Applied Research Institute – Jerusalem (ARIJ)

Climatic Zoning for Energy Efficient Buildings in the Palestinian Territories (the West Bank and Gaza)

Technical Report

Submitted To

United Nations Development Programme / Programme of Assistance to the Palestinian People (UNDP / PAPP)

September 30th, 2003

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I. Introduction:

On August 2002, an agreement was made between the Applied Research Institute – Jerusalem (ARIJ) and the United Nations Development Programme / Programme of Assistance to the Palestinian People (UNDP / PAPP) to analyze the climatic characteristics of the Palestinian Territories (PT), the West Bank and Gaza. This agreement was made on the bases of the "Establishing, Implementation and Adoption of Energy Codes for Buildings" project (ECB) which is implemented by the UNDP/PAPP and the Palestinian Ministry of Local Government (MLG).

ARIJ has conducted a research to derive the climatic zones in the PT and defined the Palestinian built-up areas according to those zones in attempt to facilitate the process of determining the different building design responses required in each area. This research aims to develop a climate classification that could support the establishing, implementation and adoption of Energy Codes for Buildings; it was not to develop an ideal climate categorization for all purposes. However, the climatic zones analysis of the PT that was submitted to UNDP / PAPP in August 2002 were reanalyzed and reclassified into new climatic zones based on the ECB second workshop recommendations and the first draft of the Energy Efficient Codes and Guidelines prepared by the Royal Scientific Association in Jordan. Accordingly the rainfall climatic parameter was excluded from this second analysis since it is not considered as a significant parameter to define the climatic zones for building designs purposes. Therefore, the following climatic parameters were considered in this new climatic zoning analysis:

1. Mean annual average of solar radiation,
2. Mean annual average of temperature, and
3. Mean annual average of relative humidity,

This technical report describes the methodology followed to implement the assigned activities of the contract between the UNDP/PAPP and ARIJ for climatic zoning of the PT.

1. Climate of the Palestinian Territories (West Bank and Gaza):

The climate of the Palestinian Territories is influenced by the Mediterranean climate marked by long, hot, dry summer and short, cool, rainy winter. Though relatively small in area, the West Bank enjoys diverse topography, soil structure and climate conditions (ARIJ 1994). The West Bank is relatively arid, with about 50% of the land having a rainfall less than 500 mm/year, including hyper-arid area with a rainfall less than 100 mm/year. However, the remaining land has a rainfall range of 500-800 mm/year. On the other hand, Gaza is located in a transitional zone between the arid desert climate of the Sinai Peninsula and the temperate and semi-humid Mediterranean climate along the coast with a rainfall range of 100-400 mm/year.

In general, climatic variations occur in the different topographical regions of the West Bank. From North to South, the annual amount of rainfall decreases, while the temperatures increase. From West to East, annual rainfall and mean temperatures undergo similar, but less regular changes. Also, there is a gradual decrease in the

annual, monthly, and diurnal averages of relative humidity from North to South and from West to East throughout the whole area. Rainfall is limited to the winter and spring months. Snow and hail, although uncommon, may occur anywhere in the area especially to the West and over the highlands (ARIJ, 1997). Most Palestinians live near the wetter more moderate western slopes in major cities.

2. Climate classification for building energy codes:

Climate has a major impact on the energy use of most commercial and residential buildings. The analysis of climate is the starting point for a design that maximizes comfort and minimizes the energy consumption for heating and cooling. "Early climatic classifications were based on vegetation, which is more apparent than climate. The division between climate and vegetation classifications became more pronounced with the development of climatology and physics as scientific disciplines…Vegetation based classifications are especially useful for identifying arid environments when soil characteristics override climatic conditions such as in glades and coastal beaches, or when extreme climatic variability is not captured by climatic classifications"(http://ialcworld.org/soils/URL:http://ag.arizona.edu/OALS/IALC/soils/classifarid.html).

Climate classifications range from simple annual precipitation classes to those that incorporate precipitation and its variability, length of humid and growing seasons, precipitation-temperature relationships, evaporation, and precipitation-evaporation relationships. In other words, climate can be classified into zones according to a variety of criteria such as rainfall, temperature, humidity and vegetation. The classification procedure of the climatic zones is determined according to the purpose of zoning. For example, climatic zoning is curried out based on rainfall in the water management studies, while temperature and humidity are the main criteria of building design. Generally, climate averages including annual temperature, annual rainfall, annual relative humidity and annual solar radiation of an area reflect its climatic conditions and characteristics. In this study, the classification of Palestinian climatic regions or zones is based on the mean annual averages of solar radiation, temperature and relative humidity of the West Bank and Gaza.

II. Activities programmed and executed:

1. Deriving climatic zones "regions" for the PT (Discriminant analysis classification):

The Palestinian Territories (West Bank and Gaza) have small area (i.e. 6023.4 km^2) with many different climatic zones. There are different ways to describe or classify climates depending on the purpose of classification and utilization. In hot and dry climate such as of the Palestinian Territories, the identification of climatic zones on the bases of rainfall is useful for irrigation planners and water supply managers but not for establishing energy codes for buildings studies. Accordingly, and based on the ECB second workshop recommendations and the first draft of the Energy Efficient Codes and Guidelines prepared by the Royal Scientific Association in Jordan, the rainfall climate parameter was excluded from this new climatic zoning analysis. However, the new analysis has included mean annual averages of solar radiation, temperature and relative humidity in the classification of the climatic zones. A

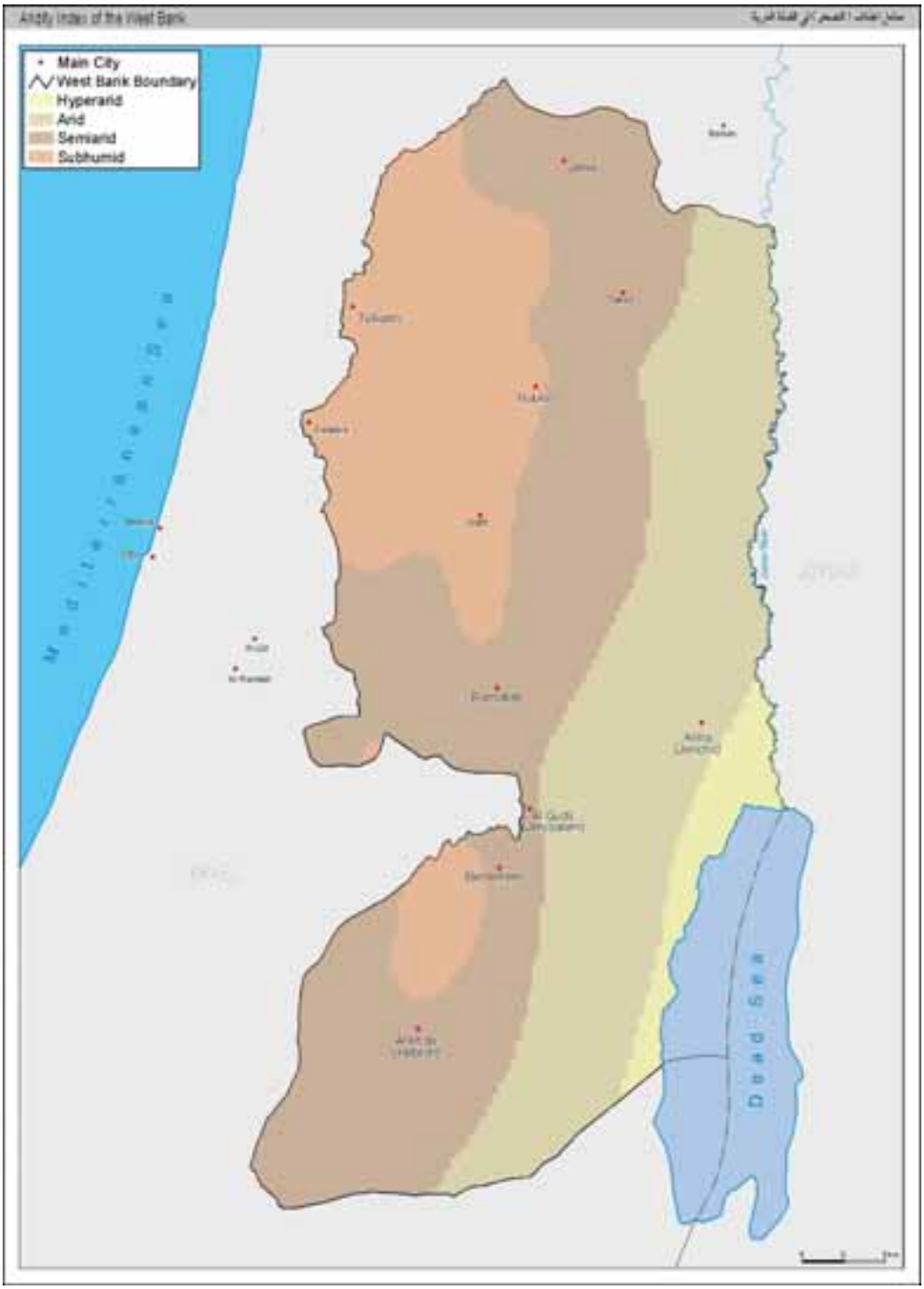
Discriminant analysis was carried out to create the climatic zones of the West Bank and Gaza. This section describes the methodology adopted to classify the climatic zones of the Palestinian Territories.

a) The generation of climate image:

The different climatic parameters including annual averages of incident solar radiation, relative humidity and temperature used in this study were created using Israeli climatic maps covering the period from year 1961 through year 1990 and saved in three GIS layers in raster format (GRID). The first step of the climatic zoning was to generate a comprehensive climate image where the three assigned climate parameters (saved in three GRID layers) were stacked together to produce one image with three layers; each layer describes a different climatic parameter.

b) The collection of data sample groups:

Different sets of sample groups were collected as area of interests (aoi) using the climate stacked image with regard to the aridity index of the region, *(see map 1)*, selecting samples from the four regions described in the aridity index map. Each area of interest selected was converted into ASCI file to be used in Excel. As a result, the transferred ASCI files of the sample groups contained climatic data for mean annual averages of incident solar radiation, relative humidity and temperature.



Map 1: The aridity index map of the West Bank

c) Processing the data sample groups (discriminant analysis):

The SPSS statistical software package was used to generate a principal component factor analysis of the selected and transferred data sample groups (i.e. ASCI data files). This allows the identification of the underlying variables, or factors, that explain the pattern of correlations within the various set of sample groups observed

with the climatic characteristics. The analysis resulted in the recognition of three correlation factors that describe most of the variance observed of the analyzed climate variables (i.e. incident solar radiation, temperature, and relative humidity). Figure 1 plots the relationship between the three components (factors).

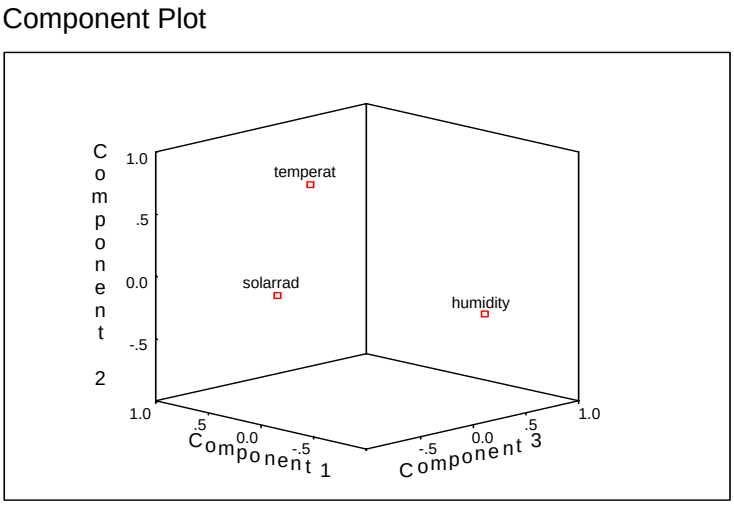


Figure 1: The relationship between the components (factors).

The principal component factor analysis has recognized the high correlation between incident solar radiation, temperature, and relative humidity. Consequently, a discriminant function has been generated for these three predictor variables providing a noticed discrimination between groups. This analysis estimates coefficients for each variable of the linear discriminant function to establish a multiple linear regression equation. That is *function1* = *a* * incident solar radiation + *b* * temperature + *c* * relative humidity, where a, b, and c are coefficients of the climatic variables used in the analysis. The discriminant analysis output included the calculation of these coefficients for the three resulted components, which describe the correlation between the climatic variables. However, each calculated function of the three components generated will have different value depending on these coefficients. Therefore, discriminating between the different climatic zones is dependant on the reliability of the selected variables. Table 1 summarizes the coefficients of each climatic parameter estimated in each function.

Table 1: **Structure Matrix**

	Function		
	1	2	3
TEMPERAT	.443	.855*	-.269
SOLARRAD	.626	-.778*	.061
HUMIDITY	-.590	.039	.807*

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
Variables ordered by absolute size of correlation within function.

*. Largest absolute correlation between each variable and any discriminant function

d) The generation of the climate model and image:

The classification results of the implemented discriminant analysis showed that about 85% of the original grouped cases are correctly classified, *see table 2*. Using ERDAS Imagine, a climatic model was produced, which included two multiple linear regression equations for the first two discriminant functions, *function1 = -0.590 * humidity+ 0.443 * temperature + 0.626 * solar radiation and function2 = 0.039 * humidity+ 0.855 * temperature + -0.778 * solar radiation*. The created model was run using the incident solar radiation, temperature, and relative humidity raster layers (images) to obtain a discriminant function image to be used in climatic zones classification.

Table 2:

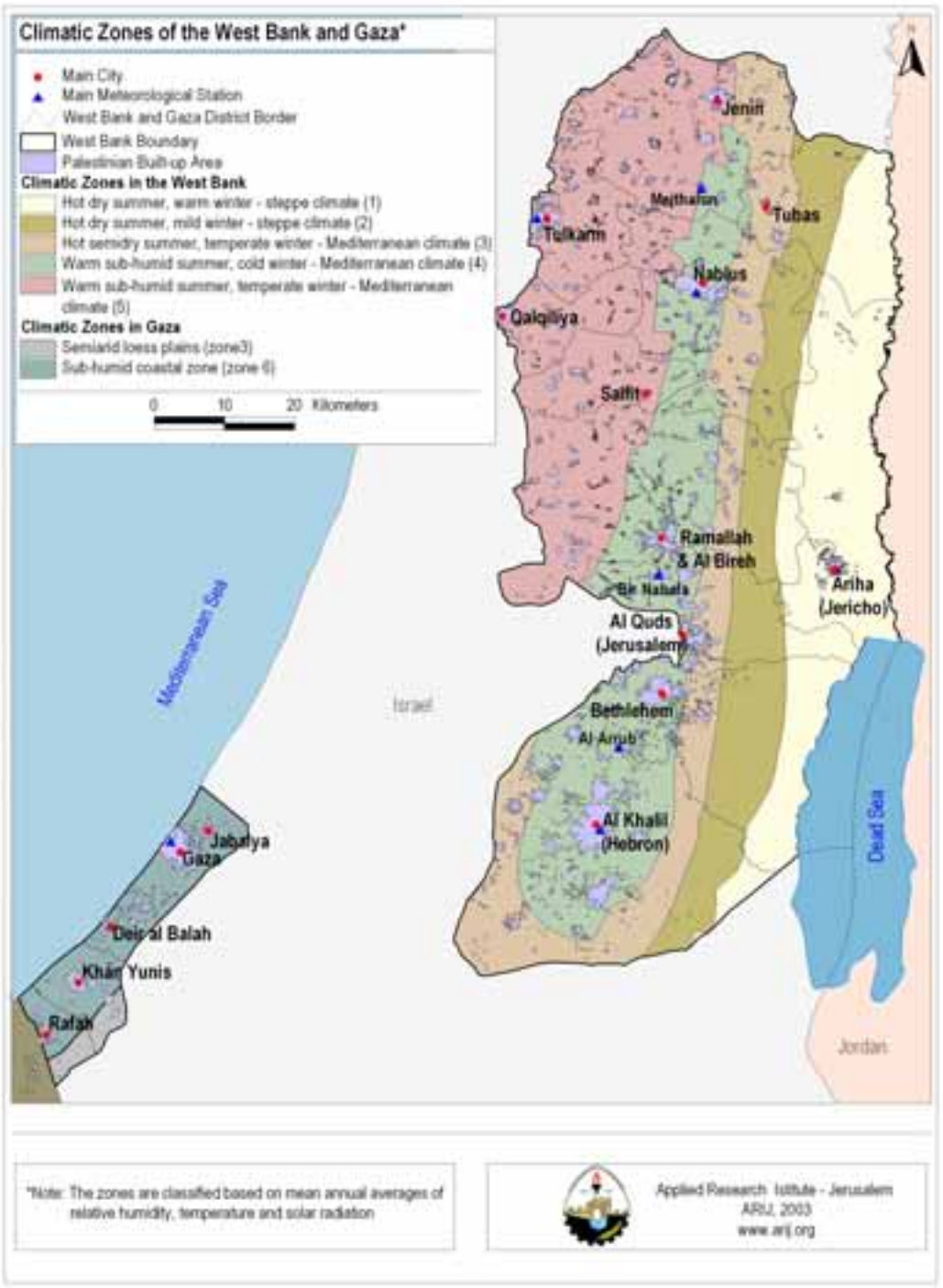
Classification Results[a]

			Predicted Group Membership				
		CODE	1	2	3	4	Total
Original	Count	1	3331	0	0	0	3331
		2	0	5208	0	1082	6290
		3	405	0	4023	351	4779
		4	0	919	163	3849	4931
	%	1	100.0	.0	.0	.0	100.0
		2	.0	82.8	.0	17.2	100.0
		3	8.5	.0	84.2	7.3	100.0
		4	.0	18.6	3.3	78.1	100.0

a. 84.9% of original grouped cases correctly classified.

e) Climatic zones classification (ISODATA -unsupervised- classification):

An Iterative Self-Organizing Data Analysis Technique (ISODATA) algorithm, unsupervised classification, was carried out on the image produced in step d. As a result, five climatic zones were classified for the West Bank and two other zones defined for Gaza, and saved as grid raster layer which was then converted into shapefile GIS files using ArcView 3.2., *see map 2*.



Map 2: The classified climatic zones of the West Bank and Gaza

<u>Climatic zones of the West Bank</u>:

The five climatic zones resulted from the dicriminant analysis classification represent the climatic characteristics of the four distinctive climatic and topographic regions of the West Bank. The first region is the Jordan Valley, which extends along the western bank of the Jordan River from the Israeli border in the north to the northern tip of the

Dead Sea in the south. Its elevation ranges from 200-300 m below sea level, and the climate is semitropical characterized by hot summers and warm winters. Annual rainfall ranges from 200 mm in the northern parts of the valley to 100 mm in the south. The second region is the Eastern Slopes that extends along the eastern side of the West Bank, east of Jenin in the north to eastern hills of the Hebron district in the south. The elevation ranges from 800 m above sea level to approximately 150 m below sea level. The climate is semidry with a very law rainfall varying between 200 and 400 mm.

The Central Highlands is the third and largest climatic and topographic region in the West Bank including the hilly area that extends from Jenin in the north to Hebron in the south. This region is predominantly mountainous with some areas exceeding an elevation of 1000 m above sea level. It has a good average of annual rain fall ranging form 400 mm in the southern foothills to about 700 mm in the mountainous areas. The fourth region is the Semi Coastal region which is an extension of the Palestinian Mediterranean coastal area in Israel. It is limited to the northwestern part of the West Bank and comprises parts of Jenin and Tulkarm districts. Its elevation varies between 100 to 300 m above sea level with relatively high average of annual rainfall of about 600 mm (ARIJ 1994).

Herein, the climatic characteristics of the five climatic zones derived for the West Bank, *see map 2*, using the discriminant analysis function and ISODATA classification are described in the following paragraphs, (refer to annex 1 for the West Bank climatic zones shapefile):

Zone One: Hot dry summer, warm winter – steppe climate

This zone is with an area of 1103.3 km^2 and includes hyper-arid and arid regions. It has annual mean temperatures in January (coldest month) and in August (Hottest month) around 15 ^{0}C and 30 ^{0}C respectively. This zone has a wind speed of about 3.4 km/h around the year where the maximum wind speed is measured during spring to reach approximately 4.3 km/h in average. The zone sunshine is about 12 hr/day in July and 5 hr/day in January. This hot dry zone has a violent and short duration of rainfall showers to have an annual mean rainfall average of about 125 mm. as described above; this zone has the climatic characteristics of the Jordan Valley and Eastern Slopes regions.

Zone Two: Hot dry summer, mild winter – steppe climate

This zone has an area of 823.2 km^2 and lies within the arid region according to the aforementioned aridity index of the West Bank. The measured still over 18 ^{0}C, having approximately 8.5 hours of sunshine per day. It has annual mean temperature is slightly lower than those in the hot dry zone with warm winter, but mean temperatures in January (coldest month) and in August (hottest month) around 13 ^{0}C and 27 ^{0}C respectively. The zone's region has hot, dry summers and mild winters with about 239 mm mean annual rainfall average. The mean wind speed of the region is about 5 km/h with southwest and northwest prevailing wind direction. Zone two illustrates the properties of the Eastern Slopes region climatic properties.

Zone Three: Hot semidry summer, temperate winter – Mediterranean climate

This zone occupies 969.1 km^2 of the total area of the West Bank and positioned in the semi-arid region. The mean annual temperature measured for this zone is 18 ^0C assigning 12 ^0C in January and 26 ^0C in August. Its winter experiences a variation in rainfall from year to year to measure 316 mm as mean annual rainfall average. The wind prevailing has a speed of about 4.7 km/h and is western, northwestern and southwestern directed.

Zone four: Warm sub-humid summer, cold winter – Mediterranean climate

This zone is about 1314.6 km^2 in area with population of 876971 persons, which represents approximately 47 % of the West Bank population. Zone five enjoys temperate mean annual temperature of 16 ^0C, mean annual average of relative humidity of 60 % and 715 mm of maximum mean annual rainfall. According to the aridity index of the West Bank, part of this zone is located in the sub-humid region; also it lies within the West Bank Central Highlands climatic and topographic region sharing the same climatic properties.

Zone Five: Warm sub-humid summer, temperate winter – Mediterranean climate

This zone occupies 1461.2 km^2 of the West Bank total area and lies in the sub-humid region according to the aridity index, refer to map 1. The annual mean temperature reaches 18 ^0C with a mean annual temperature of 12 ^0C in January and 25 ^0C in August. The zone's region is characterized by rainy and cool winter with mean annual rainfall of 534 mm and mean annual average of relative humidity of 62 %.

Climatic Zones of Gaza:

Along the Mediterranean coast the winters are short, mild and rainy and the summers long, hot and dry. Gaza (365 km^2) is a coastal area along the eastern Mediterranean Sea, 40 km long and between 6 to 12 km wide. The area forms a transitional zone between the sub-humid coastal zone of Israel in the north, the semiarid loess plains of the northern Negev Desert in the east and the arid Sinai Desert of Egypt in the south. According to the Koppen system for climatic zoning, Gaza has a Mediterranean dry summer subtropical climate with mild winters. This climate is classified as Csa indicating that the warmest month has a mean temperature above 22 ^0C.

The average daily mean temperature ranges from 25 ^0C in summer to 13 ^0C in winter. Daily relative humidity fluctuates between 65 % in the daytime and 85 % at night in the summer, and between 60 % and 80 % respectively in winter. The prevailing winds during the summer come from the northwest with a pronounced daily fluctuation of the wind speed indicating daily average maximum wind velocity of 3.9 m/s in the afternoon. At night, the wind speed declines to reach the half of this figure. In contrast, during winter the most frequent direction is southwest and the average wind velocity is about 4.2 m/s with no distinct daily fluctuation. Nevertheless, storms have been observed in winter with a maximal hourly wind speed of up to 18 m/s mainly from the southwest.

In Gaza the amount of rainfall decreases from 450 mm in the north to 200 mm per year at Rafah in the south. Due to orographic effects (i.e. influence of rising altitudes) the yearly rainfall amount increases land inward. There is a distinct yearly fluctuation in the mean monthly values of solar radiation during wintertime as they reach one third of the summer months' values. The total incoming radiation is relatively high, which is a great advantage for agriculture and greenhouse cultivation (PEPA, 1994).

The discussion above describes the major climatic characteristics and highlights the different climatic zones in Gaza that are influenced by other surrounding zones. For example, the climatic zone (zone 6) which extends along the coast including most of the northern, middle and southern parts of Gaza has climate properties of the sub-humid coastal zone of Israel with mean annual rainfall of 459 mm and mean annual temperature average of 18 ^{0}C. This zone has a population of 971330 persons that is about 97.2 % of the total population of Gaza. The second climatic zone in Gaza (zone 3) can be categorized under the semiarid loess plains of the northern Negev Desert in the east with 316 mm mean annual rainfall and population of 28467 persons comprising 2.8 % of the total population in Gaza, (refer to annex 1 for the Gaza climatic zones shapefile).

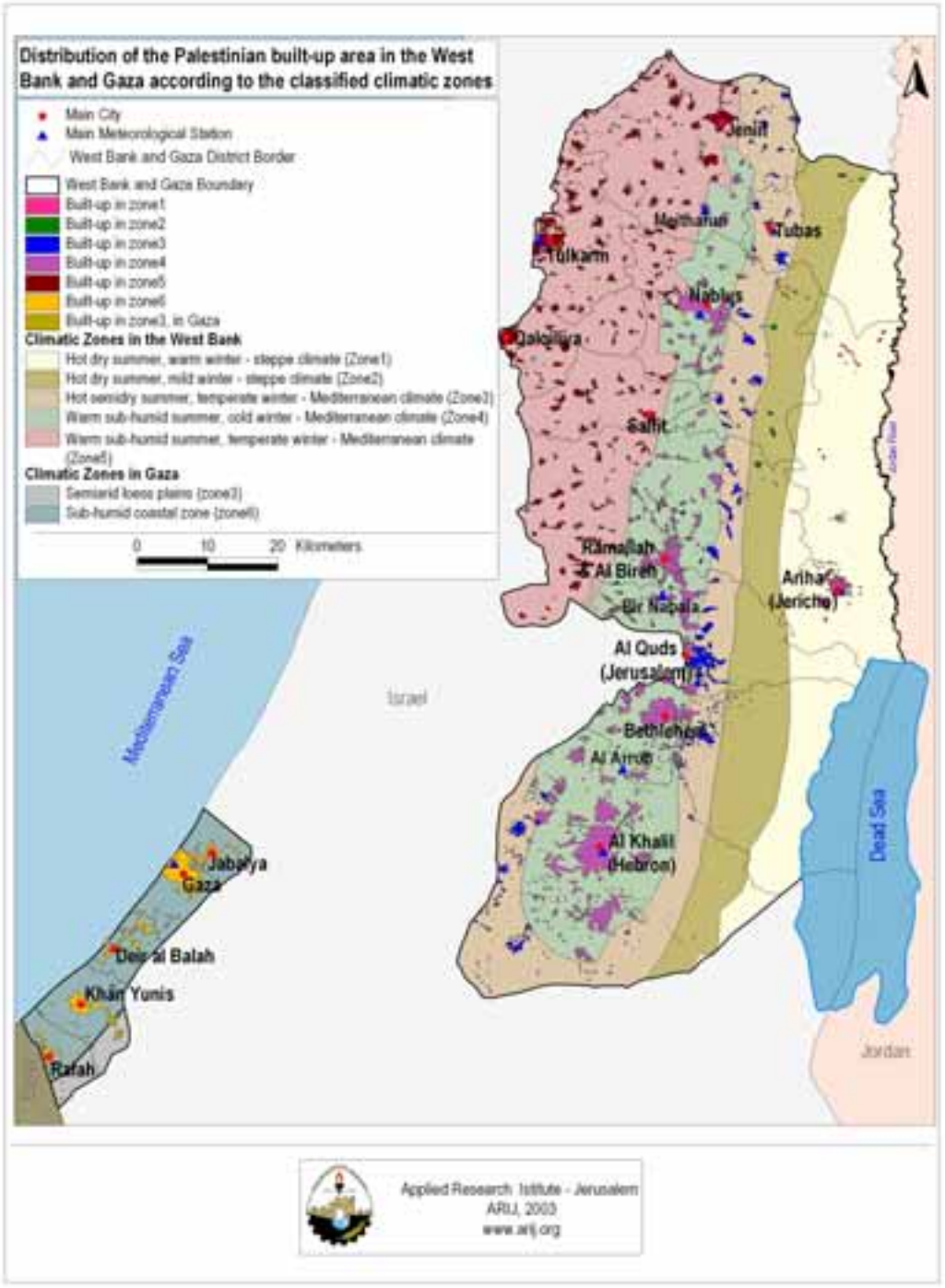
2. Identifying and analyzing the Palestinian Meteorological data:

The very next step was to complete the attribute table of the climatic zones GIS layers with related climate data of each zone including the minimum, maximum and averages of mean annual temperature, temperature of coldest and hottest months, rainfall, relative humidity, incident solar radiation and cloudiness. Additionally, the attribute file included data about the population in year 1997 (PCBS census 1997) for each climatic zone as well as their density according to the classified zones. Accordingly, this climatic information was transferred into data sheets to explain averages of the zones' minimum, maximum and mean values of the climate variables, *see annex 1*. Other monthly climatic information including mean, minimum and maximum temperature, relative humidity and wind speed data for the main meteorological stations in the PT is listed in annex 2. In addition, climate maps for averages of temperature, temperature of coldest and hottest months, rainfall, cloudiness, humidity, solar radiation and meteorological stations, which illustrate the climatic characteristics of the Palestinian Territories are generated, *see annex 3*. However, climatic maps for minimum and maximum values were not produced, as the climatic data available is for a certain number of the weather stations that are not evenly distributed in the PT in order to be interpolated into grid data.

3. Identifying Palestinian built-up areas according to the climatic zoning:

It is important to identify the Palestinian built-up areas in the West Bank and Gaza according to their classified climatic zones. A built-up area shapefile was created in ArcView to present the spatial distribution of the Palestinian urban localities in each identified climate zone. The Palestinian built-up areas division has shown that about 82 % of Palestinian population in the West Bank resides in the most moderate climate (i.e. zones four and five). On the other hand, about 4% of the population lives within zones one and two where hotter and dry climate conditions prevail besides the political constraints imposed that prevents the expansion of Palestinian urban areas

especially along the Jordan Rift Valley region which is fully controlled by Israel. While 14 % of the Palestinian total population lives in zone three experiencing hot and semidry summer and temperate winter. Map 3 shows the distribution of the Palestinian built-up areas according to climatic zones. Information about Palestinian built-up distribution according to climatic zones and locality name are provided by annex 4.



Map 3: Distribution of built-up areas according to climatic zones in the PT

4. Deriving sun path in PT for each climatic zone "region":

Finally, the path of the sun of main meteorological stations in each classified zone of the PT was calculated and presented by sun path diagrams using SunTool_V110 software. The sun path included the calculation of the altitude and azimuth angles of the sun. Information such as the station position (i.e. longitude and latitude) and station altitude were provided to the computer model in the 21st of March, June and December at 12:00 noon. Such information supports the decision-making in the energy coding and building design. Annex 5 lists the main climatic stations in the PT with their geographical positions and altitude. This information enables the calculation of the sun path in various locations and time. Furthermore, the sun position is presented in stereographic and orthographic diagrams accompanied by tabulated data. Excel data sheets are included to illustrate sunangles calculated for meteorological station in main Palestinian built-up areas within each zone in the Palestinian Territories. Also, to enable better visualizing of the output data and better presentation of sun diagrams, the SunTool setup file is contained in this report for feasibility in decision-making process and better data interpretation, *see annex 5*.

III. Conclusion:

This technical report has presented the methodology adopted to derive the climatic zones of the Palestinian Territories for "Establishing, Implementation and Adoption of Energy Codes for Buildings" project (ECB) as well as analyzing the output results of the climatic zoning classification. Discriminant analysis function was applied to the PT climatic characteristics to derive five and two climatic zones in the West Bank and Gaza respectively using mean annual averages of incident solar radiation, temperature, and relative humidity climate parameters. In addition, the report has included the analysis of categorizing the Palestinian built-up areas according to the classified climatic zones in the PT. Moreover, the position of the sun, sun path, has been calculated for the main built-up areas in each zone.

V. References:

1. Applied Research Institute – Jerusalem (ARIJ) (1994). Dryland Farming in Palestine. Bethlehem: Palestine.

2. Briggs, R. S., Lucas, R. G. and Taylor, Z. T., Climate Classification for Building Energy Codes and Standards: *Technical Paper Final Review Draft*, Pacific NW National laboratory, http://www.energycodes.gov/implement/pdfs/climate_paper_review_draft_rev.pdf.

3. Palestinian Central Bureau of Statistics (PCBS) (1999). Meteorological Conditions in the Palestinian Territory – Annual Report 1998. Ramallah: Palestine

4. Palestinian Environmental Protection Authority (PEPA) (1994). Gaza Environmental Profile: Part One (Inventory of Resources). Study funded by the Government of the Netherlands. Gaza: Palestine.

5. http://ialcworld.org/soils/URL:http://ag.arizona.edu/OALS/IALC/soils/classifarid.html.

Annexes

Annex 1:

Refer to …\climate\excel_files\ cz-hts-wb-gaza-n
The file explains the zones' minimum, maximum and mean annual averages of climatic parameters in the West Bank and Gaza.

Refer to …\climate\shapefiles\wb_zones\wb_hts_zones.shp, to …\climate\shapefiles\ gaza_zones\gaza_hts_zones.shp and to …\climate\shapefiles\stations\main-meteorological-stations.shp and rainstations.shp
Those are the shapefiles of the West Bank and Gaza classified climatic zones and the shapefiles of the main meteorological stations and rainfall gauges in the West Bank and Gaza.

Annex 2:

Refer to …\climate\excel_files\ monthly meteorological data
It provides an updated monthly meteorological data including averages of mean, minimum and maximum temperature, relative humidity and wind speed data for the main meteorological stations in the PT for several years.

Annex 3:

Refer to …\climate\climatemaps\jpg
Refer to …\climate\climatemaps\gif
The folders contain climate maps of rainfall, cloudiness, temperature, coldest and hottest months, solar radiation, relative humidity and meteorological stations in addition to the climatic zone map and the distribution of built-up areas within zones map.

Annex 4:

Refer to …\climate\excel_files\ pop_bu97_wb
…\climate\excel_files\ pop_bu97_gaza
This provides information about Palestinian built-up area distribution according to the classified climatic zones and locality name.

Annex 5:

Refer to …\climate\excel_files\ Main_meteorological_stations
This lists the main weather stations in the PT with their geographical positions and altitude.
Refer to …\climate\excel_files\maincity_sunangles
This file includes calculated sunangles for meteorological station in main Palestinian built-up areas within each zone in the Palestinian Territories.

Refer to …\climate\SunPath\stereographic
Refer to …\climate\SunPath\orthographic
Refer to …\climate\SunPath\tabulated
These folders include sun path diagrams for locations of main built-up areas in each climatic zone.
Refer to …\climate\SunPath\SunTool_v110\ Setup.exe
This is a setup file of a software model, 'SunTool' to calculate sun path for certain locations and specified times.

ID	GRIDCODE	ZONE	COUNT	MINMEANTEM	MAXMEANTEM	AVEMEANTEM	MINMEANSR	MAXMEANSR	AVEMEANSR
30	5	Zone5	289809	15	20	18	180	185	182
37	2	Zone2	162746	18	21	19	188	195	190
31	4	Zone4	163071	15	19	16	183	189	186
33	3	Zone3	316791	16	21	18	184	195	189
1	1	Zone1	209297	19	24	22	189	202	194

ID	GRIDCODE	ZONE	COUNT	MINMEANRH	MAXMEANRH	AVEMEANRH	MINMEANRF	MAXMEANRF	AVEMEANRF
30	5	Zone5	289809	59	64	62	392	710	534
37	2	Zone2	162746	52	58	55	102	424	239
31	4	Zone4	163071	58	64	60	315	715	510
33	3	Zone3	316791	56	64	59	150	527	316
1	1	Zone1	209297	44	53	49	15	327	125

ID	GRIDCODE	ZONE	COUNT	MINMEANCL	MAXMEANCL	AVEMEANCL	MINMEANCMT	MAXMEANCMT	AVEMEANCMT
30	5	Zone5	289809	33	40	37	9	14	12
37	2	Zone2	162746	25	37	29	11	15	13
31	4	Zone4	163071	29	40	35	8	14	10
33	3	Zone3	316791	27	40	32	10	14	12
1	1	Zone1	209297	21	31	27	11	18	15

ID	GRIDCODE	ZONE	COUNT	MINMEANHMT	MAXMEANHMT	AVEMEANHMT	PERIMETER_	AREAACRES	AREA_HA
30	5	Zone5	289809	23	28	25	237148	361073	146121
37	2	Zone2	162746	25	30	27	263889	203422	82322
31	4	Zone4	163071	21	26	24	305261	324848	131462
33	3	Zone3	316791	23	29	26	379859	239464	96908
1	1	Zone1	209297	26	33	30	307410	272637	110333

ID	GRIDCODE	ZONE	COUNT	AREA_METER	Population97*	Pop-Density/km^2			
30	5	Zone5	289809	1461214843	661385	453			
37	2	Zone2	162746	823223266	25879	31			
31	4	Zone4	163071	1314618052	876971	667			
33	3	Zone3	316791	969080094	271242	280			
1	1	Zone1	209297	1103325422	45940	42			

*Note: population of the West Bank includes estimated data for Jerusalem district. However, population for Jerusalem city in the district is not available.(population data source is the PCBS census 1997)

Climatic zones of the West Bank are classified based on annual mean Incident Solar Radiation,
Temperature and Relative Humidity
Climatic parameters are summarized according to each zone by minimum, maximum and average values.

TEM: temperature (^{o}C)

SR: solar radiation (kg_cal/cm^{2} per year)

RH: relative humidity (%)

RF: rainfall (mm)

CL: cloudiness (No. of days per year %)

CMT: coldest month temperature (^{o}C)

HMT: hottest month temperature (^{o}C)

ID	GRIDCODE	ZONE	COUNT	AREA_METER	MINMEANTEM	MAXMEANTEM	AVEMEANTEM	MINMEANSR	MAXMEANSR
33	3	Zone3	316791	51064176	16	21	18	184	195
28	6	Zone6	156157	325692914	18	19	18	181	195

ID	GRIDCODE	ZONE	COUNT	AVEMEANSR	MINMEANRH	MAXMEANRH	AVEMEANRH	MINMEANRF	MAXMEANRF
33	3	Zone3	316791	189	56	64	59	150	527
28	6	Zone6	156157	184	64	70	68	190	633

ID	GRIDCODE	ZONE	COUNT	AVEMEANRF	MINMEANCL	MAXMEANCL	AVEMEANCL	MINMEANCMT	MAXMEANCMT
33	3	Zone3	316791	316	27	40	32	10	14
28	6	Zone6	156157	459	34	40	37	13	14

ID	GRIDCODE	ZONE	COUNT	AVEMEANCMT	MINMEANHMT	MAXMEANHMT	AVEMEANHMT	PERIMETER_	
33	3	Zone3	316791	12	23	29	26	38225	
28	6	Zone6	156157	13	25	27	26	104243	

ID	GRIDCODE	ZONE	COUNT	ACRES	HECTARES	AREA_METER	Population97	Pop-Density/km^2	
33	3	Zone3	316791	12618	5106	51064176	28467	557	
28	6	Zone6	156157	80583	32611	326109128	971330	2979	

Climatic zones of Gaza are classified based on annual mean Incident Solar Radiation, Temperature and Relative Humidity

Climatic parameters are summarized according to each zone by minimum, maximum and average values.

TEM: temperature (^{o}C)

SR: solar radiation (kg_cal/cm^2 per year)

RH: relative humidity (%)

RF: rainfall (mm)

CL: cloudiness (No. of days per year %)

CMT: coldest month temperature (^{o}C)

HMT: hottest month temperature (^{o}C)