follow the same manner of the adopted classification method used by ARIJ (2002), (see Appendix II-B).

Less steep slopes were considered as suitable for agricultural activities and moderately steep slopes more suitable for urban development, while very steep slopes are not suitable for urban development. For the purpose of this study, the first three slope ranges (listed in Table (5.10)) are considered more suitable for agricultural activities. As for the slope ranges which are suitable for development are those ranging from (12.13 °- 24.89°) and (24.89 °- 45.00°).

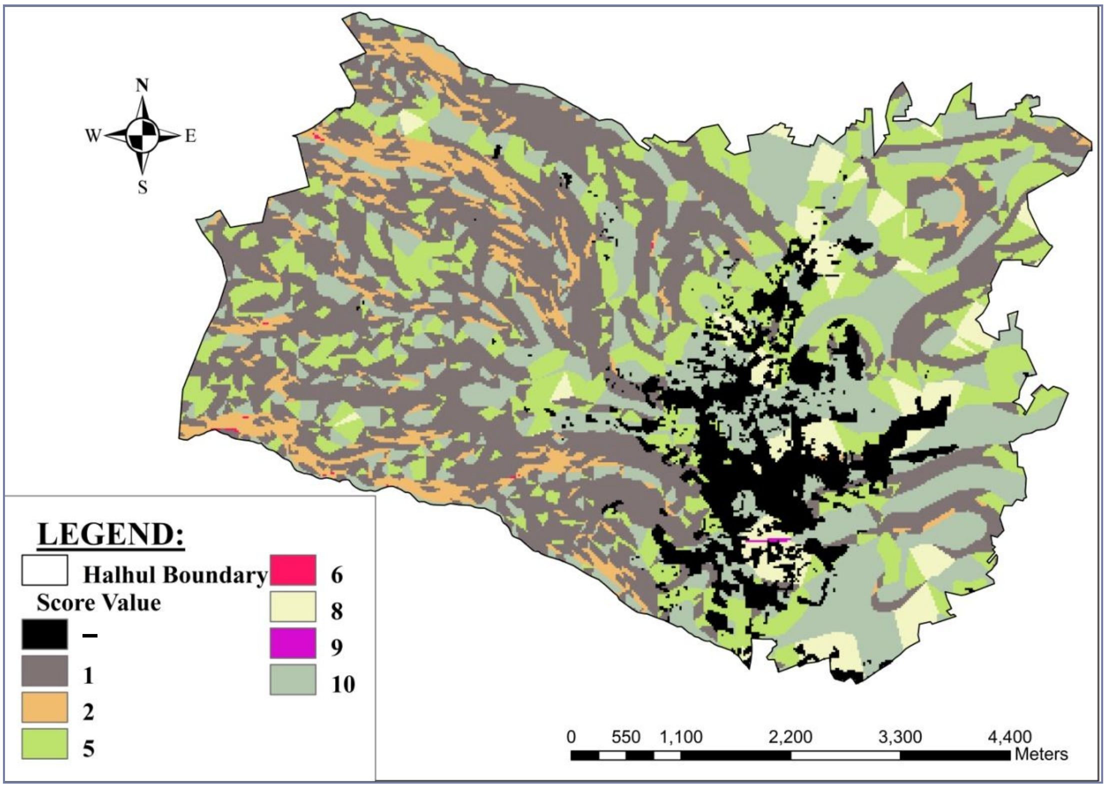
Whereas steep slopes, more than 45°, can be used for forestation in the valleys, and were thus given a high score, as they will be considered suitable for forestation. It can be seen that the slope range from 5.71 to 12.13 were given a score value of (5) which means it lies on the upper and lower limits, in other words, if any grid cell will have a higher environmental suitability then the physical factor which is the slope will add to its suitability, while if the grid cell is more suitable for urban development so this will add to its suitability, as the score value contributes to 50% on each part.

As for the Status-Quo Scenario the Palestinian built-up areas as well as the Israeli settlement and military base will be signified as freeze area while under the Peace Scenario, the Israeli settlement and the military bases no longer exist, and areas will be assigned the scores according to their locations (the score value will be according to the grid cell itself). See Table (5.11) for score values of the slope layer in each scenario (see Figure (5.11)).

Table (5.11): Slope Range in Degrees and Given Scores for each Scenario

No.	Slope Range in Degree	Score Rank for the Status-Quo Scenario	Score Rank for the Peace Scenario
1	0 - 0.57	10	10
2	1.43 - 2.66	9	9
3	2.66 - 5.71	8	8
4	5.71 - 12.13	5	5
5	12.13 - 24.89	1	1
6	24.89 - 45.00	2	2
7	45.00 - 64.29	6	6
8	Palestinian Built-Up Areas	-	-
9	Cemetery	-	-
10	Israeli Settlements	-	*
11	Israeli Military Base	-	*

Note:
(-): Freeze area
(*): Removed and do not exist under this scenario



Note:
(-): Freeze area

Figure (5.11): Ranking Scores for the Slope, Halhul Area / Peace Scenario

(5.5) Land Suitability Analysis:

The land suitability model will consider each grid cell value based on the proposed criteria and its weight. The total quality score per grid will be then calculated according to the MCE (Potential Surface Analysis), equation which is:

- $S_j = (\Sigma S_{ij} \times w_j)/ \Sigma w_j$ …equ.(4.2) where:

S_j= the total score of the sub-area
$S_{i,j}$= score for the sub-area i for factor j
W_j= weight factor

This will be applied on the suitability analysis stages and levels.

For this study four levels of land suitability analysis was developed. The first suitability level is for agricultural sensitivity suitability, the second level is for environmental land suitability, at the same level as a second stage, socio-economic land suitability was developed, and finally the land suitability model. Upon this the spatial analysis will be used, in aid of the Raster calculator by introducing the following formula expressions in the Raster calculator to obtain the suitability analysis.

(5.5.1) **Agricultural Land Suitability Analysis**:

To obtain the agricultural suitability, the soil layer, the land cover, and the annual precipitation will be introduced to the Raster calculator considering the approximated weights obtained from the questionnaire analysis (see Chapter 5).

Agricultural Suitability = 25% x Annual Precipitation + 45% x Land Cover + 30% x Soil

(5.5.1A) **Status-Quo Scenario**:

The results obtained are shown in Figure (5.12) below for agricultural land suitability analysis under the Status-Quo Scenario.

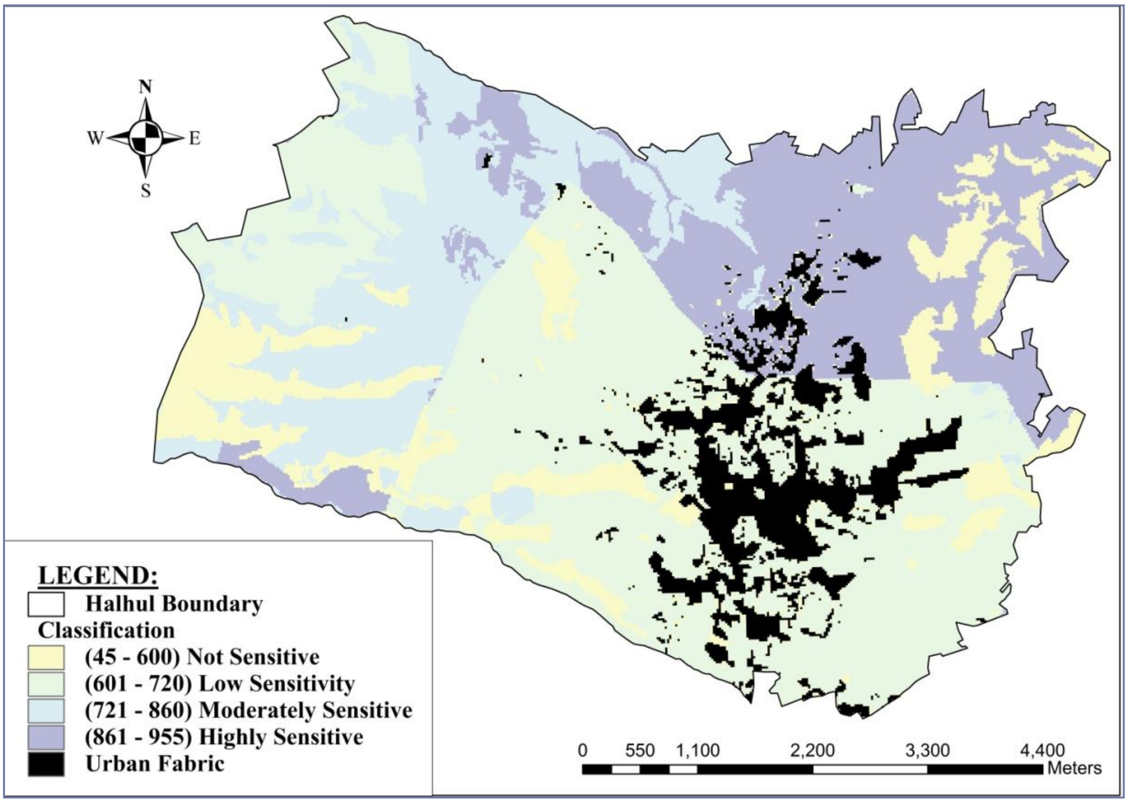


Figure (5.12): Agricultural Land Suitability Analysis/ Classified According to Land Sensitivity/ Peace Scenario

The scores obtained range from 45 to 955, whereas for the classification, the mean score value is considered the reference point and the limit above which the two ranges of moderately and highly sensitive areas are defined, below this limit are the low sensitive areas and the not sensitive (see Figure (5.12)). The standard deviation was found to be 150, with a mean value of 720. See Figure (5.12) for the agricultural lands sensitivity classification among four ranges.

(5.5.1B) <u>Peace Scenario:</u>

The agricultural land suitability was obtained from the calculations using the previously mentioned formula.

However, it is clear that there is no difference in this layer between the two scenarios, as the agricultural or environmental sensitivity is not related to and not influenced by the geopolitical situation except by the removal of Israeli settlement, and the military base, thus the agricultural value won't be affected. The mean value was found to be 721.06 and the standard deviation149.28. This insignificant change is due to the removal of Israeli settlement and military base, adding up to the total areas of Status-Quo Scenario.

In both scenarios, the highly sensitive agricultural areas are those, which lie to the Northeast, as the soil classification in the north is more fertile and the precipitation distribution is higher to the northeast than the western parts. Thus, the agricultural sensitivity decreases from east to west, as well as from north to the south, as the elevations decrease and drop in the east-west direction.

(5.5.2) <u>Environmental Suitability Analysis</u>:

(5.5.2A) <u>Status-Quo Scenario</u>:

In order to obtain the environmental land suitability, the previously obtained agricultural suitability layer and the water sensitivity layer will be used in the spatial analysis, by using the Raster calculator.

However, what should be noticed here is that the total scores obtained from the agricultural suitability analysis are out of 1000 while the scores of the water sensitivity range from (1to10). By multiplying these scores by the water sensitivity weight, which is 40, the weights obtained are out of 100, and so they are incomparable and should have the same scale. This was done by score standardization, to obtain the final formula for environmental land suitability, which is:

[60 x Agricultural Suitability + 40 x (100 x Water Sensitivity)] / 100

In this way, the obtained scores will be out of 1000. The scores obtained from the analysis are shown in Figure (5.13).

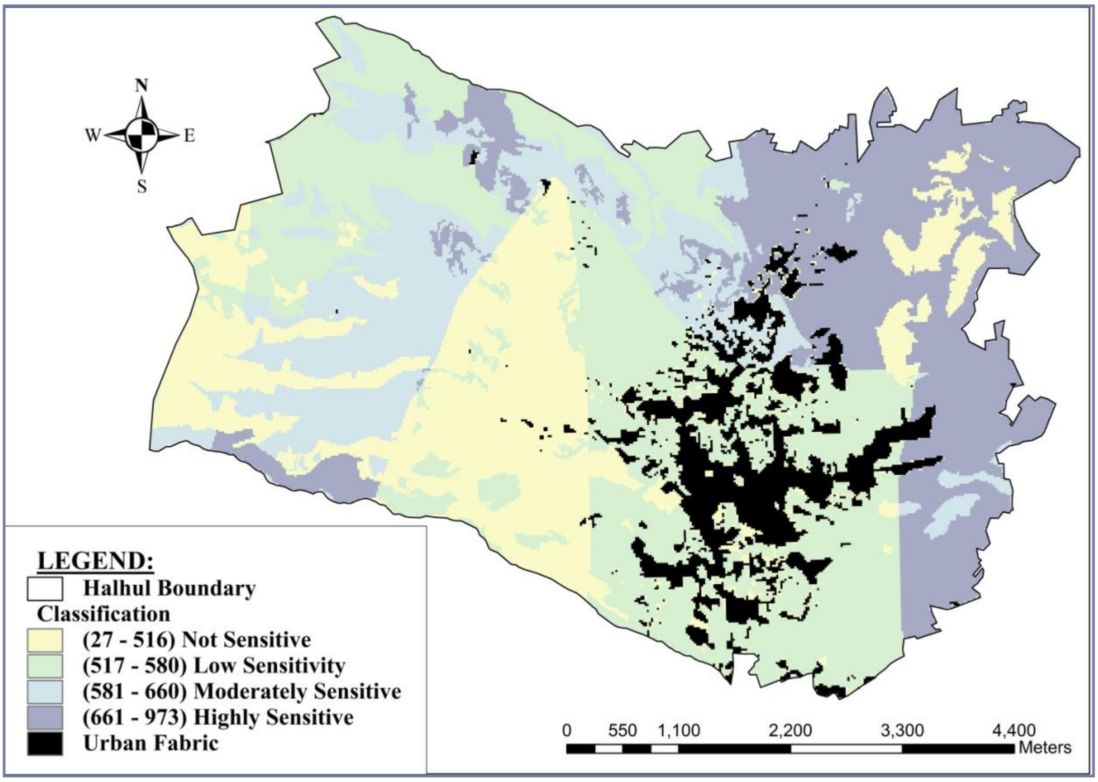


Figure (5.13): Environmental Land Suitability Analysis/Classified According to Land Sensitivity/ Peace Scenario

The scores obtained range from 27 to 973, the mean value is 578.94 and the standard deviation 125.16, whereas the classification follows the same manner as in the agricultural suitability with respect to the mean value (see Figure (5.13)).

(5.5.2B) Peace Scenario:

The environmental suitability won't be affected by the geopolitical situation as mentioned above for agricultural suitability. The mean value and the standard deviation were found to have an insignificant changes, the mean value became 579.1, and the standard deviation 124.82 (see the results for the environmental suitability). It can be noticed that the non-sensitive and low sensitivity areas are those within the urban infill areas and around it within the master plan, while the western parts and the northeastern parts are highly and moderately sensitive.

(5.5.3) Land Suitability Analysis for Socio-Economic Factors:

The land suitability for socio-economic factors considers both layers of the land value and land ownership.

And so, the socio-economic land suitability layer can be obtained by using the Raster calculator to evaluate the following formula:

[70 x Land Value + 30 x Land Ownership]

(5.5.3A) <u>Status-Quo Scenario</u>:

The results obtained are shown in Figure (5.14) for the land suitability analysis for socio-economic factors, under the Status-Quo Scenario where the scores range from 250 to 970.

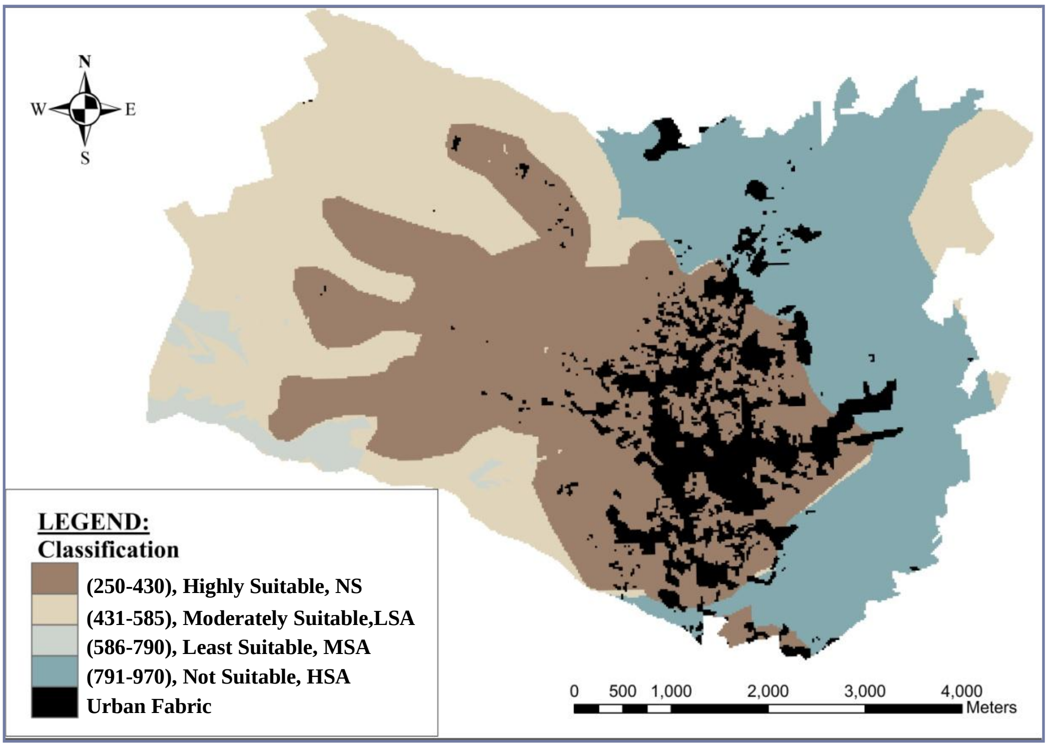


Figure (5.14): Land Suitability Analysis for Socio-Economic Factors/Status-Quo Scenario

The mean value is 585.2, and the standard deviation is 272.3. It was classified into four categories, as in the Figure (5.14) illustrating the socio -economic suitability classification.

In this scenario, the "A"-zone and the master plan are the highly suitable areas for urban development which are classified as NS, while the moderately suitable areas are those outside the master plan and within "B" zone classified as LSA, as for the political zone in this scenario it is not suitable as it is under full Israeli control, and so the direction of urban development is forced towards the western parts only.

(5.5.3B) Peace Scenario:

The resulting land suitability from the Raster calculation using the formula above, obtained scores ranging from (250 to 790) with a mean value of 459 and a standard deviation of 165.44 see Figure (5.15).

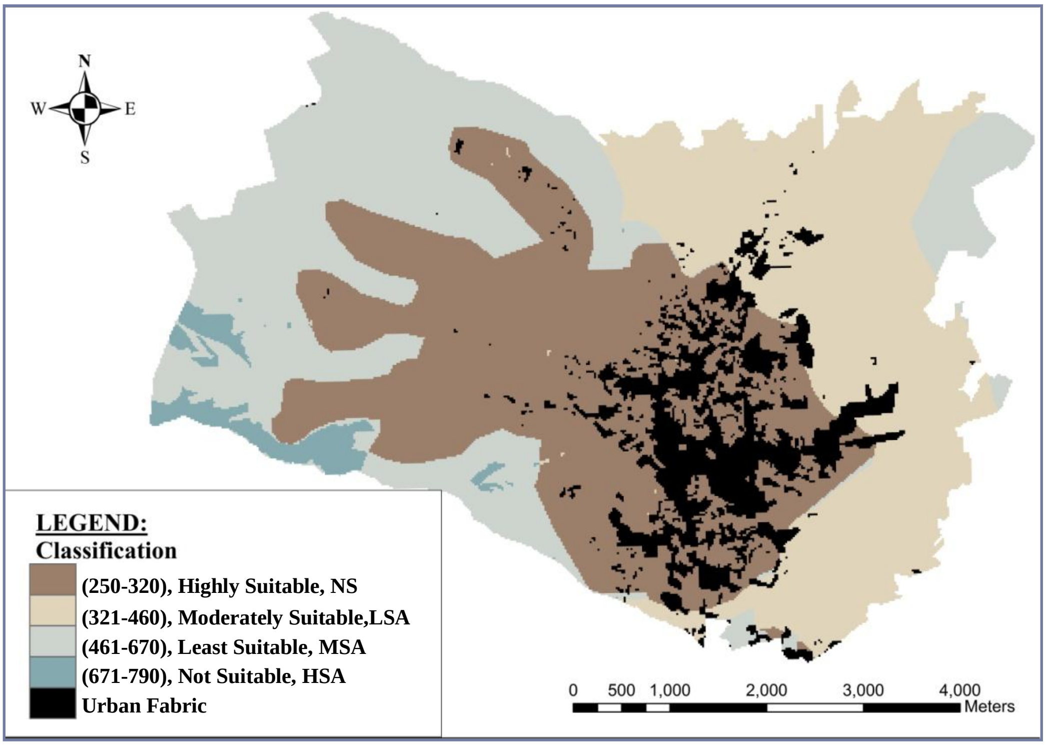


Figure (5.15): Land Suitability Analysis for Socio-Economic Factors/Peace Scenario

The resulting suitability was classified according to land suitability for urban development (socio-economic factors) (see Figure (5.15). Where the highly suitable areas (NS) are those within the urban infill area, and master plan, the moderately suitable (LSA) area are those with the ex-"C" zone as it no long exists, attracting more development along the regional road and to the north. The remaining area to the west will lose its attractiveness (least suitable) MSA. While the publicly owned lands are not suitable for development as they are state domains (HSA).

And so, in this scenario, the direction of urban development will take the form of urban infill and extend to the north, adding to the western part new areas to the north.

(5.5.4) Land Suitability Model Analysis:

The land suitability model considers the environmental, physical and socio-economic factors, and so at this final stage of analysis the environmental suitability obtained from level two in the analysis in addition to the socio-economic suitability will be used for the third level of analysis, considering the physical factor (slope). And so, by using the Spatial Analyst Raster Calculator the following formula was evaluated to obtain the suitability model:

[40 x Environmental Suitability + 40 x Socio-economic Suitability + 20 x (Slope x 100)]/ 100

What should be referred to here is that the environmental and the socio-economic suitability score values are out of 1000, while the slope scores are out of 10, to be comparable the score values should be standardized, as in the previous formula then divided by the total weight sum.

The scores obtained for the land suitability model are shown below.

(5.5.4A) Status-Quo Scenario:

In this scenario, the scores obtained range from 10 to 977, with a mean value of 556.6 and a standard deviation of 174.25 see Figure (5.16).

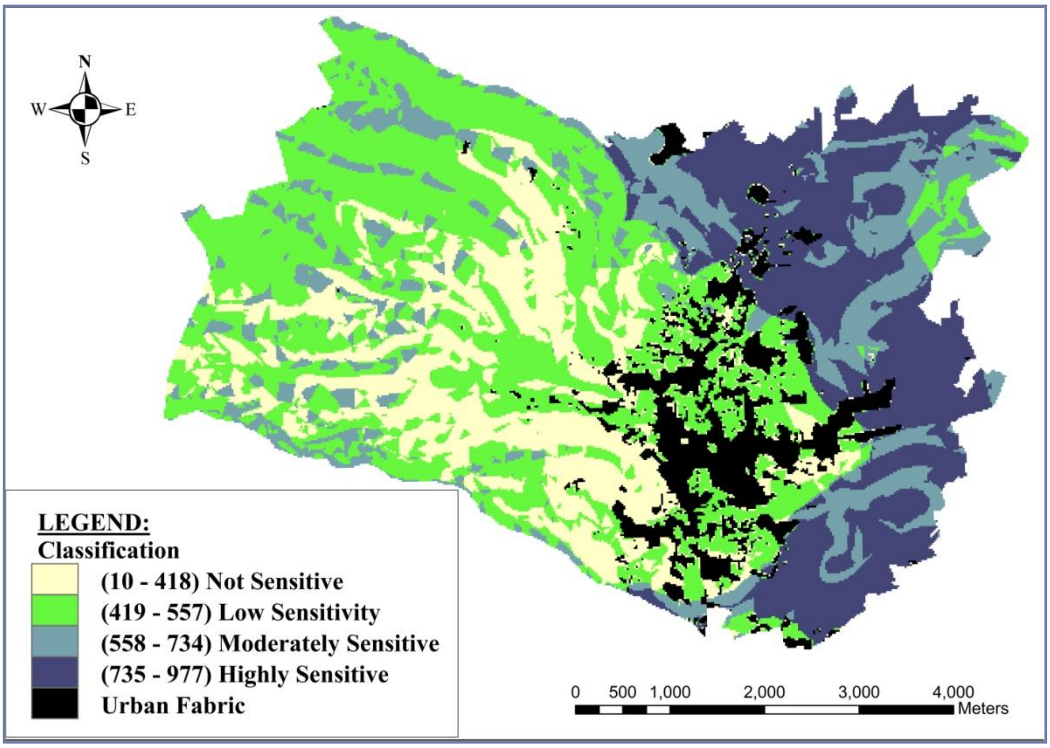


Figure (5.16): Land Suitability Model Analysis/ Classified According to Land Sensitivity/Status-Quo Scenario

The land suitability model was classified according to land sensitivity in respect to the mean value into four classifications as in Figure (5.16).

In this scenario, it is clear how the socio-economic needs for urban development will be on behalf of the moderately sensitive areas, which are agricultural areas in the western and northwestern parts as there is no other opportunity for urban development.

(5.5.4-B) <u>Peace Scenario</u>:

In this scenario the scores obtained, range from 10 to 857 with a mean value of 506 and a standard deviation of 108.13 (see Figure (5.17)).

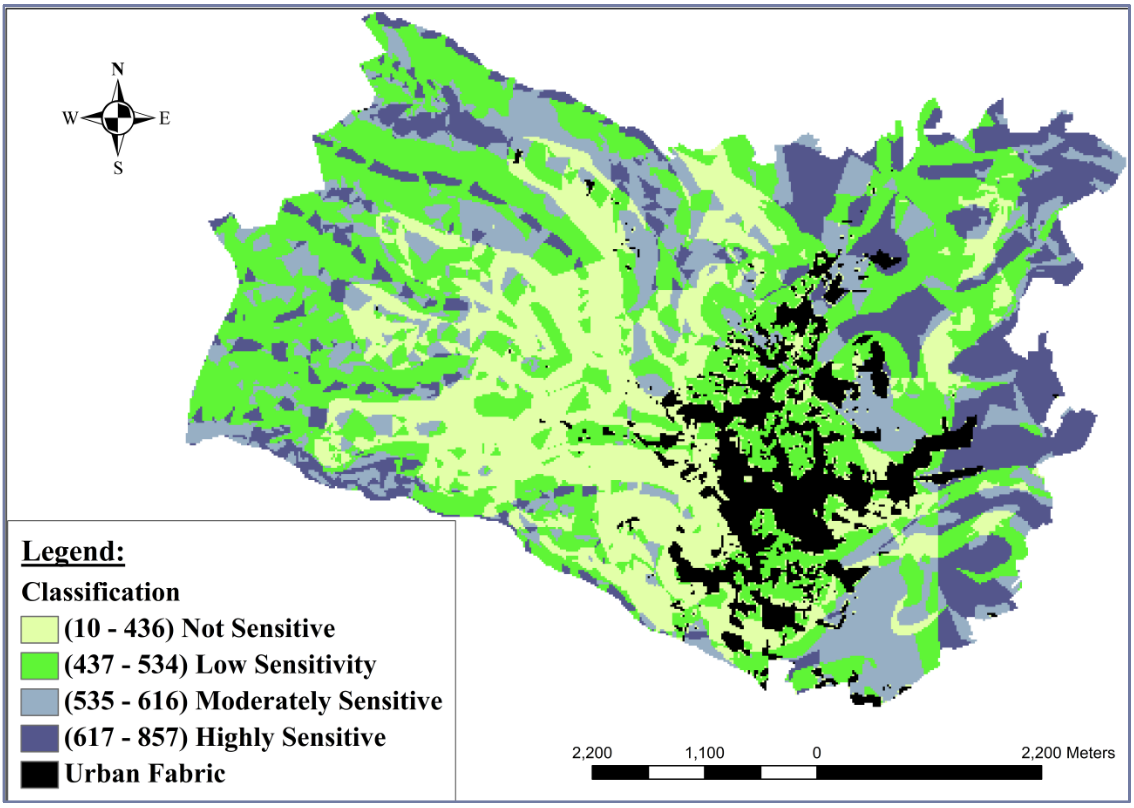


Figure (5.17): Land Suitability Model Analysis/Classified According to Land Sensitivity/Peace Scenario

In this scenario, the socio-economic factors will be driving forces that extend urban development towards the highly sensitive areas in the northern parts and along the regional road. It is clear that urban infill will extend to the eastern parts and to the north, while the western areas will be less attractive.

(5.6) <u>Final Land Suitability Models</u>:

The final land suitability models were obtained, therefore the areas of each land classification will be defined, which can then be used easily for the following stage in the analysis for the sustainable model.

From these two final suitability models the total areas were estimated using GIS as listed in the following table.

Table (5.12): Final Land Suitability Models Analysis Results/ Classified According to Land Sensitivity / Comparing the Total Areas for each Scenario

Land Classification	(1) Peace Scenario Area in (m^2)	(2) Peace Scenario Area in (m^2)	(3) Status-Quo Scenario Area in (m^2)	(4) Status-Quo Scenario Area in (m^2)
NS	8,561,932	*21,716,371	6,773,382	*21,318,549
LSA	13,154,439		14,545,167	
MSA	6,432,880	**12,236,896	4,981,594	**12,228,319
HSA	5,804,016		7,246,725	

Note: * NS+LSA, ** MSA+HSA

According to the Peace Scenario, the total sensitive areas (MSA and HSA) are about 12,237 dunums, while the non-sensitive and low sensitivity areas are about 21,716 dunums.

While as for the Status-Quo Scenario, the total sensitive areas (MSA and HSA) are about 12,228 dunums, while the non-sensitive and low sensitivity areas are about 21,318 dunums.

By comparing the two scenarios the NS areas have increased in the Peace Scenario, this can be explained by the increase in land potential for development of the eastern and northern parts (see Figures (5.16) and (5.17)), while those in the western parts become less attractive, thus become LSA and MSA, while in Status-Quo Scenario they were LSA and NS areas as a result of the socio-economic factors, therefore the development and urbanization process in the Status-Quo Scenario attract it to the west, while in the Peace Scenario to the east and north. It is also clear that in Peace Scenario the increase in the available lands for development will be on the highly sensitive and moderately sensitive areas. Whereas the increase in the MSA for the Peace Scenario is due to the decrease in the LSA which were classified as LSA in the Status-Quo Scenario as a result of the socio-economic factors' influence on the western areas, but by releasing the socio-economic factors' influence they will retain their value as MSA. As for the HSA, they have decreased in the Peace Scenario as a result of the socio-economic factors, which has influence on some areas in the north changing them to MSA while they were HSA in the Status-Quo Scenario.

Even though in the total outcome, the total areas suitable for development are approximately the same in both scenarios, but the attention should be made on the different locations for each scenario, so as to judge which is more sustainable, it seems that the Peace Scenario is more sustainable as it will create a balance between socio-economic and environmental factors within the area, having

HSA and MSA to the north, east and west, while the Status-Quo Scenario will consume more sensitive areas, and leave nothing to the west.

Also the Status-Quo Scenario maybe misleading and drive us to a critical case. In other words, as the current situation which is available, is the Status-Quo Scenario, and so the urban development is expected to reach the master plan boundaries, which is still on the safe side. But should this scenario continue and more development is needed as well, this will have to be on the moderately environmentally sensitive areas and low sensitive areas (see environmental suitability analysis Figure (5.13)). After that if there is a new opportunity for the Peace Scenario to be available, then the western areas would have already been exploited, and so according to the new Peace Scenario the western sensitive areas won't be available, as they have already been utilized in the Status-Quo. Then the new attractiveness to the north and east will threaten and attack the remaining sensitive areas.

That's why the only solution for this is to save the sensitive areas within both scenarios and limit the urban development within the non-sensitive areas only, to conserve it as much as possible to accommodate any expected scenarios. Whereas, the environmental land suitability should be adopted here, as it allows development within the non-sensitive areas, common between both scenarios. This way it can be guaranteed that highly and moderately sensitive areas are conserved, and more suitable areas for development are to be exploited instead, this can be done by altering the boundaries of the master plan or by not servicing areas outside the master plan. This was done by using the environmental land suitability analysis results, and drawing the proposed boundary for urban development in consideration for the "C" zone borders (not to be included).

In this way, the environmental sensitive areas will not be affected and also additional area will be conserved for development in "C" zone to be used if the Peace Scenario will be available, and also within the existing scenario there will be other areas in the western parts suitable for development (see Figure (5.18)).

Furthermore, between the two extremes the Status-Quo Scenario and the Peace Scenario, the guideline for the most appropriate one is the environmental sensitivity, which should be the reference to measure which one is more related or doesn't violate the environmental sensitivity, and allows for accepted development. By comparing the environmental suitability land classification, one can find that the environmental land suitability resembles to a certain degree the Peace Scenario. But the concern, is that this scenario is not certain and depends on the peace process with the Israeli, and so as much as there is nothing certain, the urban development will be extended to the west, decreasing the environmentally sensitive areas. The fear is in the continuation in Status-Quo Scenario, to reach its optimum, and then if any new peace process becomes valid, the conserved environmental sensitive areas will be in a critical situation.

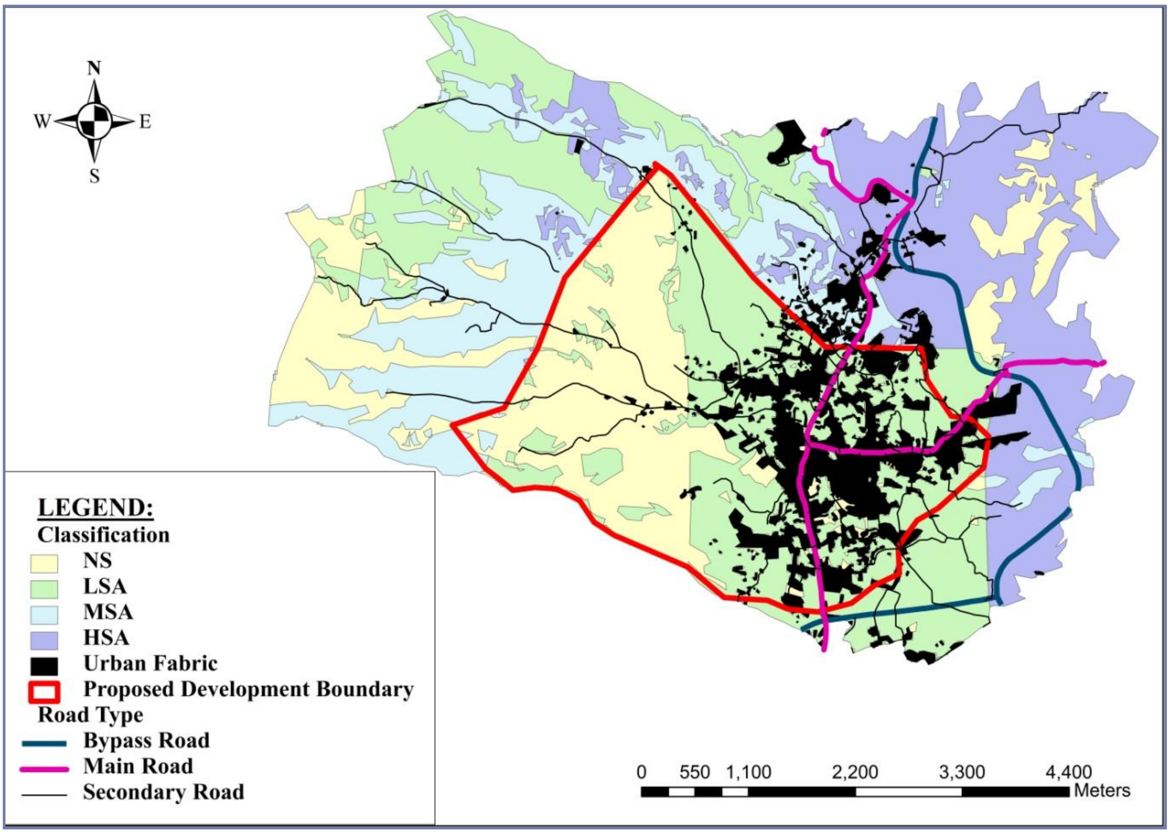


Figure (5.18): Proposed Development Boundary Imposed on the Environmental Land Suitability

From here, the Peace Scenario is the more conservative and applicable on both scenarios. Thus it will be selected as the best alternative for a sustainable model to guarantee the existing situation or any other foreseen ones. As it is the ideal model, which accommodates the Status-Quo and the foreseen Peace Scenario, by adding the proposed development boundary to the model that should be adopted for the current situation to minimize the possibility of extending to the western areas as much as possible, until any future peace process changes the current situation.

(5.7) <u>Sustainable Land Model</u>:

The final selected sustainable model is the Peace Scenario (see Figure (5.19) shows the urban development boundary with respect to the geopolitical zoning, should the Peace Scenario be valid. The urban development plan will be extended on the suitable areas within the political zone "C".

While as for the current situation, the proposed boundary will be valid, and also there will be additional lands suitable for development to the west (see Figure (5.19)).

The total area of the proposed development boundary is about 12,938 dunums, this boundary considers the geopolitical boundaries of "C" zone, the environmental suitability, and the results of the land suitability analysis. And so the total available area within the sustainable model is 21,716 dunums (see Table (5.12) columns (1) and (2)). After that, the sustainable model should pass through three stages, the first is the proposed development boundary (see Table (5.13)), then the total available areas upon the current situation and the status-quo are those which include all of the available areas suitable for development out of the "C" zone as it is a restricted area within the current situation according to the sustainable model (see Table (5.14)). Finally, the last stage is by the continuation of the peace process, and so the total available suitable areas for development within the sustainable model will be utilized to saturate urban development needs see Table (5.12) columns (1) and (2).

From this, the model will gradually pass through these stages, whereas the time at which each stage is saturated and ended, then move to the next stage, can be determined. It is the time balance for each stage, and will be evaluated hereafter.

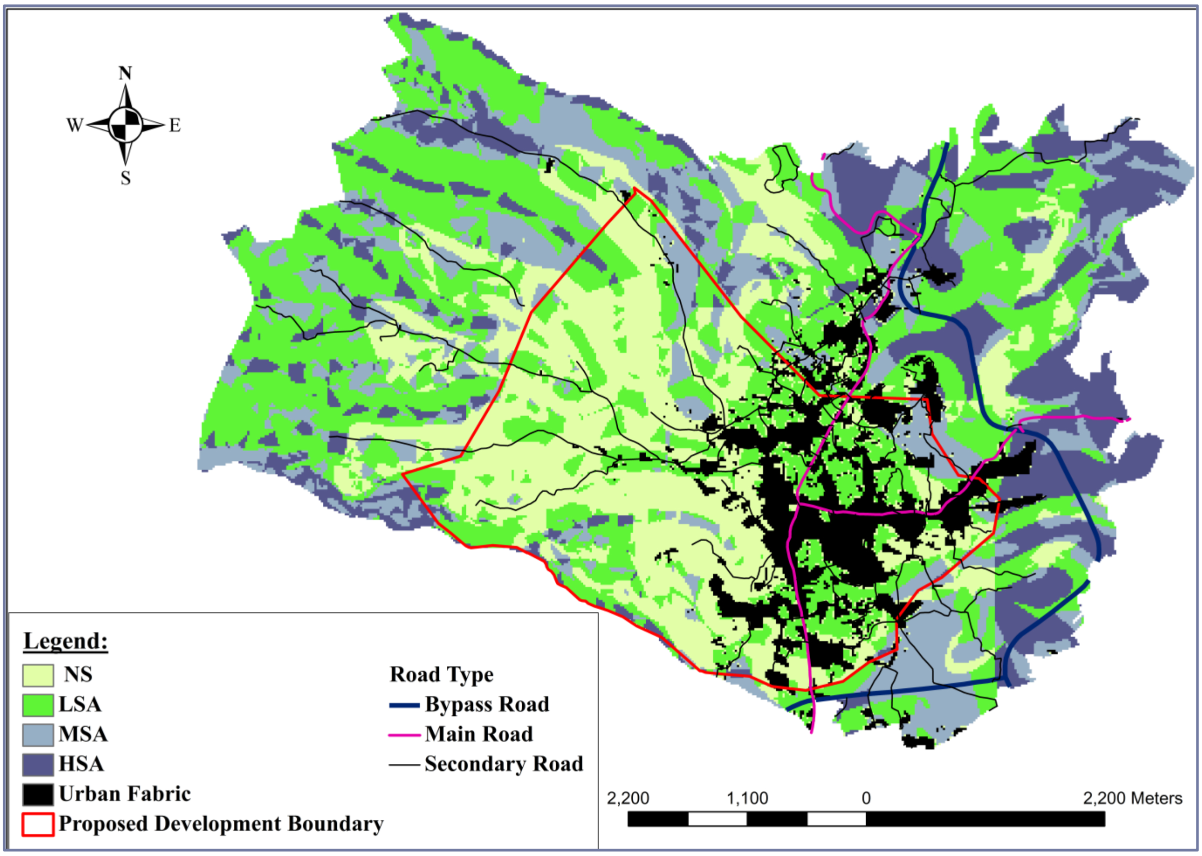


Figure (5.19): Proposed Development Boundary with Respect to the Geopolitical C-Zone Imposed on the Sustainable Model.

Table (5.13): Sustainable Model Analysis Results/ Classified According to Land Sensitivity / Comparing the Total Areas in Relation to the Proposed Development Boundary Areas

Land Classification	(1) Sustainable Model (Peace Scenario) Area in (m²)	(2) Proposed Development Boundary (m²)	Proposed Development Boundary Area in (m²)
NS	8,561,932	5,592,818	*9,170,611
LSA	13,154,439	3,577,793	
MSA	6,432,880	888,045	**1,112,067
HSA	5,804,016	224,022	

Note: * NS+LSA, ** MSA+HSA

Table (5.14): Sustainable Model Analysis Results/ the Total Available Areas in Relation to the Status-quo, by Excluding the Geopolitical C-Zone

Land Classification	Sustainable Model (Peace Scenario) Area in (m²)	Available Areas within the Sustainable model excluding C-Zone (for the status-quo) (m²)	Available Areas within the Sustainable Model Excluding C-Zone (for the status-quo) Area in (m²)
NS	8,561,932	7,017,586	*16,661,786
LSA	13,154,439	9,644,200	
MSA	6,432,880	4,103,617	**6,698,608
HSA	5,804,016	2,594,991	

Note: * NS+LSA, ** MSA+HSA

(5.8) Measuring Sustainability of the Models:

A sustainable framework was developed, in order to assess the sustainability of the models, as mentioned in Chapter (4). The saturation limit will be reached once the total available areas are used, which are suitable for development, and these include the non-sensitive and the low sensitive areas, expressed as the saturation limit (L+N). As defined in Chapter (4) the ideal model will reach its balance at the saturation limit and the sustainable limit, which was defined as the system balance when $(\Delta H + \Delta M) = 0$, no change in land use for the highly sensitive areas or the moderately sensitive areas, and they will remain for agricultural activities and other uses, while the total suitable areas for urban development are completely used and nothing is left. At this limit the system has reached a point which is defined as the system balance after which the system will be unsustainable and before this point the system will be unsaturated.

For this purpose, the land cover (built-up area) of the year 2006 (obtained from ARIJ) and upon which the models were analyzed, is the time reference for the models, from which at any time later, the sustainability of the model can be observed and measured. At this time reference (2006), the highly sensitive areas index (HSA_{index}) and moderately sensitive areas index (MSA_{index}) will be zero as the model itself was created for this time of reference, so there is no change in the built-up area, and so no change in ΔM, ΔH, ΔL, or ΔN. This implies that the NS_{index} and LSA_{index} are also zero, and so the un-sustainability index and the saturation index will be zero (see Chapter 4).

In order to estimate the time at which the model reaches its balance, the total available areas within the sustainable model which are suitable for development for each scenario (stage) will be used. Where:

- Stage (1): (NS + LSA) for the proposed development boundary = 9,171 dunums.
- Stage (2): (NS + LSA) for the status-quo according to the sustainable model = 16,662 dunums.
- Stage (3): Sustainable model (which is according to the Peace Scenario) = Total available area (21,716) dunums.

In order to estimate the time at which these available areas for urban development will reach the saturation limit or the system balance, two procedures were used which are the natural urban growth and the estimations according to MOLG planning standards.

1. According to the natural urban growth, and by considering the actual urban density for the year 2006 which is 165 m^2/person, the available areas will satisfy the urban development needs as in Table (5.15) (for calculations see Appendix VIII).

Table (5.15): Estimating the Time of System Balance (Sustainable Limit) of the Sustainable Model, by Natural Urban Growth

Natural Urban Growth			**Time of System Balance**	**Urban Density (m^2/person)**
Sustainable Model Stage	Total Available Areas (dunums) (LSA+NS)	Estimated Population	Targeted Years Estimations	
Proposed Development Boundary	*9,171	76,716	2045	165
Status-quo (Excluding C-zone)	*16,662	122,116	2059	165
Sustainable Model	*21,716	152,746	2066	165

*Urban fabric not added (should be added for population projections)

2. According to the MOLG planning standards the total area required for each person in the total master plan area is 280 m^2 /capita (see Appendix IX) for planning standards, and so the available areas will satisfy the needs till the years as calculated in Table (5.16) (see Appendix (X)).

Table (5.16): Estimating the Time of System Balance (Sustainable Limit) of the Sustainable Model, By Using the MOLG Planning Standards

Sustainable Model Stage	**Total Available Areas (dunums) (LSA+NS)**	**Designed Urban Density according to MOLG Standards (m^2/capita)**	**No. of Population according to the Designed Density**	**Estimated Targeted Year according to the Design (year of system balance)**
Proposed Development Boundary	*9,171	280	45,208	2029
Status-quo (Excluding C-zone)	*16,662	280	71,961	2043
Sustainable Model	*21,716	280	90,011	2050

*Urban fabric not added (should be added for population projections)

Therefore, the targeted year for the available areas to satisfy urban development's needs according to the MOLG planning standards will be 2050 for the sustainable model (the Peace Scenario). At which the available lands for urban development are expected to be saturated and reach the saturation limit or as defined the balance of the system, but by following the natural urban growth for the same year , it can be seen that the natural growth will not reach the saturation limit at this year, and there will still be available areas for further development. Thus, to find the saturation limit upon the natural urban growth, the proposed year is required to be estimated, this will be done by estimating the population at time (t) according to the proposed urban density (165 m^2/person). Then to evaluate the predicted year for this population by using equation (4.1). From the estimated population, the available areas according to natural growth will satisfy urban development needs till the year 2066. As the urban density will be less than the planning standards (280 m^2 /person), which is clear, as the targeted year according to the MOLG urban density will be reached before the natural urban growth to accommodate convenience design for adequate services.

From Tables (5.15) and (5.16), it is obvious that the track will pass through the proposed development boundary and which will be saturated in the years of 2045 and 2029 respectively according to the natural urban growth and to the MOLG minimum standards. After that the total areas within this model excluding the C-zone according to the status-quo will satisfy the needs until the years of 2059, and 2043 respectively according to the natural growth and to the MOLG minimum standards.

It can be noticed that there is a 16 year difference between the time balance of the system according to the natural urban growth and the MOLG standards at all stages, This difference is due to the higher urban density for the MOLG standards compared to the one used for the natural growth.

Whereas there is about 14 years between the time of system balance for the proposed development boundary and the status quo time balance. After that only seven years remain to reach the sustainable model time balance.

And so, whatever the expected growth rate in the future, whether it is more or less than the MOLG standards, the time gap between the first saturation limit of the proposed boundary and the whole system balance, will be approximately the same and which is 21 years at which the system will be saturated according to the model of Halhul. However, this implies that the growth rate will continue at the same rate within each stage.

In order to compare the selected Peace Scenario for the sustainable model to the Status-Quo Scenario which was eliminated as it is not sustainable (see Table (5.17)).

As for the Status-Quo Scenario, the (LSA+NS) areas, which lie within the C-zone, will be excluded, as in this scenario, they cannot be used for urban development, and so they will be invalid see Table (5.17).

Table (5.17): Estimating the Total Available Areas for Urban Development within the Land Suitability Model of Status-Quo Scenario

Land Classification	Status-Quo Scenario Area in (m²)	Status-Quo Scenario Area in (m²)	Status-Quo Scenario, Excluding C-Zone Area in (m²)	Status-Quo Scenario Excluding C-Zone Area in (m²)
NS	6,773,382	*21,318,549	6,771,185	*21,240,916
LSA	14,545,167		14,469,731	
MSA	4,981,594	**12,228,319	2,148,854	**2,242,881
HSA	7,246,725		94,027	
Urban Fabric	3,627,000		3,022,052	
Total Area (M²)	37,173,868		26,505,849	

Note: * NS+LSA, ** MSA+HSA

Table (5.18): Estimating the Time of System Balance (Sustainable Limit) of the Land Suitability Model /Status-Quo Scenario, by Natural Urban Growth

Natural Urban Growth			**Time of System Balance**	**Urban Density (m^2/person)**
Land Suitability Model /Status-Quo Scenario	Total Available Areas (dunums) (LSA+NS)	Estimated Population	Targeted Years Estimations	
Status-Quo Scenario (Excluding C-zone)	*21,240	149,860	2065	165

*Urban fabric not added (should be added for population projections)

Table (5.19): Estimating the Time of System Balance (Sustainable Limit) of the Land Suitability Model/Status-Quo Scenario, Using the MOLG Standards

Land Suitability Model /Status-Quo Scenario	**Total Available Areas (dunums) (LSA+NS)**	**Designed Urban Density According to MOLG Standards (m^2/Capita)**	**Estimated Population**	**Estimated Targeted Year according to the Design (year of system balance)**
Status-Quo Scenario (Excluding C-zone)	*21,240	280	88,311	2049

*Urban fabric not added (should be added for population projections)

It is clear that the land suitability model of Status-Quo Scenario will be saturated by the time gap of one year only before the selected alternative for the sustainable model, putting in mind that it will utilize more environmentally sensitive areas; therefore, this scenario is not sustainable (see Table (5.18) and Table (5.19)).

(5.9) Final Sustainable Land-Use Plan:

The main objective of this study was to obtain a sustainable model for a land resources management plan, where the land suitability analysis was conducted in three levels. From the first level the agricultural land suitability analysis was obtained, which shows that about 7,606 dunums are HSA, 6,409 dunums are MSA, 14,822 dunums LSA, and 4,727 dunums NS (see Appendix XI). From the second level of analysis, in the first stage the environmental land suitability was obtained, for results (see Appendix VII): The moderately and highly environmental sensitive areas are concentrated in the northwest, and northeast. As for the second stage, the socioeconomic land suitability analysis reveals that for the Status-Quo Scenario, the direction of urban growth will be towards the western areas, while as for the Peace Scenario, it will be concentrated in the middle and to the north.

The final land suitability models indicates that the Peace Scenario is more sustainable than the Status-Quo Scenario, as it conserves more areas to the north east and west creating a balance in the area about (12,236 dunums) and resembles the environmental suitability.

Upon this, the Peace Scenario was selected to be the sustainable model, where the proposed growth boundary was suggested to accommodate the status-quo urban growth. After that, the sustainable limit for the system was defined, and the time at which the system balance occurs was estimated to be the year of (2050) according to the MOLG standards, and the year of (2066) according to the natural urban growth.

The final land use plan for Halhul was then developed, considering the available land resources within Halhul area, the land suitability analysis and the sustainable model results, in addition to the actual land use (land cover in Halhul). It also considers both of the geo-political scenarios to accommodate for different development opportunities, direction of urban growth and the urbanization process upon both of them. The final land use plan is shown in Figure (5.20). From which the total area for each land-use category is listed in Table (5.20).

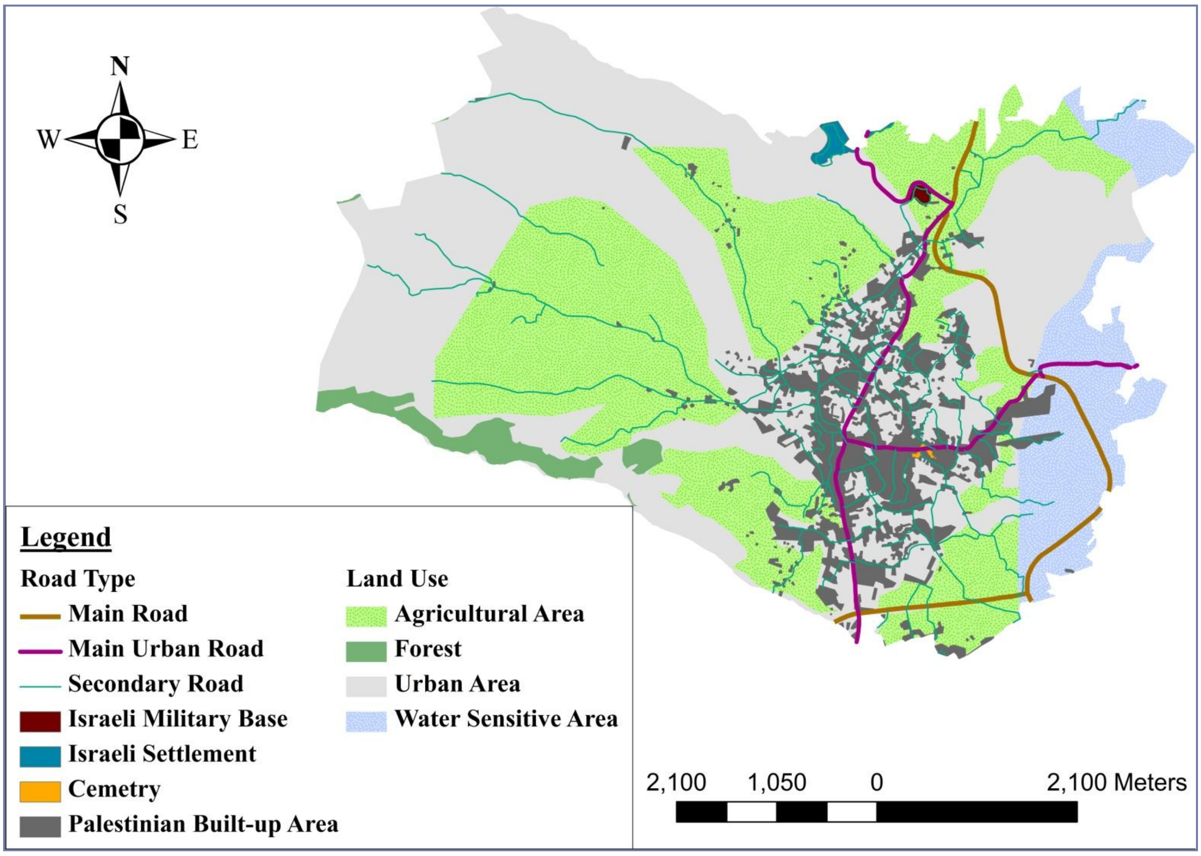


Figure (5.20): Sustainable Land Use Plan for Halhul.

Table (5.20): Land-Use by Area in Dunums According to the Sustainable Land-Use Plan for Halhul

Land Use	Area (Dunums)
Agricultural Area	13,541
Forest	804
Urban Area	19,581
Water Sensitive Areas	3,366
Total	37,292

CHAPTER VI: CONCLUSION:

In this research, a sustainable framework for land resources management and sustainable urban development was developed. This framework was based upon the definition of two concepts of sustainability, for which some indicators and measures were developed. Then a planning process for a sustainable land resources management plan and development was outlined and evolved into two phases, which are the evaluation phase for the area of concern for the assessment of the available resources value and degree of sensitivity, and the monitoring phase for the urbanization process and land use change. To guarantee that the plan is implemented in the suitable areas for urban development and in compliance with the design standards according to the designed period.

Therefore, land suitability analysis was used as a tool to classify lands according to the land resources sensitivity classifying land into four zones HSA, MSA, NS & LSA where HSA has a high resource value, while NS area has no resource value, making it the most suitable for development.

After that, new definitions were introduced in order to promote a sustainable framework, including: the system balance that was defined as" the point at which the total available areas classified as suitable for urban development, will be completely utilized, in addition to excluding the HSA and MSA (Environmentally sensitive areas) from any urban use ($\Delta M = 0$ & $\Delta H = 0$)". From here another two limits were defined: the sustainable limit and the saturation limit.

The saturation limit is the point at which all the available lands classified as suitable for urban development will be saturated and utilized completely. While as for; the sustainable limit "it is the point at which the environmentally sensitive areas are sustained and yet not utilized ($\Delta M = 0$ & $\Delta H = 0$). Therefore, the sustainable limit is not correlated to the saturation or un-saturation state but when the system reaches the sustainable limit and the saturation limit, it reaches the system balance. Where the system balance is achieved by the saturation of the available lands suitable for socio-economic needs, and sustaining the environment by sustaining land resources areas, achieving a balance between the environment and the socio-economic needs, and so the resources sustainability and saturation of socio-economic needs mean the system balance. This is the optimum level of sustainability between socio-economic conditions and environment within an area. Thus, the sustainable limit and saturation limit and system balance were defined and considered as the basic important elements to achieve a conceptual framework for resources sustainability upon which some measures and indicators were developed to measure sustainability, which are the HSA_{index}, the MSA_{index} , un-sustainability index (or sustainability index), LSA_{index}, NS_{index} ,and saturation index.

Whereas the sustainability index measures the degree of sustainability at any time reference, and the saturation index measures the degree of saturation in the available areas suitable for development.

In order to estimate the time of system balance, the MOLG minimum design standards were adopted to determine the time of system balance for the available areas suitable for development. The design period for the available areas was then estimated.

However, the urbanization process may proceed at different scales and extents. Hence to examine how the urbanization process is performing in accordance to the designed model, the efficiency measure was set.

Whereas the efficiency measure is needed:

1. To examine how the actual system is performing in compliance to the designed model, whether it is environmentally sustainable or has attained socio-economic sustainability. In addition to determine or identify the reason of un-sustainable urban growth whether socio-economic or environmental.

2. To find the most suitable area for further future urban expansion after reaching the system balance. If the urbanization process takes place at a higher rate than the predicted designed one, the development boundary will be utilized at a higher rate than the (projected) designed period, which means there is a need to consider this for the next phase, as a new expansion for the boundary will be necessary.

3. To monitor the efficiency of the design with time, and ensure that the plan is implemented perfectly on ground and assure that the design standards will be achieved.

From here two concepts of sustainability could be distinguished. The first was the sustainability of land resources within the region by maintaining the system balance (saturation limit and sustainable limit).

However, the second is the sustainability of the activities and the urbanization process within the development boundary (the system sustainability).

As for the second concept, it was based upon the urban development boundary (available areas for development), which should comply with the design standards, so as to guarantee that the actual system is performing according to the design. New measures were defined, which are ($\Delta U\ (t)_{sustainability}$), and the efficiency of the system.

According to this concept the socio-economic activities within the development boundary has influence on the sustainability inside the development boundary (L+N) and on the area as a whole. From which also the influence of the urbanization process on the system balance can be observed. As what we care for is to maintain the system balance and the resources sustainability ($\Delta M = 0$ & $\Delta H = 0$), in addition to the socio-economic sustainability within the development boundary according to the design standards. (Here the system is at or below the system balance)

Even though the system balance is reached, it is required that the new urban development will be determined according to sustainability measures by allowing urban development on the areas of the least environmental value and sensitivity (by using the sustainability index).

The outcome is that, the activities within the development boundary are the driving force for the sustainability within the development boundary and the sustainability of the system as a whole. Therefore, it may lead to socio-economic sustainability in the development boundary attaining social equity, environmental sustainability, or to a balance between the socio-economic and environmental aspects at which is the sustainability of these communities by achieving the design standards. This may all occur, at or before reaching the whole system balance.

On the other hand, it may lead to the un-sustainability of land resources by reaching the system balance following the urbanization process outside the suitable development boundaries and utilizing the environmentally sensitive areas.

Upon these concepts of sustainability, the planning process for sustainable land resources management was developed. It was constructed in two phases: the evaluation phase for the area in concern upon the available resources' value and degree of sensitivity, and the monitoring phase for the urbanization process and land use change. To guarantee that it takes place on the suitable areas for urban development and complies with the design standards according to the designed period.

From which, a managerial approach was set, illustrating the process for a sustainable land resource management as shown in Figure (4.5)

This process starts by land suitability analysis to identify and classify areas according to the land resources value and environmental sensitivity to determine the urban growth development boundary within the suitable areas for development, then to design the development boundary according to the MOLG standards to estimate the time of system balance. Therefore, within this boundary, the master plans can be designed for different phases, until it reach the time of system balance and the designed period.

However, before reaching the designed period and system balance during this period a sustainable approach was defined to monitor the urbanization process and its influence on the natural resources areas and environmental sensitive areas. Besides monitoring the performance of the system, and compare it to the designed model by evaluating the system efficiency to assess the efficiency of the design, if the actual reality complies with the design or is inefficient.

However if it is environmentally un-sustainable, then the higher rate of urbanization process may lead to the exploitation of the environmental areas and resource value. Therefore, it is necessary to evaluate when the new time of system balance will occur, as it will be reached before the projected one (designed). In order to plan for the next phase of urban expansion, which will be selected within the environmental sensitive areas upon the sustainable indices measures and indicators, to select the least resource value and to determine a new development boundary that is more appropriate for land resources sustainability.

This approach is suitable and adequate for land resources management within a sustainable development plan for the municipalities and rural areas. It can be applied on any other cases considering the variation in resources' values for different regions. Whereas by evaluating the available land resources within the jurisdiction areas, then by defining zones that are suitable for development, and monitoring the urbanization process and resources sustainability to comply with the designed standards, and in accordance to resources sustainability.

Besides, it could be used to examine the source of the inefficient urbanization process in relation to the design, and decide whether some actions could improve the situation into some degree equivalent to the designed standard. As this managerial method can be used for monitoring the efficiency of the design for master plans. By studying the sources of difference in efficiency, this may help and indicate the source of un-sustainability whether it is due to environmental un-sustainability or socio-economic inequity. For which certain measures may be taken and considered if possible to promote certain conditions in the community.

REFERENCES:

- Aa'zem, Fadwa.2010.Personal Interview. Ramallah: The Ministry of Planning (MOP).
- Abu-Hantash, Salam.2010.Personal Interview. Ramallah: Palestinian Water Authority (PWA).
- Abu-Rayyan, Mudar.2010.Personal Interview. Halhul-Hebron: Halhul Municipality.
- Al-Amleh, Jamal.2010. Personal Interview. Halhul-Hebron: The Land Research Center.
- Al-Hjouj, A'zam.2010.Personal Interview. Ramallah: The Ministry of Local Government (MOLG).
- Al-Jabareen, Bahjat.2010.Personal Interview. Hebron: Ministry of Agriculture.
- Angel, Shlomo, Stephen C. Sheppard, Daniel L. Civco, Robert Buckley, Anna Chabaeva, Lucy Gitlin, Alison Kraley, Jason Parent, and Micah Perlin, 2005. The Dynamics of Global Urban Expansion. Washington D.C.: The World Bank.
- Applied Research Institute for Jerusalem Studies (ARIJ).2009. Palestinian Localities Study, Hebron Governorate, Halhul Town Profile. http://proxy.arij.org/vprofile/
- ARIJ, 2004, Impact of Urbanization on Land Use and Local Communities in the West Bank. Palestine: Applied Research Institute - Jerusalem
- ARIJ. 1995. Environmental Profile for the West Bank, Volume 3: Hebron District. Palestine: Applied Research Institute - Jerusalem.
- ARIJ. 2009. Locality Profiles and Needs Assessment in the Hebron Governorate. Palestine: Applied Research Institute - Jerusalem.
- ARIJ. 2010, The Constant Israeli Targeting of Palestinian Agriculture and Livelihoods In The Occupied Palestinian Territory. Palestine: Applied Research Institute - Jerusalem.
- ARIJ.2001. Localizing Agenda 21 in Palestine. Palestine: Applied Research Institute - Jerusalem.
- Awadallah, Wael and Maher Owaiwi. 2005. Springs and Dug Wells of Hebron District, Hydrogeology and Hydro-chemistry. Palestine: Palestinian Hydrology Group.

- Awadallah, Wael.2010.Personal Interview. Hebron: Palestinian Hydrology Group (PHG).
- Bar, Oded,Ezra Zilberman, Zohar Gvirtzman and Shimon Feinstein. 2006. Geological Survey of Israel, Reconstruction of the Uplift Stages of the Mountain Backbone in Central Israel. Jerusalem: The Ministry Of National Infrastructures.
- Benites, J.R., F. Shaxson and M. Vieira.1997. Land Condition Change Indicators for Sustainable Land Resource Management, Italy. FAO
- Dale, Peter and John McLaughlin. 1990. *land information management, an introduction with special reference to cadastral problems in third world countries.*Oxford: Oxford University Press
- Darin, Haim.1977. *Land Policy and Urban Growth*. Oxford: Pergamon Press Ltd.
- Davidson, D., 1979. *Topics in Applied Geography, Soils and Land Use Planning.*Glasgow.University of Strathclyde.
- Douglas, Tim.2006. Keeping the Rural Vision, Protecting Rural Character and Planning For Rural Development. Washington: http://www.mrsc.org/subjects/planning/rural/ctedrural.aspx
- El-Atrash, Ahmad. (2009). Promoting Sustainable Urban Growth Strategies to Curb Sprawl in the Urban Area of Bethlehem Governorate. Ramallah-Palestine. Birzeit University.
- El-Atrash, Ahmad.2010.Personal Interview. Bethlehem: Applied Research Institute - Jerusalem (ARIJ).
- Environmental systems research institute (ESRI). 1996. *Introduction to Arc View GIS*, ESRI Inc.
- European Commission. 1994. CORINE land cover. Technical guide. Luxembourg.
- FAO. 1995. Sustainability indicators or change indicators or land quality indicators, Netherlands: FAO
- Hadawi, Sami.1957. Land Ownership in Palestine. New York: The Palestine Arab Refugee Office. http://palestinerememebred.com/

- Haddad, Marwan and Eran Feitelson. 2000, *Management of Shared Groundwater Resources: The Israeli-Palestinian Case with an International Perspective, Natural Resource Management and Policy*. Massachusetts: Kluwer Academic Publishers.
- Halhul Municipality,2010,Halhul Master plan 1975, Halhul
- Hosh, Leonardo and Jad Isaac. 2000, Challenges for Sustainable Development in Palestine. Palestine: Applied Research Institute -Jerusalem (ARIJ).
- Kelly, Eric and Barbara Becker. 2000. *Community Planning, an Introduction to the Comprehensive Plan*. Washington D.C: Island Press.
- Klawitter, Simone.2006.Water Resources at Stake: The Mountain Aquifer beneath the Occupied West Bank, Palestinian Territories. Waterwiki.net.URL: http://hdr.undp.org/en/reports/global/hdr2006/papers/Simone_Klawitter_Water_resources_at_stake.pdf
- Laurin, Jennifer and Nizar Qattoush and Wafa' Safar. 2000. Infringements in Hebron District.Palestine: Applied Research Institute - Jerusalem.
- Levy, John. 2003. *Contemporary Urban Planning*. *Sixth Edition.* United States of America: Upper Saddle River, New Jersey.
- Mere'b, Hani.2010.Personal Interview. Halhul-Hebron: Halhul Municipality.
- Mere'b, Hussein.2010.Personal Interview. Halhul-Hebron: Halhul Municipality.
- MOLG.1966. Law of Cities, Villages and Buildings Organization 1966. Ramallah-Palestine: Ministry of Local Government.
- Palestinian Central Bureau of Statistics. Homepage.www. pcbs.org
- PIALES.1996. Palestine country Report to the FAO, International Technical Conference on Plant Genetic Resources (Leipzig, 1996). Palestine: The Palestinian Institute of Arid Land and Environmental Studies (PIALES).
- Rabayah, A. 2006. Sustainable Land Use Planning Using GIS.Palestine: Birzeit University.

- Randolph, John, 2004.*Environmental Land Use Planning and Management*. Washington: Island Press.
- Ruiter, Wilke and Frank Sanders. 1998. *Physical Planning, Policies, Methods and Techniques*. The Netherlands: TU University.
- Saleh, Ahmad.2010.Personal Interview. Ramallah: The Ministry of Planning (MOP).
- Scarpa, David.2002. Capacity Building for a Program in Water Resources Management in Gaza and the West Bank. Palestine: Bethlehem University.
- Shaheen, Alaa.2010.Personal Interview. Hebron: Hebron Municipality.
- Woo, Myungje, 2007, Impacts of Urban Containment Policies on Urban Growth and Structure.Ohio: The Ohio State University.
- World Bank.Land Resources Management, Agriculture and Rural Development. World Bank Homepage, www.worldbank.org
- Zayed,Omar,Mutaz Abadi, Batool Rajoub, and Henning Moe.2005.Groundwater Vulnerability of Palestinian Drinking Water Sources in the West Bank. Palestine : Palestinian Water Authority, Ramallah, Palestine and Camp Dresser & McKee, Inc, Al-Ram, Palestine

المراجع العربية:

- مركز أبحاث الأراضي,2002,محافظة الخليل- الأرض و السكان .القدس:جمعية الدراسات العربية.
- معهد الأبحاث التطبيقية (أريج). 2005.أثر النشاطات العمرانية المختلفة على استخدام الأرض و المجتمعات الفلسطينية في الضفة الغربية. معهد الأبحاث التطبيقية – القدس(أريج).
- معهد الأبحاث التطبيقية (أريج). 2002. أثر النشاطات العمرانية المختلفة على المجتمعات الفلسطينية المحلية في محافظتي بيت لحم و الخليل . معهد الأبحاث التطبيقية – القدس (أريج).
- الجهاز المركزي للإحصاء الفلسطيني. 2008. التعداد العام للسكان والمساكن والمنشآت2007, النتائج النهائية للتعداد في الضفة الغربية (ملخص السكان والمساكن) آب/أغسطس.فلسطين :الجهاز المركزي للإحصاء الفلسطيني.
- الجهاز المركزي للإحصاء الفلسطيني .2009. التعداد العام للسكان والمساكن والمنشآت2007 , المؤشرات الأساسية حسب نوع التجمع السكاني, كانون ثاني /يناير.فلسطين :الجهاز المركزي للإحصاء الفلسطيني .
- الجهاز المركزي للإحصاء الفلسطيني. 2009 . التعداد العام للسكان والمساكن والمنشآت2007, النتائج النهائية , ثقرير المساكن, محافظة الخليل, آب/أغسطس.فلسطين :الجهاز المركزي للإحصاء الفلسطيني.
- الجهاز المركزي للإحصاء الفلسطيني .2009. التعداد العام للسكان والمساكن والمنشآت2007 -, النتائج النهائية للتعداد – ملخص السكان، المباني، المساكن، المنشآت,محافظة الخليل ,آذار/مارس..فلسطين :الجهاز المركزي للإحصاء الفلسطيني.
- الجهاز المركزي للإحصاء الفلسطيني.2009.كتاب فلسطين الإحصائي السنوي " رقم10 ", كانون أول.فلسطين :الجهاز المركزي للإحصاء الفلسطيني.
- وزارة التخطيط و التعاون الدولي. 1996 . المخطط الطارئ لحماية المصادر الطبيعية في فلسطين (محافظات الضفة الغربية).فلسطين: مديرية التخطيط الحضري و الريفي، الإدارة العامة للتخطيط البيئي.
- الوشاحي، صايل، و عبد القادر عابد. 1999. جيولوجية فلسطين و الضفة الغربية و قطاع غزة، القدس : مجموعة الهيدرولوجيين الفلسطينيين.

APPENDICES

APPENDIX I:

قيم أوزان العوامل المستخدمة في نموذج تعيين الأراضي الأكثر ملائمة للتطوير العمراني في منطقة الدراسة المستهدفة في الخليل:
لمعهد الأبحاث التطبيقية – القدس (أريج)

نوع التربة	الوزن
Brown Lithoesols and Loessial Serozems	1
Brown Lithoesols and Loessial Arid Brown Soils	2
Brown Ranzinas and Pale Rendzinas	3
Dark Brown Soils	7
Terra Rossa Brown Rendzinas	10

تقسيمات المناطق	إسم التقسيم	الوزن
القسم (1)	مركز المدينة	5
القسم (2)	الضواحي الداخلية	1
القسم (3)	الضواحي الخارجية	10

التواصل	المنطقة المعينة	الوزن
مناطق تمر بها شبكة الطرق	في مجال 200 متر على جانبي الطريق	1
مناطق لا تمر بها شبكة الطرق	لم تحدد قيم في هذه المناطق	10

المخططات الهيكلية	التطوير العمراني	الوزن
مناطق حدود المخططات الهيكلية	داخل حدود المخططات	1
بقية المنطقة المستهدفة	خارج حدود المخططات	10

مناطق ذات حساسية للمصادر المائية	الوزن
مناطق غير حساسة	1
مناطق متوسطة الحساسية	3
مناطق حساسة	6
مناطق شديدة الحساسية	10

استخدامات الأراضي و الغطاء الأرضي	الوزن
إنشاءات عمرانية فلسطينية	1
مساحات مفتوحة مع قليل أو عدم وجود نباتات	2
إنشاءات عمرانية إسرائيلية	3
مواقع مناجم، مكبات و بناء	4
شجيرات و نباتات عشبية	5
مناطق زراعية مختلفة	6
محاصيل دائمة	7
أرض صالحة للزراعة	8
غابات	9

البعد عن مركز المدينة	الوزن
3000 - 0	1
6000 - 3000	2
9000 - 6000	3
12000 - 9000	4
15000 - 12000	5
18000 - 15000	6
21000 - 18000	7
24000 - 21000	8
26550 - 24000	9

الحدود السياسية	الموقع	الوزن
مناطق أ	مركز المدينة	1
مناطق أ	الضواحي الداخلية	2
مناطق ب	الضواحي الداخلية	4
مناطق أ	الضواحي الخارجية	6
مناطق ب	الضواحي الخارجية	8
مناطق ج	الضواحي الداخلية و الخارجية	10

الإنحدار (بالدرجات)	الوزن
5.3 - 0	10
10.7 - 5.3	9
16.1 - 10.7	8
21.5 - 16.1	7
26.9 - 21.5	6
32.3 - 26.9	1
37.7 - 32.3	2
43.1 - 37.7	3
48.5 - 43.1	4
53.9 - 48.5	5

المصدر: معهد الأبحاث التطبيقية – القدس (أريج)، 2002, أثر النشاطات العمرانية المختلفة على المجتمعات الفلسطينية المحلية في محافظتي بيت لحم و الخليل.

APPENDIX II:

قيم أوزان العوامل المستخدمة في نموذج تعيين الأراضي الأكثر ملائمة للتطوير العمراني في منطقة الدراسة المستهدفة في الخليل:

A.

الوزن	نوع التربة
1	Brown Lithoesols and Loessial Serozems
2	Brown Lithoesols and Loessial Arid Brown Soils
3	Brown Ranzinas and Pale Rendzinas
7	Dark Brown Soils
10	Terra Rossa Brown Renzinas

B.

الوزن	الإنحدار (بالدرجات)
10	5.3 - 0
9	10.7 - 5.3
8	16.1 - 10.7
7	21.5 - 16.1
6	26.9 - 21.5
1	32.3 - 26.9
2	37.7 - 32.3
3	43.1 - 37.7
4	48.5 - 43.1
5	53.9 - 48.5

C.

الوزن	استخدامات الأراضي و الغطاء الأرضي
1	إنشاءات عمرانية فلسطينية
2	مساحات مفتوحة مع قليل أو عدم وجود نباتات
3	إنشاءات عمرانية إسرائيلية
4	مواقع مناجم، مكبات و بناء
5	شجيرات و نباتات عشبية
6	مناطق زراعية مختلفة
7	محاصيل دائمة
8	أرض صالحة للزراعة
9	غابات

المصدر: معهد الأبحاث التطبيقية – القدس (أريج)، 2002, أثر النشاطات العمرانية المختلفة على المجتمعات الفلسطينية المحلية في محافظتي بيت لحم و الخليل.

APPENDIX III:

- **نظام تصنيف الكورين (CORINE) المتبع لتحليل إستخدام الأرض / غطاء الأرض في هذا البحث:**

المستوى الأول	المستوى الثاني
1. السطوح الصناعية	1.1 منشآت عمرانية 1.2 صناعي، تجاري و وحدة النقل 1.3 مواقع مناجم، مكبات و بناء 1.4 مناطق خضراء صناعية غير زراعية
2. مناطق زراعية	2.1 أرض زراعية 2.2 محاصيل دائمة 2.3 كلأ (مراعي) 2.4 مناطق زراعية مختلفة
3. غابات و مناطق شبه طبيعية	3.1 غابات 3.2 شجيرات و نباتات عشبية 3.3 مساحات مفتوحة مع قليل او عدم وجود نباتات
4. أراضي مبللة	4.1 أراضي مبللة داخلية 4.2 أراضي مبللة ساحلية
5. أجسام مائية	5.1 أجسام مائية 5.2 ماء بحري

المصدر: معهد الأبحاث التطبيقية – القدس (أريج), 2005,أثر النشاطات العمرانية المختلفة على استخدام الأرض و المجتمعات الفلسطينية في الضفة الغربية .

- **<u>CORINE Land Cover Nomenclature:</u>** (European Commission. 1994)

The CORINE land cover nomenclature is divided into 44 Land Cover classes grouped in three levels. The main categories of the first level are the following:

1. Artificial surfaces
2. Agricultural areas
3. Forest and semi natural areas
4. Wet lands
5. Water bodies

Under the above-mentioned categories, it is possible to classify all the land cover classes in Palestine, the addition of a fourth level makes the CORINE nomenclature adaptable to the particular land cover classes of Palestine.

<u>III.1. Nomenclature Definitions:</u>

The CORINE land cover Technical guide has a specific definition of the different land cover classes that could be summarized as following:

1. Artificial surfaces

1.1 Urban fabric

1.1.1 Continuous urban fabric

Most of the land is covered by structure, roads and artificially surfaced areas cover almost all the ground.

1.1.2 Discontinuous urban fabric

Most of the land is covered by structure associated with vegetation and bare soil.

1.2 Industrial, commercial and transport units

1.2.1 Industrial or commercial units

Artificially surfaced area with concrete, asphalt, etc, devoid of vegetation, occupy most of the area in question

1.2.2 Road and rail networks and associated land

Motorways, railways including associated installations, platforms, embankments.

1.2.3 Port area

Infrastructure of port areas including quays dockyards and marinas

1.2.4 Airports

Airport installations, runways, buildings and associated lands

1.3 Mine, dump and constructions

1.3.1 Mineral extraction site

Areas with open-pit extraction of industrial minerals (sandpits, quarries) or other minerals (open cast mines)

1.3.2 Dump sites

Landfills or mine dumpsites, industrial or public.

1.3.3 Construction sites

1.4 Artificial, non-agricultural vegetated areas

1.4.1 Green urban areas;

Areas with vegetation, within urban fabric, it includes parks and cemeteries with vegetation.

1.4.2 Sport and leisure facilities

Camping grounds, sports grounds, leisure parks, golf courses, racecourses, etc. Includes formal parks not surrounded by urban zones

2. Agricultural Areas

2.1 Arable Land

Cultivated areas, regularly ploughed and generally under rotation system. 2.1.1 Non-irrigated arable Land

Cereals, legumes, fodder crops, root crops and fallow land. Includes flower and tree (nurseries) cultivation and vegetables. Whether open field, under plastic or glass (includes market gardening, aromatic, medicinal and culinary. Exclude permanent pastures.

2.1.2 Permanently irrigated Land

Crops irrigated permanently and periodically, using a permanent infrastructure (Irrigation channels, drainage network). Most of these crops could not be cultivated without an artificial water supply and do not include sporadically irrigated land.

2.1.3 Rice field**

Land developed for rice cultivation. Flat surfaces with irrigation channels. Surfaces regularly flooded.

2.2 Permanent Corps

Corps not under rotation system which provide repeated harvests and occupy the land for a long period before being ploughed and replanted; mainly plantation of woody crops, exclude pastures, grazing land and forests.

2.2.1 Vineyards

Areas planted with vine.

2.2.2 Fruit trees and berry plantations

Parcels planted with fruit trees or shrubs; singular or mixed fruit spices with permanent grassed surfaces. Includes chestnuts and walnut groves.

2.2.3 Olive groves

Areas planted with olive trees, it includes mixed occurrence of olive trees and vines on the same parcel.

2.3 Pastures

2.3.1 Pastures **

Dense, predominantly graminoid grass cover, of floral composition, not under a rotation system. Mainly used for grazing, but the fodder may be harvested mechanically, it includes areas with hedges (bocage).

2.4 Heterogeneous agricultural areas

2.4.1 Annual crops associated with permanent crops. Non permanent crops (arable land or pasture) associated with permanent crops on the same parcel.

2.4.2 Complex cultivation patterns. Juxtaposition of small parcels of diverse annual corps, pasture and/or permanent corps.

2.4.3 Land principally occupied by agriculture with significant areas of natural vegetation.

Areas principally occupied by agriculture, interspersed with significant natural areas.

2.4.4 Agro- forestry area**

Annual crops or grazing land under the wooded cover of forestry species.

3. Forests and semi-natural areas

3.1. Forests

3.1.1 Broad -leave forest.

Vegetation formation composed principally of trees, including shrub and bush where broad -leaved species predominate.

3.1.2 Coniferous forest;

Vegetation formation composed principally of trees, including shrub and bush where coniferous species predominate.

3.1.3 Mixed forest

Vegetation formation composed principally of trees, including shrub and bush where broad -leave and coniferous species co-dominate.

3.2. Shrub and/or herbaceous vegetation associated

3.2.1 Natural grass land

Low productivity grasses land. Often situated in areas of rough uneven ground. Frequently includes rocky areas, briars and heath land.

3.2.2 Moors and heath land**

Vegetation with low and closed cover, dominated by bushes, shrubs and herbaceous plants (heath, briars, broom, grose, laburnum, etc.).

3.2.3 Sclerophyllous vegetation

Bushy sclerphyllous vegetation includes Marquis and Garrigue Marquis: a dense vegetation association composed of numerous scrubs associated with siliceous soil in the Mediterranean environment.

Garrgue: discontinuous bushy associations of Mediterranean calcareous plateaus.Generally composed of kermis oak arbutus, lavender thyme, cactus, etc. May include a few isolated trees.

3.2.4 Transitional wood land /scrub

Bushy or herbaceous vegetation with scattered trees. Can represent wood or degradation or forest regeneration/ colonization.

3.3. Open spaces with little or no vegetation

3.3.1 Beaches, dunes and sand plains

Beaches, dunes and expanses of sand or pebbles in coastal or continental location, including beds of stream channels with torrential regime.

3.3.2 Bare rock

Scree, cliffs, rocks and outcrops.

3.3.3 Sparsely vegetated area

Includes steppes, tundra and Bad Lands. Scattered high altitude vegetation.

3.3.4 Burnt areas

Areas affected by recent fires. Still mainly black.

3.3.5 Glaciers and perpetual snow**

land covered by glaciers or permanent snow fields.

4. Wetlands

4.1 Inland wetlands***

Non- forested areas either partially, seasonally or permanently water logged. The water may be stagnant or circulating.

4.1.1 Inland marshes

Low- lying land usually flooded in winter, and more or less saturated by water all year round.

4.1.2 Peatbogs**

Peat-land consisting mainly of decomposed moss and vegetation matter. May or may not be exploited.

4.2 Coastal wet lands

Non-wooded areas, tidally, seasonally or permanently waterlogged with brackish or saline water.

4.2.1 Salt marshes

Vegetated low-lying areas, above the high tide line. Susceptible to flooding by seawater. Often in the process of filling in, gradually being colonized by halophytic plants.

4.2.2 Salinas

Salt-Pans, active or in process of abandonment. Sections of the salt marsh exploited for the production of the salt by evaporation. They are clearly distinguishable from the rest of the marsh by their segmentation and embankment systems.

4.2.3 Inter tidal flats**

Generally non-vegetated expanses of mud, sand or rock lying between high and low watermarks.

5. Water bodies

5.1 In Land waters

5.1.1 Water courses

Natural or artificial water- courses serving as water drainage channels. Includes canals: minimum width to include 100m.(for scale 1/100000)

5.1.2 Water bodies

Natural or artificial stretches of water.

5.2 Marine waters

5.2.1 Coastal Lagoons**

Non vegetated stretches of salt or brackish waters separated from the sea by the tongue of land or other similar topography. These water bodies can be connected with the sea at limited points, either permanently or for parts of the year only.

5.2.2 Estuaries **

The mouth of a river within which the tide ebbs and flows.

5.2.3 Sea and ocean

Zone seaward of the lowest tide limit

III.2. CORINE Land Cover Fourth Level:

To meet the particularities of the land cover in Palestine and to have more detailed classification classes, a fourth level of CORINE land cover with the following categories was added:

1.1.1.1 Continuous urban fabric

It has the same definition as it's in CORINE technical guide.

1.1.1.2 Camps

Palestinian, crowded, refugee camps which were built to absorb Palestinians expelled by Israel from their land.

1.1.2.1 Discontinuous urban fabric

It has the same definition as it's in CORINE technical guide.

1.1.2.2 Colonies

Illegal built up areas used by Israelis mainly for residential purposes.

1.2.1.1 Industrial or commercial units

It has the same definition as it's in CORINE technical guide.

1.2.1.2 Military camps

Israeli military installations on the West Bank and Gaza governorates.

2.1.2.1 Permanently irrigated land

It has the same definition as it's in CORINE technical guide.

2.1.2.2 Drip irrigated land

Despite the fact that the definition of CORINE to the "permanently irrigated land" excludes the drip and sprinkler irrigated land and just consider flood or flush irrigation technique, we consider the drip and sprinkler irrigated arable land as permanently irrigated due to the permanent infra-structure used for such a technique of irrigation which is the most common technique of irrigation in Palestine.

2.2.1.1 Vineyards

It has the same definition as it's in CORINE technical guide.

2.2.1.2 Drip irrigated vineyards

Vineyards irrigated with dripping system, mainly located on the Jordan Valley.

2.2.2.1 Palm groves

Includes palms that is non-irrigated or drip irrigated.

2.2.2.2 Citrus plantations

It includes drip irrigated and flush irrigated citrus plantations.

2.2.2.3 Others

Include all fruit trees rather than vineyards, citrus and palm trees.

2.4.2.1 Non irrigated complex cultivation pattern

It has the definition of the complex cultivation pattern, but on the condition that the cultivation is non-irrigated.

2.4.2.2 Drip irrigated complex cultivation pattern

Includes the crops that satisfy the definition of "complex cultivation pattern", but on the condition that the cultivation is irrigated by drip or sprinkler irrigation system.

3.3.3.1 Sparsely vegetated area

It has the same definition as it's in CORINE technical guide.

3.3.3.2 Halophytes

Plants that grow on saline land or salty marshes, such as Tamarix ssp. that grow on the Jordan Valley.

Table: CORINE Land Cover Nomenclature

Level 1	Level 2	Level 3
1. Artificial surfaces	1.1. Urban fabric	1.1.1. Continuous urban fabric
		1.1.2. Discontinuous urban fabric
	1.2. Industrial, commercial and transport units	1.2.1. Industrial or commercial units
		1.2.2. Road and rail networks and associated land
		1.2.3. Port areas
		1.2.4. Airports
	1.3. Mine, dump and construction sites	1.3.1. Mineral extraction sites
		1.3.2. Dump sites
		1.3.3. Construction sites
	1.4. Artificial non-agricultural vegetated areas	1.4.1. Green urban areas
		1.4.2. Sport and leisures facilities
2. Agricultural areas	2.1. Arable land	2.1.1. Non-irrigated arable land
		2.1.2. Permanently irrigated land
		2.1.3. Rice fields
	2.2. Permanent crops	2.2.1. Vineyards
		2.2.2. Fruit trees and berry plantations
		2.2.3. Olive groves
	2.3. Pastures	2.3.1. Pastures
	2.4. Heterogeneous agricultural areas	2.4.1. Annual crops associated with permanent crops
		2.4.2. Complex cultivation patterns
		2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation
		2.4.4. Agro-forestry areas
3. Forests and semi-natural areas	3.1. Forests	3.1.1. Broad-leaved forest
		3.1.2. Coniferous forest
		3.1.3. Mixed forest
	3.2. Shrub and/or herbaceous vegetation associations	3.2.1. Natural grassland
		3.2.2. Moors and heath land
		3.2.3. Sclerophyllous vegetation
		3.2.4. Transitional woodland shrub
	3.3. Open spaces with little or no vegetation	3.3.1. Beaches, dunes and sand plains
		3.3.2. Bare rock
		3.3.3. Sparsely vegetated areas
		3.3.4. Burnt areas
		3.3.5. Glaciers and perpetual snow
4. Wetlands	4.1. Inland wetlands	4.1.1. Inland marshes
		4.1.2. Peat bogs
	4.2. Coastal wetlands	4.2.1. Salt marshes
		4.2.2. Salines
		4.2.3. Intertidal flats
5. Water bodies	5.1. Inland waters	5.1.1. Water courses
		5.1.2. Water bodies
	5.2. Marine waters	5.2.1. Coastal lagoons
		5.2.2. Estuaries
		5.2.3. Sea and oceans

Source: European Commission. 1994

APPENDIX (IV)

مناطق إستخدام الأراضي حسب مخطط الحماية الطارىء:

إن الهدف الرئيسي لتقييم الحساسية للمناطق المختلفة الذي تم عمله من اجل مخطط الحماية الطارىء، هو عبارة عن وضع الأسس لتحديد و تعيين مناطق إستخدام الأراضي من أجل تنظيم التنمية المسموح بها في البيئات الحساسة و القيّمة، و التي بناء عليها تم تقسيم محافظات الضفة الغربية الى ثلاث مناطق تخضع لدرجات مختلفة من الحماية و ضوابط إستخدام الأراضي بحيث يمكن إجمال أهداف و مميزات و سياسات تنمية المناطق الثلاث على النحو التالي:

أهداف المنطقة	مميزات الأراضي	سياسة و أدوات إدارة و تنمية الأراضي
المنطقة (1) حماية	• بيئات طبيعية بالغة الحساسية. • أراضي بالغة الأهمية بيئيا. • بيئات طبيعية ثقافية و حضارية مختارة. • غابات و محميات طبيعية بناء على إتفاقية أوسلو 2.	• يمنع تغيير إستخدام الأراضي. • إحمها و حافظ عليها.
المنطقة (2) تنمية محدودة	• أراضي بالغة القيمة زراعيا. • بيئات طبيعية بالغة و متوسطة القيمة. • مناطق حساسة أو بالغة الحساسية من منظور إعادة ملىء المياه الجوفية و خزاناتها. • مناطق متوسطة الحساسية بيئيا.	• طورها كملاذ أخير (إذا لم يتوفر بديل في المنطقة (3)). • ضوابط تنموية صارمة. • يطلب إجراء تقييم التأثير على البيئية.
المنطقة (3) تنمية خاضعة للمراقبة و الإشراف	أراضي متدنية القيمة و الحساسية في المناطق لا علاقة خاصة لها بالزراعة أو إعادة ملىء الأحواض المائية أو التنوع الحيوي أو البيئة الطبيعية.	• يطلب إعداد مراجعة أو قائمة مراجعة بيئية لتحديد مدى الحاجة الى إجراء تقييم التأثير على البيئية. • يجب أن يقام الجزء الأكبر و الرئيس من مشاريع التنمية في هذه المنطقة بعد إستيفاء الشروط و ضوابط التخطيط حسب الأصول .

• **المصدر:**وزارة التخطيط و التعاون الدولي، 1996 / مديرية التخطيط الحضري و الريفي، الإدارة العامة للتخطيط البيئي ايلول 1996، المخطط الطارئ لحماية المصادر الطبيعية في فلسطين (محافظات الضفة الغربية)

APPENDIX V:

Birzeit University

ماجستير التخطيط العمراني

نموذج استمارة لتقييم رؤية مسئولي عملية التخطيط و المؤسسات المعنية بالتخطيط

تهدف هذه الاستمارة لتقييم أهم المعايير و أولويتها لدى التخطيط للمناطق الريفية والبلدات والقرى، حول محور المحافظة على مورد الأرض من الإستنزاف، بحيث تعنى الدراسة التي سيقوم على أساسها التقييم، بالحالة الدراسية للتخطيط في بلدة حلحول ضمن المعايير التي سيتم ذكرها لاحقاً، و الهدف هو تقييم رؤية كل مؤسسة من وجهة نظرها الخاصة للأولويات التي تعنى بها لدى التخطيط في مثل هذه المناطق.

*ملاحظة: يوجد أربعة أقسام من الأسئلة لكل منها عدد من الأفرع ، يرجى الإجابة على كل فرع بحيث يكون مجموع كل فرع =100%

1) القسم الأول: معلومات عامة:

1.1) إسم المؤسسة : ________________________________
1.2) الإسم الشخصي : ________________________________
1.3) المسمى الوظيفي : ________________________________
1.4) مجال عمل المؤسسة : ________________________________

2) القسم الثاني: اهم المعايير للتخطيط:

2.1) في حال قيام مؤسستكم بالمشاركة للتخطيط لمنطقة حلحول حول محور المحافظة على الأرض من الإستنزاف، لإيجاد خطة مناسبة لتحديد المناطق الملائمة للإمتداد العمراني، و المناطق المحمية الزراعية، و المناطق الحساسة للمياه الجوفية، فما هي نسبة أهمية كل من العوامل التالية حسب تقييم مؤسستكم و الأولويات الخاصة بها عند وضع دراسة لمخطط بهذا الشأن على المستوى المحلي :

أ. أهمية العوامل البيئية __________%
ب. أهمية العوامل الإجتماعية و الإقتصادية __________%
ج. أهمية تأثير العوامل الفيزيائية،ممثلة بعامل الإنحدار، وحدة الميلان في طبوغرافية الأرض__________%

3) القسم الثالث: أهم العوامل الإجتماعية و الإقتصادية:

3.1) عند تصنيف الأراضي حسب أهميتها الإجتماعية و الإقتصادية، تعتبر العوامل التالية من اهم العوامل الإجتماعية و الإقتصادية التي تؤثر في عملية الإمتداد العمراني، ما هي نسبة أهمية كل من العوامل التالية على عملية إزدياد المناطق العمرانية:

أ. قيمة الأرض و مدى ملائمتها للإمتداد العمراني __________%
ب. طبيعة ملكية الأراضي (خاصة أم عامة) __________%

3.2) كل من العوامل التالية تؤثر في عملية اختيار المناطق الجديدة الملائمة للإمتداد العمراني، ما هي وجهة نظركم الخاصة في مدى تأثير كل من التالية على عملية اختيار المناطق الجديدة وآلية توجه الإمتداد العمراني، و ذلك بإعطاء نسبة مئوية لأهمية كل عامل في ضوء رؤية مؤسستكم الخاصة:

أ. المناطق القريبة من المناطق السكنية (تقع ضمن النسيج العمراني الحالي أو بقربه) و ضمن حدود الخدمات العامة و المخطط الهيكلي: __________%

ب. طبيعة ملكية الأراضي (خاصة أم عامة)__________%

4) القسم الرابع: أهمية العوامل البيئية:

4.1) عند تصنيف الأراضي حسب أهمية العوامل البيئية لمنطقة حلحول، فما هي نسبة أهمية كل من التالية لاعتبارها بتصنيف الأراضي حسب أهميتها البيئية:

أ. الأراضي الزراعية __________%

ب. المناطق الحساسة للمياه الجوفية __________%

4.2) عند تصنيف الأراضي حسب أهميتها الزراعية، فما هي النسبة التي تعطيها لأهمية كل من التالية في اختيار المناطق الزراعية:

أ. معدل توزيع الأمطار السنوية __________%

ب. الغطاء الأرضي أو استعمالات الأراضي __________%

ج. التربة __________%

- Please fill this form for the weights of the selected criteria set in the purpose of this study for Halhul town:

<table>
<tr><th>Analysis Level (Stage)</th><th>First Level Criteria Weights</th><th>Weight Sum</th><th>Second Level Criteria Weights</th><th>Weight Sum</th><th>Third Level Criteria Weights</th><th>Weight Sum</th><th>Fourth</th></tr>
<tr><td rowspan="4">Environmental</td><td>A. Annual Precipitation Weight ( )%</td><td rowspan="3">100%</td><td rowspan="3">1) Land Value For Agricultural Sensitivity Weight ( )%</td><td rowspan="4">100%</td><td rowspan="4">I) Environmentally Sensitive Areas Weight ( )%</td><td rowspan="7">100%</td><td rowspan="7">Land Suitability Analysis Model</td></tr>
<tr><td>B. Land Cover Weight ( )%</td></tr>
<tr><td>C. Soil And Fertility Weight ( )%</td></tr>
<tr><td></td><td></td><td>2) Land Value For Ground Water Sensitivity Weight ( )%</td></tr>
<tr><td>Physical</td><td></td><td></td><td></td><td></td><td>II)Slope Weight ( )%</td></tr>
<tr><td rowspan="2">Socio-economical</td><td></td><td></td><td>1) Land Potential for New Urban Areas (distance from existing built up area, geopolitical zones, municipal boundary) Weight ( )%</td><td rowspan="2">100%</td><td rowspan="2">III) Land Potential for Socio-economic Needs Weight ( )%</td></tr>
<tr><td></td><td></td><td>2)Land Ownership Weight ( )%</td></tr>
</table>

- **Related Data for the Study Area:**

1) Land Use Land/ Cover Data:

Land-use areas and percentage of each land-use (land cover) classification as shown in the Table below:

Table (1): Classification of the Land Use/Land Cover for Halhul in 2006

Land Use/Land Cover for Halhul	Area in Dunums	% from Total
Arable land	4938	13.20%
Forest	806	2.16%
Industrial, commercial and transport unit	56	0.15%
Heterogeneous agricultural areas	193	0.52%
Mine, dump and construction	217	0.58%
Open spaces with little or no vegetation	3995	10.71%
Permanent crops	19040	51.06%
Plastic House	19	0.05%
Shrub and/or herbaceous vegetation associations	4401	11.80%
Palestinian built-up area	3475	9.32%
Israeli Settlement	105	0.28%
Israeli Military Base	34	0.09%
Cemetery	13	0.03%
Total Area	**37,292**	**100.00%**

Source: Applied Research Institute Jerusalem (ARIJ), 2010

*Built up Area =3.5 Km^2

* Total population in 2007 =21,797   * (according to the Palestinian Central Bureau of Statistics PCBS, 2010)

2) Geopolitical Status of Halhul:

Table (2): Classification of the Geopolitical Zones in Halhul according to Oslo Agreement

Political Zone	Area (Dunums)	% from Total Area
A	5,191	14%
B	21,082	56.50%
C	10,869	29.10%
H1	150	0.40%
Total	**37,292**	**100%**

Source: Land Research Center (LRC) GIS Database, 2010

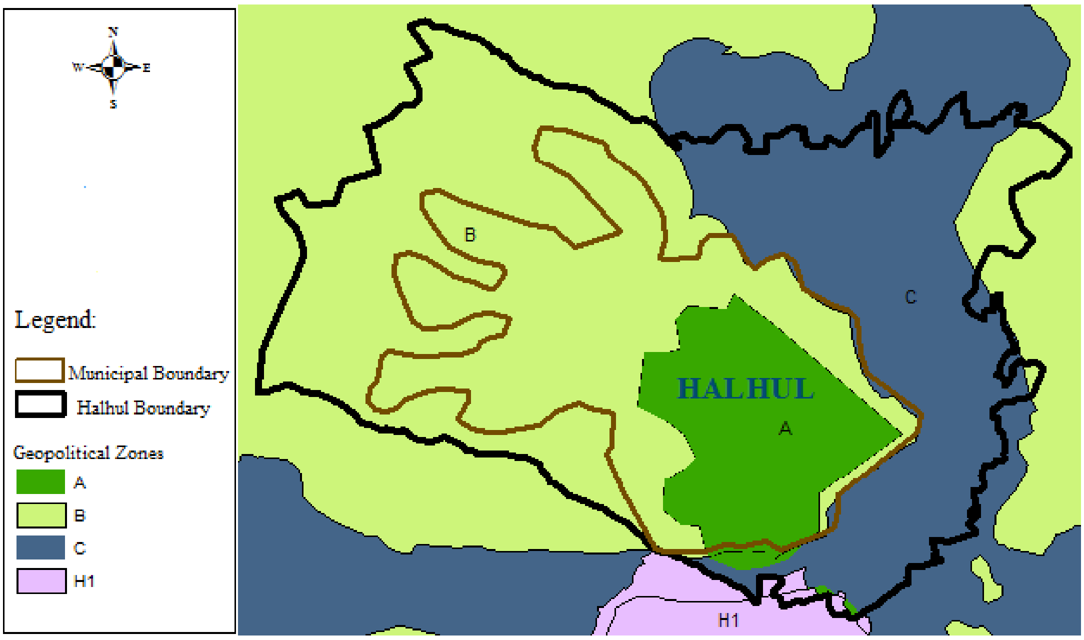


Figure (1): Municipal Boundary and Geopolitical Zones according to Oslo Agreement/Halhul.

Source: Land Research Center (LRC) GIS Database, 2010

*Municipal Boundary Area =15,000 dunums, Halhul Area=37,292 dunums

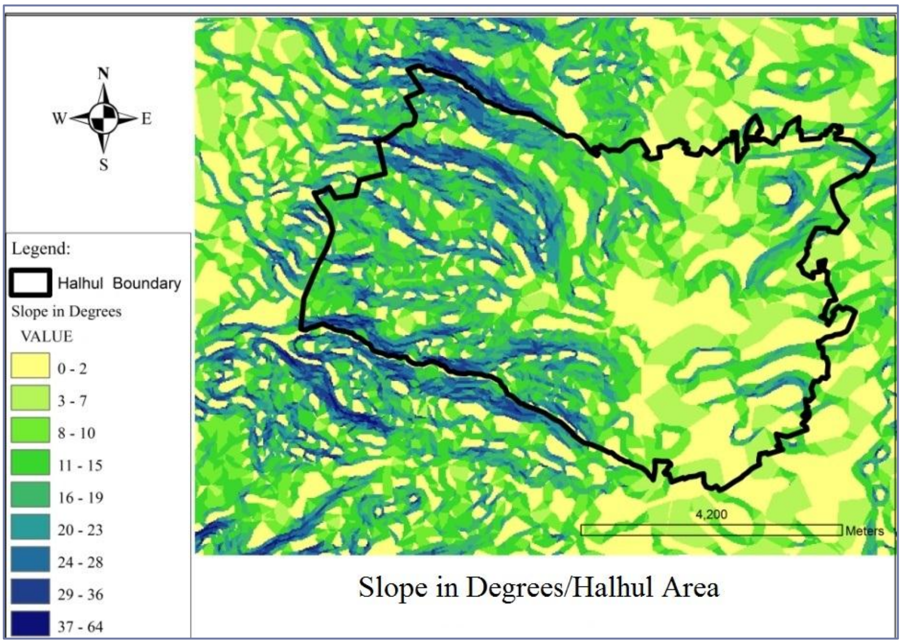


Figure (2): Slope in Degrees, Halhul

Source: Prepared by the Researcher, Derived from Contour Map, Source: Land Research Center (LRC) GIS Database, 2010

APPENDIX (VI)

The incremental increase in urban area and decrease in the available area is from different sources, in another word, is the decrease from HSA, MSA, or LSA or from NS. This means:

- H (t0) =H (constant) $\rightarrow$ H (t) =H (t0) - ΔH $\rightarrow$ΔH= H (t0)-H (t) …………equ. (VI-1)

Where:
H (t0) =H = is the total area of HSA according to the land suitability model (Ideal Model), and which is constant.
H (t) = is the total area of the highly sensitive area at time t.
ΔH= H (t0)-H (t) = is the decrease in HSA by time from the original constant value obtained by the model.

Similarly, this will be applied on the MSA, LSA, and the NS areas, having the same equations above.

- M (t0) =M (constant) $\rightarrow$ M (t) =M (t0) - ΔM $\rightarrow$ΔM= M (t0)-M (t)……..equ. (VI-2)

Where:
M (t0) =M = is the total area of MSA according to the land suitability model (ideal model), and which is constant.
M (t) = is the area of the moderately sensitive area at time t.
ΔM= M (t0)-M (t) = is the decrease in MSA by time from the original constant value obtained by the model.

- Also for the low sensitivity area:

L (t0) =L (constant) $\rightarrow$ L (t) =L (t0) - ΔL $\rightarrow$ΔL= L (t0)-L (t) ………………equ. (VI-3)

Where:
L (t0) =L = is the total area of LSA according to the land suitability model (ideal model), and which is constant.
L (t) = is the area of the low sensitivity area at time t.
ΔL= L (t0)-L (t) = is the decrease in LSA by time from the original constant value obtained by the model.

- N (t0) =N (constant) $\rightarrow$ N (t) =N (t0) - ΔN $\rightarrow$ΔN= N (t0)-N (t) ………..equ.(VI-4)

Where:
N (t0) =N = is the total area of NS according to the land suitability model (ideal model), and which is constant.
N (t) = is the area of the no particular sensitivity area at time t.
ΔN= N (t0)-N (t) = is the decrease in NSA by time from the original constant value obtained by the model.

Therefore, by time, the change in urban area is due to the change in ΔH, ΔM, ΔL, and or ΔN

$\rightarrow$ΔU= U (t)-U (t0)……………………………………………………….. equ. (4.4)

$\rightarrow$ΔU= ΔH+ ΔM+ ΔL+ ΔN……………………………………………………... equ. (4.5)

By the time, the system may follow different trends and a number of possibilities for equ. (4.5) (Change in existing urban areas), the number of possibilities can be estimated and which is:

$P(\Delta U) = (2)^{(4)} = 16$ where: 2= stands for the two possibility of ΔH or H, ΔM or M, ΔL or L, and ΔN or N

From which, the following cases in which the system may pass are developed and listed in the Table (VI-1) below:

Table (VI-1): Cases of the Change in Urban Area by Time in Consideration of Change in Land Suitability Model

Case No.	ΔU	Values for the Expressions: (ΔH+ΔM), (ΔL+ΔN) =0 or const. Or for ΔH, ΔM, ΔL, ΔN=0 or const.	Sustainability and Saturation Stage
1	ΔU= ΔH+ ΔM+ ΔL+ ΔN	as ΔH=0,ΔM=0,ΔL=0,ΔN=0→ΔU=0 as (ΔH+ΔM)=0 →ΔU=ΔL+ ΔN as (ΔL+ΔN)=0 →ΔU=ΔH+ΔM	Existing built up area, at t0, U(t)=U(t0) →ΔU=U(t)-U(t0) =0 sustainable limit at (ΔH+ΔM)=0, above this limit the system is unsustainable
2	ΔU= ΔH+ ΔM+ ΔL+ N	as (ΔH+ΔM)=0, ΔL=0→ΔU= N as (ΔH+ΔM)=0 →ΔU= ΔL+ N as ΔL=0→ΔU=(ΔH+ΔM)+N	Sustainable Limit at (ΔH+ΔM)=0, above this Limit the System is Unsustainable
3	ΔU= ΔH+ ΔM+L+ ΔN	as (ΔH+ΔM)=0, ΔN=0→ΔU= L as (ΔH+ΔM)=0 →ΔU= L+ ΔN as (ΔN)=0 →ΔU= ΔH+ ΔM+L	Sustainable Limit at (ΔH+ΔM)=0, above this Limit the System is Unsustainable
4	ΔU= ΔH+ΔM+L+ N	as (ΔH+ΔM)=0 →ΔU= L+ N	Saturation Limit and Sustainable Limit (System Balance) (Ideal Model)
5	ΔU= ΔH+ M+ ΔL+ ΔN	as ΔH=0, (ΔL+ ΔN)=0→ΔU= M as ΔH=0 →ΔU= M+ ΔL+ ΔN as (ΔL+ ΔN)=0→ΔU= ΔH+ M	Unsustainable as ΔH>0 or ΔM>0
6	ΔU= ΔH+ M+ ΔL+ N	as ΔH=0, ΔL=0 →ΔU= M+ N as ΔH=0 →ΔU= M+ ΔL+ N as ΔL=0→ΔU= ΔH +M+ N	Unsustainable as ΔH>0 or ΔM>0
7	ΔU= ΔH+ M+ L+ ΔN	as ΔH=0,ΔN=0 →ΔU= M+ L as ΔH=0 →ΔU= M+ L+ΔN as ΔN=0 →ΔU= ΔH+ M+ L	Unsustainable as ΔH>0 or ΔM>0
8	ΔU= ΔH+ M+ L+ N	as ΔH=0 →ΔU= M+L+ N	Unsustainable, Saturated as ΔH>0 or ΔM>0
9	ΔU= H+ ΔM+ ΔL+ ΔN	as (ΔL+ ΔN)=0, ΔM=0 →ΔU= H as ΔM=0 →ΔU= H+ΔL+ΔN as (ΔL+ ΔN)=0, →ΔU= H+ ΔM	Unsustainable
10	ΔU= H+ ΔM+ ΔL+ N	as ΔM=0, ΔL=0 →ΔU= H+ N as ΔM=0 →ΔU= H+ΔL+ N as ΔL=0 →ΔU= H+ ΔM+ N	Unsustainable
11	ΔU= H+ ΔM+ L+ ΔN	as ΔM=0,ΔN=0 →ΔU= H+L as ΔM=0→ΔU= H+L+ΔN as ΔN=0→ΔU= H+ΔM+L	Unsustainable
12	ΔU= H+ ΔM+ L+ N	as ΔM=0 →ΔU= H+L+ N	Saturated, Unsustainable
13	ΔU= H+ M+ ΔL+ ΔN	as (ΔL+ΔN)=0 →ΔU= H+M	Maximum Limit of Un-sustainability as ΔM=M →ΔH= H
14	ΔU= H+ M+ ΔL+ N	as ΔL=0 →ΔU= H+M+ N	Maximum Limit of Un-sustainability as ΔM=M →ΔH= H
15	ΔU= H+ M+ L+ ΔN	as ΔN=0 →ΔU=H+M+L	Maximum Limit of Un-sustainability as ΔM=M →ΔH= H
16	ΔU= H+ M+ L+ N	No Case to be measured for sustainability, because in this case ΔU means the total area of the town is used nothing left, and so its logic that there is nothing to be measured.	---

Source: The Researcher

Upon this and according to the above Table (VI-1):

*the cases from (1-4) in Table (VI-1) are considered the most common cases which should be available and shouldn't exceed them to the next cases (5-16) in Table (VI-1)

That is because in these cases the model is sustainable as $(\Delta H+\Delta M)=0$, (Except in the highlighted ones) where; $(\Delta H+\Delta M)>0\rightarrow$

4. $0<\Delta H<H$ (and) $0<\Delta M<M$ (or)
5. $\Delta H=0$ (and) $0<\Delta M<M$ (or)
6. $0<\Delta H<H$ (and) $\Delta M=0$

Table (VI-2): The Cases of Un-Sustainable Model before and at Saturation Limit
(Before and at the System Balance)

Case No.	**ΔU for the unsustainable cases below system balance**	**Sub-Cases from major cases of unsustainable cases only which are unsaturated (or) at saturation limit At and Below system balance where; $(\Delta H+\Delta M)>0\rightarrow$ $0<\Delta H<H$ (and) $0<\Delta M<M$ (or) $\Delta H=0$ (and) $0<\Delta M<M$ (or) $0<\Delta H<H$ (and) $\Delta M=0$ (And) $L+N>\Delta L+\Delta N>$ or $=0$ (Under Saturated).**	**Sustainability and Saturation**
1	$\Delta U=\Delta H+\Delta M+\Delta L+\Delta N$ as $(\Delta L+\Delta N)=0\rightarrow\Delta U=\Delta H+\Delta M$	$0<\Delta H<H$ (and) $0<\Delta M<M$ as $(\Delta L+\Delta N)=0\rightarrow\Delta U=\Delta H+\Delta M$ as $L+N>(\Delta L+\Delta N)>0\rightarrow\Delta U=\Delta H+\Delta M+\Delta L+\Delta N$ $\Delta H=0$ (and) $0<\Delta M<M$ as $(\Delta L+\Delta N)=0\rightarrow\Delta U=\Delta M$ as $L+N>(\Delta L+\Delta N)>0\rightarrow\Delta U=\Delta M+\Delta L+\Delta N$ As $0<\Delta H<H$ (and) $\Delta M=0$ as $(\Delta L+\Delta N)=0\rightarrow\Delta U=\Delta H$ as $L+N>(\Delta L+\Delta N)>0\rightarrow\Delta U=\Delta H+\Delta L+\Delta N$	Un-Sustainable, Un-Saturated
2	$\Delta U=\Delta H+\Delta M+\Delta L+N$ as $\Delta L=0\rightarrow\Delta U=(\Delta H+\Delta M)+N$	$0<\Delta H<H$ (and) $0<\Delta M<M$ as $\Delta L=0\rightarrow\Delta U=(\Delta H+\Delta M)+N$ as $L>\Delta L>0\rightarrow\Delta U=\Delta H+\Delta M+\Delta L+N$ $\Delta H=0$ (and) $0<\Delta M<M$ as $\Delta L=0\rightarrow\Delta U=\Delta M+N$ as $L>\Delta L>0\rightarrow\Delta U=\Delta M+\Delta L+N$ As $0<\Delta H<H$ (and) $\Delta M=0$ as $\Delta L=0\rightarrow\Delta U=\Delta H+N$ as $L>\Delta L>0\rightarrow\Delta U=\Delta H+\Delta L+N$	Un-Sustainable, Un-Saturated
3	$\Delta U=\Delta H+\Delta M+L+\Delta N$ as $(\Delta N)=0\rightarrow\Delta U=\Delta H+\Delta M+L$	$0<\Delta H<H$ (and) $0<\Delta M<M$ as $(\Delta N)=0\rightarrow\Delta U=\Delta H+\Delta M+L$ as $N>\Delta N>0\rightarrow\Delta U=\Delta H+\Delta M+L+\Delta N$ $\Delta H=0$ (and) $0<\Delta M<M$ as $(\Delta N)=0\rightarrow\Delta U=\Delta M+L$ as $N>\Delta N>0\rightarrow\Delta U=\Delta M+L+\Delta N$ As $0<\Delta H<H$ (and) $\Delta M=0$ as $(\Delta N)=0\rightarrow\Delta U=\Delta H+L$ as $N>\Delta N>0\rightarrow\Delta U=\Delta H+L+\Delta N$	Un-Sustainable, Un-Saturated
4	$\Delta U=\Delta H+\Delta M+L+N$ as $(\Delta H+\Delta M)=0\rightarrow\Delta U=L+N\rightarrow$ Saturation limit and sustainable limit (Ideal Model)	$0<\Delta H<H$ (and) $0<\Delta M<M\rightarrow$ $\Delta U=\Delta H+\Delta M+L+N$ $\Delta H=0$ (and) $0<\Delta M<M$ $\rightarrow\Delta U=\Delta M+L+N$ As $0<\Delta H<H$ (and) $\Delta M=0$ $\rightarrow\Delta U=\Delta H+L+N$	Un-Sustainable, Saturated

Source: the Researcher

APPENDIX (VII)

- **Results for the Environmental Land Suitability Analysis:**

Table: Environmental Land Suitability Analysis Results/ Classified According to Land Sensitivity / and the Total Areas of Each Classification

<table>
<tr><th>Land Classification</th><th>Area in (m^2)</th><th>Area in Dunums</th><th>Area in Dunums</th></tr>
<tr><td>NS</td><td>7,958,188</td><td>7,958.188</td><td rowspan="2">19,353.029</td></tr>
<tr><td>LSA</td><td>11,394,841</td><td>11,394.841</td></tr>
<tr><td>MSA</td><td>6,361,180</td><td>6,361.18</td><td rowspan="2">14,206.228</td></tr>
<tr><td>HSA</td><td>7,845,048</td><td>7,845.048</td></tr>
<tr><td>Urban Fabric</td><td>3,627,000</td><td>3,627</td><td></td></tr>
<tr><td>Total Area (m^2)</td><td>37,186,257</td><td>37,186.257</td><td></td></tr>
</table>

APPENDIX VIII:

- **Estimation for the Time Balance Using the Natural Urban Growth Calculations:**

According to the natural urban growth, and by considering the actual urban density for the year 2006, which is 165 m^2/person. The targeted years can be estimated for the time at which the available areas will be utilized completely by natural urban growth.

In order to estimate the time of system balance, this means at this time, the total available areas which are areas obtained from the model (LSA + NS) and the built-up area, will be utilized completely, and so the projected population numbers can be estimated according to the urban density (165 m^2/person), then the projected time can be found by using the population growth equation. As illustrated in the following:

1) $A(t) = (LSA + NS) + A(t_0)$

> Where:
> LSA = total available areas of low sensitive areas as obtained from the model (area in dunums)
> NS =total available areas of not sensitive areas as obtained from the model (area in dunums)
> A (t_0) = built-up areas for the year 2006 = 3,487 dunums
> A (t) =total urbanized area at time t (dunums)

2) P(t)=A(t)*1000/urban density (t) → then find P (t)

> Where:
> P (t) = population projection at the targeted year (time of system balance)
> A (t) =total urbanized area at time t (dunums)
> Urban density (t) = 165 m^2/person as assumed according to the year 2006 urban density to continue within this rate (natural urban growth)

- This obtains the total population at time (t) and who will completely use the (existing built-up and available areas (LSA + NS)).

3) And so, (t): will be the time at which the system reaches the balance state or sustainable limit and is calculated as follows:(from equ.(4.1))

$$\left.\begin{array}{l}\Delta t = \text{Log}_{(GR+1)} (\text{Pop}(t) / \text{Pop}(t_0=2007)) \\ \\ \Delta t = \text{Log}_{(3.35\%+1)} (\text{Pop}(t) / (21{,}797))\end{array}\right\}$$

> GR = Population Growth Rate
> Pop (t) = Population at time (t) as obtained from step (2)
> Pop (t_0) = Population according to a past record (2007) will be used.
> Δ t = Projected Period

t = Δ t + 2007 → and which is the time balance of the model

Example: (Table (5.16), p.93) sustainable model: time of system balance calculations:

1) A (t) = (LSA + NS) + A (t_0) → A (t) = 9,171+3,487=12,658 dunums

2) P (t) =A (t)*1000/urban density (t) → P (t) = 12,658 *1000/ 165 =76,716 person

3) $\Delta t = \text{Log}_{(3.35\%+1)} (\text{Pop}(t) / (21{,}797)) \rightarrow \Delta t = \text{Log}_{(3.35\%+1)} (76{,}716 / (21{,}797)) = 38 \rightarrow$ t=38+2007=2045

APPENDIX IX:

1) Planning Standards Used by the MOLG: Minimum Requirements for Urban Area per Person (m^2/Capita)

No.	Land Use	Area (m^2/Capita)	Notes
1	Residential Areas	250	
2	Schools • Elementary 1.6 m^2/Capita • Middle 1.1 m^2/Capita • Secondary 1.2 m^2/Capita	3.9	16% of the population considered to be in elementary school, each student 10 square meters, and 7% in the middle school 15 square meters per student, and 7% in secondary schools about 18 square meters for each student.
3	Parks and Playgrounds	1.0	
4	Cemeteries	0.4	Based on existing population
5	Sport and Cultural Centers	0.5	
6	Hospitals and Health Centers	0.1	Assuming 3 beds for each 1000 citizen, or 17% from the total area needed for 1000 citizens
7	Industrial Area	24.1	17% of the space needed by all those working in the industrial area about 90 square meters per worker.
Total		**280**	

Source: Ministry of Local Government "MOLG", Ramallah – Palestine

2) Detailed Planning Standards Used by The MOLG (m^2/ Person):

Land Use	Area (m^2)
Residential Areas	28 m^2/capita
Garden	5 m^2/capita
Playgrounds	1 m^2/capita
Parking	2 m^2/capita
Health Center	0.5 m^2/capita
Commercial Center	2 m^2/capita
Administration Center	0.6 m^2/capita
Cultural Center	0.6 m^2/capita
Child Care Center	15 m^2/child after counting 3% from the total population
Police Center	0.2 m^2/capita
Clubs	50 chair /1000 capita, with 1.5 m^2/chair
Post Office	0.2 m^2/capita
Social Center	0.5 m^2/capita
Custody of Children	30 m^2/child after counting 2% from the total population
Kindergarten	35 m^2/child after counting 6% from the total population
Hospital	150 m^2/bed, an average of 3 beds/ 1000 capita
Mosque	1 m^2/capita
Cemeteries	0.4 m^2/capita based on the existing no. of population
Elementary Schools	10 m^2/student after counting 16% from the total population
Middle and Secondary School	15 and 18 m^2/student after counting 7% from the total population

Source: Ministry of Local Government "MOLG", Ramallah – Palestine

3) Residential Areas Planning Regulations Used by the MOLG:

Residential Type	Allowed Percentage of Built up Area	Minimum Plot Area (m^2)
Residential A	36%	1000
Residential B	42%	750
Residential C	48%	500
Residential D	52%	300
Agricultural Residence	15% at maximum 600 m^2	5000
Rural Residence	10% at maximum 300 m^2	2500

Source: Law of Construction and Management of Local Bodies, 1996, MOLG, Ramallah – Palestine

APPENDIX X:

- **Calculation for the Time Balance Using the MOLG Standards:**

According to the minimum design standards for the MOLG, the urban density (urban area /person) is 280 m^2/person. Upon which the year of system balance will be estimated for the available areas according to the MOLG minimum standards. As follows:

1) $A(t) = (LSA + NS) + A(t_0)$

> Where:
> LSA = total available areas of low sensitive areas as obtained from the model (area in dunums)
> NS =total available areas of not sensitive areas as obtained from the model (area in dunums)
> A (t_0) = built-up areas for the year 2006 = 3,487 dunums
> A (t) =total urbanized area at time t (dunums)

2) P(t)=A(t)*1000/urban density (t) → then find P (t)

> Where:
> P (t) = population projection at the targeted year (time of system balance)
> A (t) =total urbanized area at time t (dunums)
> Urban density (t) = 280 m^2/person according to the MOLG minimum standards

3) $\Delta t = \text{Log}_{(GR+1)} (P(t) / P(2007))$

$\Delta t = \text{Log}_{(3.35\% + 1)} (P(t) / 21{,}797)$

Find Δt

> GR = Population Growth Rate
> Pop (t) = Population at time (t) as obtained from step (2)
> Pop (t_0) = Population according to a past record (2007) will be used.
> Δ t = Projected Period

$t = \Delta t + 2007$ = Year of System Balance

<u>Example: (Table (5.17), p.94) sustainable model: time of system balance calculations:</u>

1) A (t) = (LSA + NS) + A (t_0) → A (t) = 9,171+3,487=12,658 dunums

2) P (t) =A (t)*1000/urban density (t) → P (t) = 12,658 *1000/ 280 =45,207 person

3) $\Delta t = \text{Log}_{(3.35\% + 1)} (\text{Pop}(t) / (21{,}797)) \rightarrow \Delta t = \text{Log}_{(3.35\% + 1)} (45{,}207 / (21{,}797)) = 22 \rightarrow$ t=22+2007=2029

APPENDIX (XI)

- **Results for the Agricultural Land Suitability Analysis:**

Table: Agricultural Land Suitability Analysis Results/ Classified according to Land Sensitivity / by the Total Areas of Each Classification in dunums.

Land Classification	Area in Dunums	Area in Dunums
NS	4,726.812	19548.927
LSA	14,822.115	
MSA	6,409.426	14015.571
HSA	7,606.145	
Urban Fabric	3,627	
Total Area (m^2)	**37,191.498**	