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# **Patterns in the Utilization of Constructed Land in Israel**

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# *Abstract*

## **1.1 Background**

Planning is naturally meant to arrange future reality, with the present as its starting point. So, too, is the planning in Israel: it tries to put order into complex and complicated systems that are managed in the confines of a small piece of land, on which a constantly growing population lives.

The major issue with which national planning has been trying to cope for the last decade is the demand for building and development, which has come in response to the increase in population and the rise in housing standards. The results of this demand include urban sprawl, extending outward from the cities into open spaces, the building of suburbs, and increasing population dispersal. Israel's planning authorities have been trying for years to temper and curb this phenomenon that threatens Israel's open spaces, as well as the quality and stability of its cities. This problem is exacerbated by the special circumstances in Israel, which include high population density, a high rate of natural population growth, increases in the standard of living, and with them constant demands for the conversion of open land to land for building.

The starting point for planning for the future is the dimensions of area for construction today, and the size of the population living in it. This information raises a number of basic questions:

- ◆ What are the proportions of the built area today?
- ◆ What uses are made of the areas for building – building of various sorts, industry, employment, etc., and what are the dimensions of each of these?
- ◆ How is the built-up land distributed geographically?
- ◆ What is the size of the population in the built-up areas, and into what categories can it be divided up?
- ◆ How are the built-up areas distributed in terms of municipalities and nationally?

Different databases were available to the national planning authorities of Israel, beginning with the data from the 2020 Master Plan for Israel from 2000 and up to the National Master Plan, no. 35 ("TAMA 35"). But these data bases were built up in different ways, using different methods, over different periods of time.

This project tries to solve the problem of the lack of a single set of data, organized and open to criticism, set in a single point of time and used as a starting point for the coming years. The data base that this project has created is intended to be used as an agreed-upon base on a national level.

These data bases include land elements – its extent, uses, national distribution, and its municipal status – as well as the element of population, its size and characteristics. The inclusion of these statistics and their processing make it possible to learn about how the land is currently used and how it can be taken advantage of in the future.

The real success of this research will be found in its implementation and its use. We hope that master plans at all levels will take advantage of this work and that the database itself will be updated periodically.

## **1.2 Goals**

This research has two main goals:

- ◆ the creation of a data base that reflects the extent of built area in Israel, its distribution, the patterns of its usage, and the ways it is utilized. Such a data base is essential for understanding processes – natural and directed – of concentration in the built-up areas, their saturation and widening, and for use as a starting point for national policy and for future planning of relations between built and open areas.
- ◆ the comparison of a mapping of built-up areas and a data base updated to 2003 with a map and a data base that was created and processed by the same methodology in 1998. This comparison reflects the development in size and the patterns of building in Israel over that period of time.

### 1.3 Methodology

The mapping work was executed with a Geographic Information System (GIS) using ESRI Arc View software.

The mapping and the construction of the polygons for the built-up areas were done on the basis of rectified aerial photos (orthophotos) from the years 1998 and 2003.

In the **first stage** precise polygonal digitalization was performed on built-up areas in orthophoto 1998. The mapping of the built-up areas was done at a scale of 1:4,000. The polygons were categorized into four main groups according to land use: 1) residential areas, 2) industrial and employment areas, 3) quarries, and 4) other.

In the **second stage** mapping was done of additional areas that were built up after 1998 (i.e., over the period 1998-2003) on the basis of comparisons between the aerial photos from those two years.

Results of the work include the following maps:

1. A map of built-up areas in 1998;
2. A map of areas built up between the years 1998 and 2003.

The following data bases are included:

1. A data base of land use for each polygon on the map;
2. A data base from the Central Bureau of Statistics with calculated density for the residential areas in each settlement (name of settlement, municipal status, population statistics, population groups, characteristics of the settlement).

Onto this data base was added the area of roads in Israel, based on the road map of the "Mapa" company. The area was calculated according to a set width for each type of road.

## **1.4 Analysis of the Data Bases**

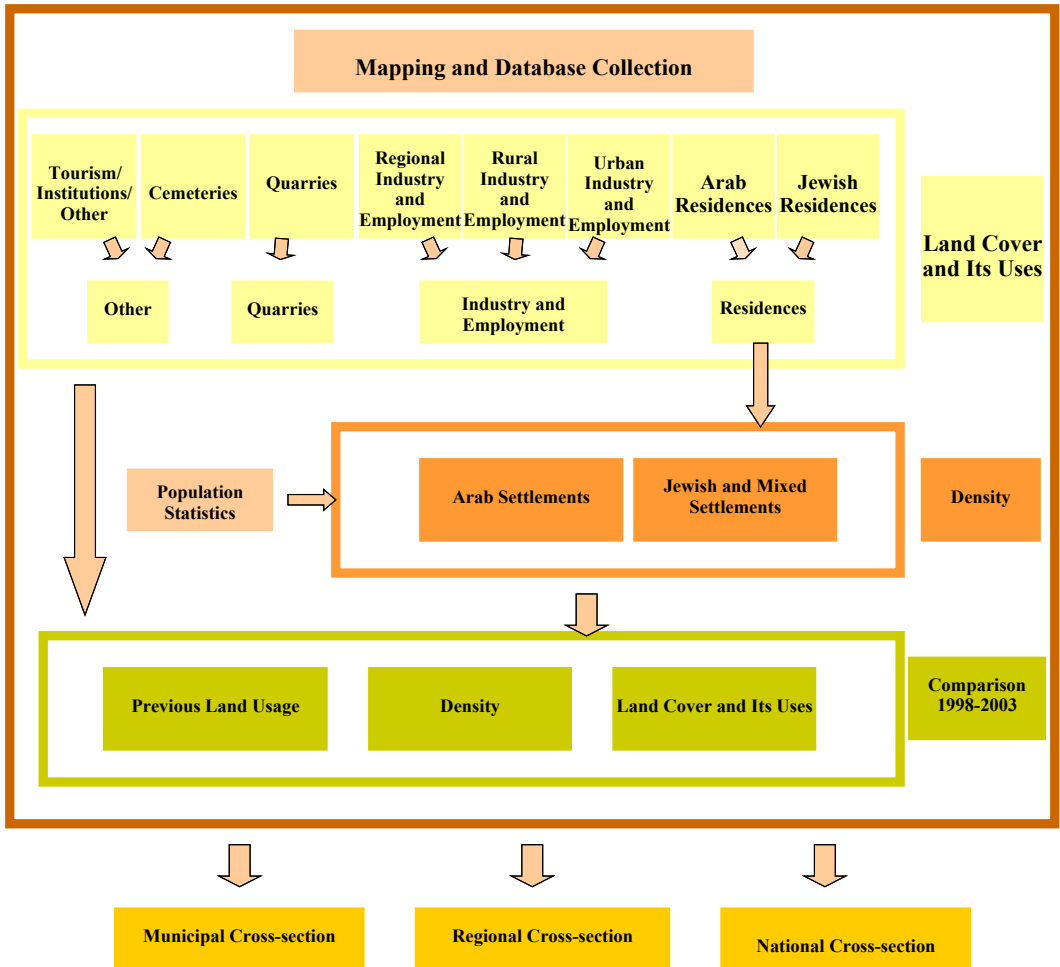
Analysis of the data base was performed in three ways:

1. Land cover and its uses (2003): includes analysis of the utilization of the built up areas, their proportions, and their association with the region (in this case we will refer to all built-upon land of every kind as "land covering");
2. Population, land covering for residence, and population density (2003): in this case we analyze the use of land for residence and the population density of settlements according to different criteria;
3. Comparison between 1998 and 2003: in this analysis we present the additions to land cover and density, and analyze the changes that took place between 1998 and 2003. In addition we analyze the former land use of new land cover.

Each of the analyses is presented according to three cross-sections: national, regional, and municipal.

In addition the correspondence between the data on population density and the socio-economic data was evaluated, as was the utilization of environmental resources in each settlement.

Graph 1.1



## 1.5 Primary Findings

- ◆ The land cover in the country, for all uses combined, reached 1,094 square kilometers in 2003, which is approximately 5% of the country's territory. North of Beersheva, land cover is 11%.
- ◆ Roads comprise 130 square kilometers of total land cover.
- ◆ The percentage of land used for residences, as of 2003, was 70% of all built-on land.
- ◆ Israel's population in 2003 was 6.5 million. Average population density in built areas was 7.7 inhabitants per dunam (1 dunam= k<sup>2</sup>/1000); median density was close to the average, and stood at 9.5 inhabitants per dunam
- ◆ The data from 2003 suggests a dichotomization in the distribution of land resources:  
Half of the population uses 70% of the built-upon land for residences, whereas the second half uses only 30%;  
Population density varies widely, ranging from 0.5 to 28.5 inhabitants per built dunam;  
Population density in 75% of the settled areas (768 settlements) was less than 4 inhabitants per dunam; only 600,000 people reside in such conditions, comprising less than 10% of the country's population. Most of these are rural settlements belonging to regional councils.
- ◆ Average density in Israel's cities is 10.5 residents to dunam. Average density in local councils is 5.7 and in regional councils – 2.5 per dunam.
- ◆ The average population density in Arab villages is 6.1 residents per dunam. Building standards are relatively uniform in this sector, and no significant differences were found between different regions or municipal councils.
- ◆ Between 1998 and 2003 Israel's population grew by approximately 0.6 million people (about 2.2% a year) and the built-upon areas grew by 48 square kilometers (a growth rate of approximately 1% per annum). The average national density therefore grew by 0.5 residents per dunam over this period, a rate of 1.3 % per year.



- ◆ The polarization in land use is growing, despite the fact that overall density has grown. The data shows a movement of population and of building towards the local councils, with a continuing trend of population migration from the dense cities to settlements of lower density.
- ◆ No correlation was found between population density and socio-economic status or usage of environmental resources as were evaluated in this research – waste production per person, vehicles per person, water usage per person.

The GIS maps on layers of building can be viewed on the site of the Ministry of Environmental at the address: [www.sviva.gov.il](http://www.sviva.gov.il)

### Distribution of Land Cover According to Use:

**Table 1.1 – Distribution of National Land Cover According to Use**

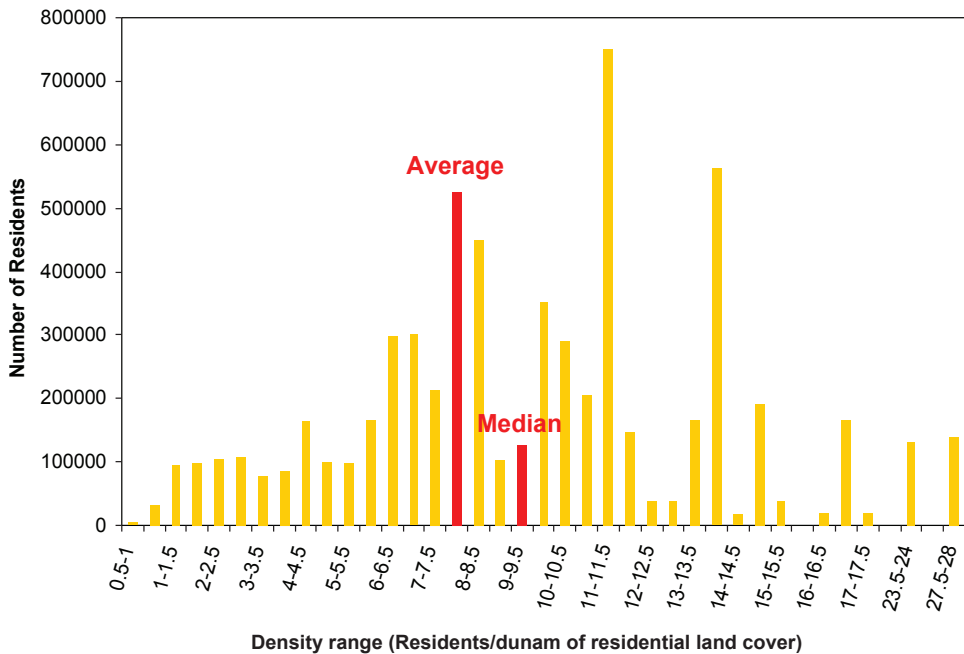
	<b>Residence</b>	<b>Industry and Employment</b>	<b>Quarries</b>	<b>Other Uses</b>	<b>Sub Total not including Roads</b>	<b>Roads</b>	<b>Total</b>
<b>Total National Land Cover (in Dunams)</b>	<b>840,714</b>	<b>192,469</b>	<b>28,109</b>	<b>32,758</b>	<b>1,094,051</b>	<b>130,000</b>	<b>1,224,051</b>
<b>Usage of Land as Percentage of Total Usage</b>	<b>68.7%</b>	<b>15.7%</b>	<b>2.3%</b>	<b>2.7%</b>		<b>10.6%</b>	<b>100%</b>

## Population Density and Polarization of Land Use – 2003

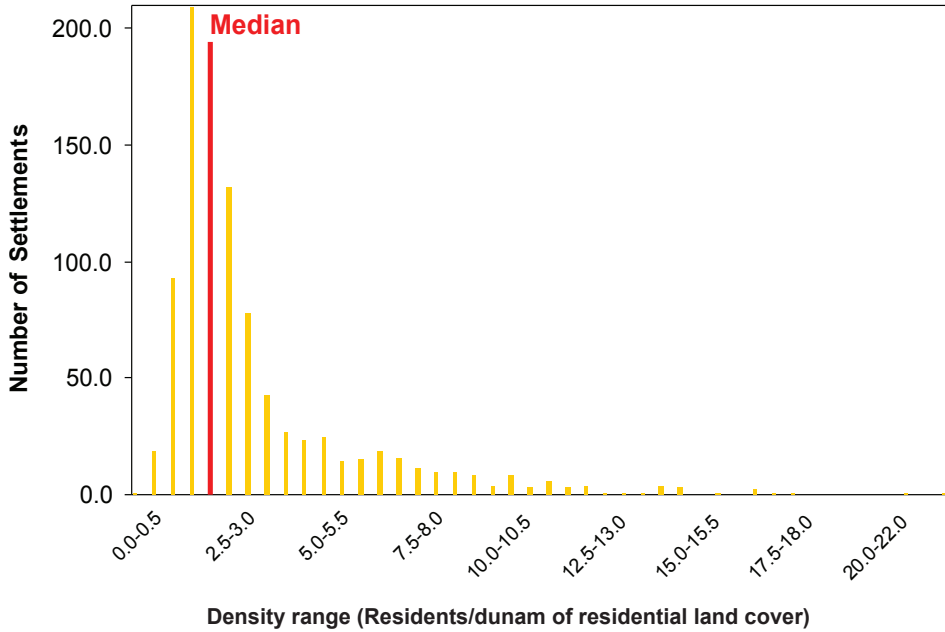
**Table 1.2 – Population, Land Cover for Residence, and National Density**

	Population 2003	Cover for Residence (in (Dunams	Average Density (Residence/ dunam of residential (land cover	Minimum Density	Maximum Density	Median
<b>Total National</b>	<b>6,436,870</b>	<b>840,714</b>	<b>7.7</b>	<b>0.5</b>	<b>28.5</b>	<b>9.5</b>

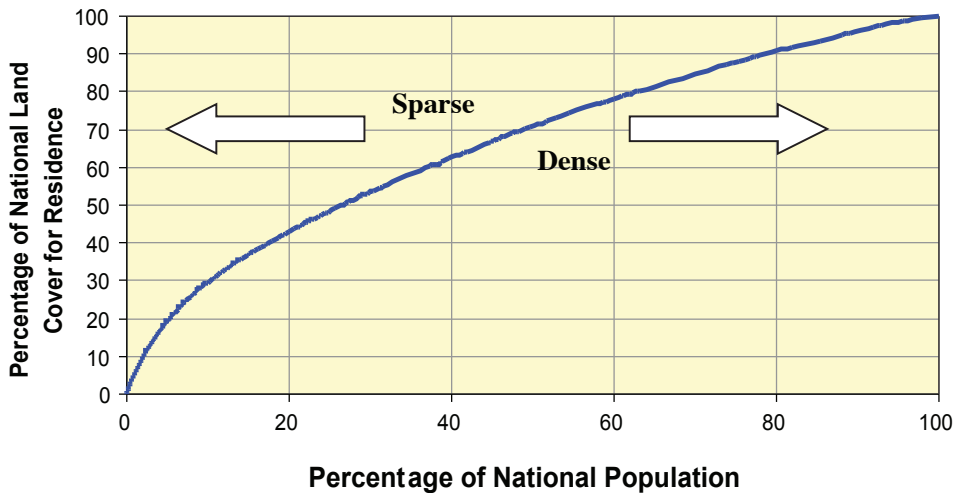
**Graph 1.2 – Population Distribution According to Density (Residents/dunam of residential land cover)**



**Graph 1.3 – Distribution of Settlements According to Density  
(Residents/dunam of residential land cover)**



**Graph 1.4 – Distribution of Settlements According to Density  
(residents/dunam of residential land cover)**



## 1.5.2 The Arab Sector 2003

**Table 1.3 – Population, Land Cover for Residence, and Density According to Sector in National Perspective**

	Population 2003	Population 2003 as Percentage of National Population	Residential Land Cover (in dunams)	Residential Land Cover as Percentage of National Total	Number of Settlements	Number of Settlements as Percentage of National Total	Average Density (Residence per dunam of residential cover)
Arab Settlements	921,084	14%	150,222	18%	104	10%	6.1
Jewish and Mixed Settlements	5,515,786	86%	690,492	82%	888	90%	8.0
<b>Total</b>	<b>6,436,870</b>	<b>100%</b>	<b>840,714</b>	<b>100%</b>	<b>992</b>	<b>100%</b>	<b>7.7</b>

## 1.5.3 Comparison of Data 1998-2003

### National Comparison of Population and Population Density 1998-2003:

**Table 1.4 – Population, Cover for Residence, and Density 1998-2003 in National Perspective**

	Population	Land Cover for Residence (in dunams)	Density Statistics (Residents per dunam of residential cover)			
			Minimum	Maximum	Median	Average
<b>1998</b>	5,794,256	806,633.6	0.5	27.5	2.4	7.2
<b>2003</b>	6,436,870	840,714.1	0.5	28.5	2.5	7.7
<b>Growth Relative to 1998</b>	<b>642,614</b>	<b>34,080.45</b>	<b>0.01</b>	<b>1.0</b>	<b>0.1</b>	<b>0.5</b>
<b>Rate of Growth Relative to 1998 (%)</b>	<b>11.1%</b>	<b>4.2%</b>	<b>2.9%</b>	<b>3.5%</b>	<b>4%</b>	<b>6.6%</b>

## Comparison of Municipal Population and Density 1998-2003:

**Table 1.5 – Population, Land Cover for Residence and Density 1998-2003, Municipal Cross-section**

	Population				Residential Land Cover (in dunams)				Average Municipal Density (Residents/dunam of residential land cover)			
	1998	2003	Population Growth	Rate of Population Growth Compared to 1998	1998	2003	Growth of Land Cover	Rate of Growth in Land Cover Compared to 1998	1998	2003	Growth in Average Density	Rate of Growth in Density Compared to 1998
<b>Cities</b>	4,487,500	4,896,294	<b>408,794</b>	<b>9.1%</b>	447,940	464,522	<b>16,582</b>	<b>3.7%</b>	10.0	10.5	<b>0.5</b>	<b>5.2%</b>
<b>Local Councils</b>	899,499	1,079,192	<b>179,693</b>	<b>20.0%</b>	178,249	189,136	<b>10,886</b>	<b>6.1%</b>	5.0	5.7	<b>0.7</b>	<b>13.1%</b>
<b>Regional Councils</b>	407,257	461,384	<b>54,127</b>	<b>13.3%</b>	180,444	187,056	<b>6,612</b>	<b>3.7%</b>	2.3	2.5	<b>0.2</b>	<b>9.3%</b>
<b>Total</b>	<b>5,794,256</b>	<b>6,436,870</b>	<b>642,614</b>	<b>11.1%</b>	806,634	<b>840,714</b>	<b>34,080</b>	<b>4.2%</b>	7.2	7.7	<b>0.5</b>	<b>6.6%</b>

### 1.5.4 Social and Environmental Measures

**Table 1.6 – Correlation Values Between Settlement Density and Socio-Economic Parameters and Use of Environmental Resources**

	Socio-economic Level	Average Monthly Wage of Salaried Employees	Municipal Water Consumption Per Capita	Waste Per Capita
Correlation With Density - All Settlements	0.042	0.068	0.298	0.130
Correlation With Density – Arab Settlements	0.081	0.043	0.084	0.044
Correlation With Density – Jewish Settlements	0.042	0.068	0.298	0.130

## **Methodological Significance**

This work presents the distribution of land cover and density in the country, divided according to different types of settlement and according to national geographic distribution. The statistical basis may be used as a starting point for future estimations of the needs for building and development.

The data base may also be used for establishing measures with the help of which it will be possible to evaluate the rate of loss of open land and to locate sensitive areas, in which the development rate is swift and dangerous. This kind of tool integrates well with an attempt to create indicators for quantitative measurement and follow-up on environmental changes in the country.

## **The Significance for Planning**

The national map of density shows density distribution and the great differences in levels of density. With the assistance of this map it is possible to locate sparsely settled areas that may be made denser or fuller. Of course, a more thorough evaluation must be made of the particular conditions in the settlement prior to development.

Cross-checking between density maps and sensitivity maps may help locate groups of settlements in areas of low-sensitivity, in order to create a unified and contiguous region of denser settlement.

The polarization in the use of land is the basis for waste, wrong and unequal division of the land and its resources, and for environmental injustice.

Currently, the frameworks for land settlement and land utilization are well-ingrained and unchanging. New frameworks of development are needed in order to alter the course and create more equal divisions of land resources.

Practically speaking, in the present situation, high-density urban settlements are encouraged, while next to them settlements of high quality and high standards of

living are developed (as one can see from the information gathered about urban settlements); the expansion of existing rural settlements and suburbs should be avoided, and the building of new settlements of these sorts should certainly not be initiated. The direction of large populations to rural and suburban settlements will in essence increase polarization, widen gaps, and distance the goals of equality and environmental justice, exacerbating problems that are already extreme and deeply embedded in the social infrastructure and environment in Israel today.

## **10. Implementation**

### **10.1 Methodological Significance**

- ◆ This work provides a spread of density by different divisions of settlement types, by national geographic division. This set of data may serve as a starting point for planning population distribution, according to different programs and in terms of different assumptions and scenarios.
- ◆ The data bases make possible the analysis according to different criteria – beginning from the level of the district, the region, the city, the regional council, the settlements of the Arab sector, and for policy- making up to the level of a whole category of settlements or to a single settlement, urban or rural.
- ◆ The work presents a data base from two known points in time. The continuation of the work to additional points in time will allow for observations of changes in the proportions of built-up areas and in the density of settlements in different, which will make it possible to try to intervene and offset processes of change.
- ◆ The data bases will enable analyses to be made in the future of the rate of loss of open areas (that will vary according to different possible circumstances). It will be possible to identify areas of fast or dangerous development, and to mitigate the loss of land in sensitive areas. This is of great importance for the development of indicators and quantitative measurements for surveying environmental and other changes that affect the quality of life.

## 10.1 The Significance for Planning

- ◆ The national density map shows the national distribution of density and the great differences in the levels of density nationwide. Using this map, one can set policy for responding to the rise or fall of settlement density: one can encourage an increase in density by offering incentives to this end, where higher density may make land use more efficient and entail better use of existing infrastructure; on the other hand, one can discourage the scattering of population by offering disincentives. Of course, thorough evaluation of the specific conditions must be insured for each case.
- ◆ The cross-checking of maps of population density with maps of environmental sensitivity will help in the location of adjacent settlements in relatively insensitive areas, so as to allow the creation of denser, more unified blocs of settlements by joining together existing, smaller ones.
- ◆ The map of national population density may serve as an aid in defining the borders of settlements, especially in dense and limited settlements for which no additional land for expansion is available. This document includes detailed tables of comparison of settlements, including their densities, from which one can estimate their rate of growth, land reserves for development, and, in essence, their potential for development. These national tables can be used as instruments for decision-making in the process of setting borders between settlements, according to their real needs.
- ◆ Demand for quality building (low-density, land-attached) should be directed to peripheral areas, especially to the Negev. In this way, strong populations can be attracted. On the other hand, if land-attached property is offered in the center of the country, land will be wasted and lost; in addition, incentives to move to the Negev will be made ineffective.
- ◆ The polarization in land use, according to which a small portion of the population uses a large portion of the land, is the basis for waste and signifies the unequal division of land resources.
- ◆ Currently, the frameworks for land settlement and utilization are inflexible and unchanging. **New frameworks of development are needed in order to change course and establish a more equal division of land resources.**



Practically speaking, in the present situation, high-density urban settlements are encouraged, while next to them settlements of high quality and high standards of living are developed (as one can see from the information gathered about urban settlements); the expansion of existing rural settlements and suburbs should be avoided, and the building of new settlements of these sorts should certainly not be initiated. The direction of large populations to rural and suburban settlements will in essence increase polarization, widen gaps, and distance the goals of equality and environmental justice, exacerbating problems that are already extreme and deeply embedded in the social infrastructure and environment in Israel today.

This outlook found expression in the recommendations of the National Master Plan ("TAMA 35"), in its preference for and fostering of urban life: "in the competition for strong populations, of employment requiring great human resources and quality services, TAMA 35 emphasizes the need to guarantee that the city has clear priority over suburbs or rural communities (TAMA 35, volume 1: Primary Findings and Policy Recommendations).

## **11. Afterword – Sustainable Development and Built-up Space**

Policy for sustainable development for cities or built-up space in general, is a central chapter in the overall policy for sustainable development on a national level.

For years Israel has been going through a process of loss of land resources, both in quality and in quantity, which threatens the foundations of the environment and the society in almost every field. The open spaces take upon themselves a range of roles for those around them – as natural, ecological systems, as "green lungs", and as a manifestation of the country's historical and social values.

It will not be possible to talk about the preservation of biological diversity if there is not enough open land for the flora and fauna of which it is composed: as the available open space diminishes, the variety of life will as well. There will be no penetration of precipitation and run-off water into the ground water without open land with the appropriate properties to enable this downward flow. Different

species and biological material will not be transferred between areas, without ecological pathways open across the length and width of the country. Society's worries and concerns will grow as the population becomes ever more crowded, and people will find themselves without the green spaces they need for recreation and relaxation; they will find themselves, instead, overwhelmed by clogged transportation routes, caught in centers of air pollution, and with concentrations of waste within their midst. All these are the direct consequences of the loss of land and the overload of development.

But Israel cannot escape from what is necessary – the need to accommodate a large and growing population, a rise in standards of living and quality of housing, and a steady increase in the amount of built-up land.

The role of a sustainable development policy is to direct, regulate, and establish rational guidelines that can provide good and suitable responses to the existing needs, on the basis of principles:

- ◆ To preserve the land and environmental resources for this and coming generations, offering the widest range of choice in their ability to choose a way of life;
- ◆ To see to it that development takes into consideration the long-term costs and consequences, and includes a realistic estimation of what these will be;
- ◆ To avoid making maximum use of the development of spaces, in order to maintain room for opportunities and freedom of choice to the coming generations;
- ◆ To leave as many options open as possible, and to avoid steps that are irreversible. It is important to remember that decisions to build are fundamentally irreversible; built-on land does not go back to being open;
- ◆ To avoid development that entails uncertainties, whose results or implications are unknown;
- ◆ To evaluate planning in a holistic and broad way, and not to make do with assessing parts of plans or details alone.

These principles, expressing the basis for sound, general policies for sustainable development, are especially important for matters of land resources, which must be protected and guarded for the benefit of all the surrounding and related systems, and whose loss will mean an end to all chances for preserving the nature dependent on it.

According to these principles, both built-up land and open land should be seen as part of a single framework, or as two parts of one framework that complement one another. The open spaces cannot be preserved without providing solutions for the constant demands for building and development.

The basic principle of sustainable development is to maintain a distinction between the urban functions that should be concentrated within the city and the functions reserved for the open spaces. Clear lines must be drawn between the types of land use. If building expands and infringes upon the open areas, the center and focus of the cities will be lost, as will be the open spaces.

The fear of smudging what should be a clear line between open and built-up space was well articulated by Lord Rogers:

"Over the last several decades we have witnessed in the world a tendency of the rich to leave the cities for the suburbs and new areas in a search for better and cheaper schools, less traffic and less crime. The free market of the last decades has brought with it a policy of laissez-faire, in the field of planning as well. Loosening control over planning and building has quickened the growth of suburbs. In England building has been going on in rural and open areas, in such a way that city centers have emptied out and dependence on private vehicles has grown. This destructive process of sub-urbanization, working underneath the surface in many areas of the world, is going the way of the American model.

The wasteful and exaggerated use of land has brought about the worst possible result. All over the world we are losing rural areas and their views, and we are building low density urban areas. In such a way the worst forms of urban living imaginable are being developed. On the other hand, areas of high density, high quality of urban life in which buildings are used for a wide

variety of uses – stores, schools, work places, and recreation – these are the attractive places to live."

And the solution he proposes:

"The aspirations for a world-class urban revival demands a number of decisions: the encouragement of higher-density living and a wide variety of uses for buildings; the discouragement of low-density building or the development of residential areas beyond city limits, if it is possible to find spaces for building within the city; building to be done in industrial areas – polluted areas that must be cleaned and cultivated; re-use of urban areas within the city, that can be revitalized and re-built – before the use of rural or agricultural land."<sup>1</sup>

Create quality urban culture: that is the message of the modern national master plan, and only thus will the city be able to attract population. Many people will find themselves drawn into a compact city, internalized and efficient, frequently renewing itself with dynamism and activities of interest, and will find in it a good and quality choice, to be preferred over the suburb and the rural areas. It has been found that the best strategy for preserving green and open spaces is actually to deal with and improve the other part of the equation – the creation of good quality cities.

This work, which deals with databases of the built-up areas and their uses, may assist in the planning strategies for compact, efficient, and internalized cities, and in this way contribute to the sustainable development of both types of areas – the built-up and the open. Balanced and careful development of built-up areas will help in the preservation of the open areas that still remain in Israel.

<sup>1</sup> Lord Rogers of Riverside, *Towards an Urban Renaissance*. London: The Department of the Environment, Transport, and the Regions, 1999.