THE USAGE OF STOCHASTIC AND MULTICRITERIA DECISION-AID METHODS EVALUATING GEOTHERMAL ENERGY EXPLOITATION PROJECTS

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ABSTRACT

This study is based on three main questions about the utilization of geothermal energy. The first question is how much heat energy the geothermal resource contains? The second one is what the utilization alternatives are for this resource? And the last question is according to which criteria the scenarios formed by integration of the selected utilization alternatives in specified proportions could be assessed, and what the alternative schema obtained could be like?

The method of forming a model by simulations, which is developed as an approach to the solutions of the problems that contain uncertain parameters, like what the heating capacities of the reservoirs are, is used in this study. A model is formed with parameters of the heating capacity of Balçova Geothermal Field by employing Monte Carlo Simulation Technique. Here the aim is to find the amount of the heating energy that could be exploited by sustainable way from the resource. Efforts are given to form the amount of this energy by the help of cumulative probability distribution of the model.

It is emphasized what the estimated heating reserve and the alternatives that could be locally utilized. Here, parameters such as the enthalpy of the geothermal resource, content of the fluid, volume of the geothermal field, pattern of the settlement in the field, ability of the soil, topography and structure of the labor etc. should be considered in the light of reconnaissance and exploration studies done in the geothermal field. From the assessment done for Balçova, it is concluded that geothermal resource could be utilized for heating of the dwellings, greenhouse agriculture, thermal tourism and dehydration of fruit and vegetable.

Having determined the utilization schema of the geothermal resource, the issue of the assessment of the scenarios, which will be formed from these alternatives, comes up. Here begins the decision making process with a political aspect. By determining the criteria that will be considered while selecting the scenarios, and by determining the relative weights of this criteria, an order which shows the desired situation between the scenarios could be obtained. In this study, the scenarios formed in Balçova are assessed by the help of PROMETHEE method –one of the Multicriteria Decision Aid technique. As a result, it is seen that in Balçova tourism related scenarios stand out because of their superiority in employment created and Tons of Petroleum Equivalent energy values.

ÖZ

Jeotermal enerjinin kullanımı ile ilgili üç ana sorudan hareket edilerek bu çalışma hazırlanmıştır. Birincisi, sahip olunan jeotermal kaynağı ısıl potansiyeli ne kadardır? İkincisi, bu kaynak ne tür kullanımlar için değerlendirilebilir? Üçüncüsü ise, seçilen bir kullanım veya kullanımların belirli oranlarda birleştirilmesi ile oluşturulan senaryolar hangi kriterlere göre değerlendirilebilir ve nasıl bir kullanım şeması elde edilebilir?

Jeotermal enerji rezervuarlarının ısıl kapasitesinin büyüklüğünün ne kadar olduğu gibi çeşitli belirsiz parametreleri içinde barındıran problemlerin çözümüne bir yaklaşım olarak geliştirilen, simülasyonlar ile model oluşturma yöntemi bu çalışmada da kullanılmıştır. Monte Carlo Simülasyon tekniği kullanılarak Balçova sahasının ısıl kapasitesine ait parametrelerle bir model oluşturulmuştur. Buradaki amaç kaynaktan sürdürülebilir şekilde kullanılabilecek ısı enerjisi miktarını bulmaya çalışmaktır. Bu enerji miktarı modelin kümülatif olasılık dağılımı verileri yardımıyla oluşturulmaya çalışılmıştır.

Tahminlenen ısı rezervi ile yerel olarak değerlendirilebilecek kullanımların neler olabileceği üzerinde durulmuştur. Burada jeotermal sahada yapılan keşif ve arama çalışmalarının sonuçları ışığında jeotermal kaynağın entalpisi, akışkanın içeriği, alanın hacmi, topografyası, alandaki yerleşmelerin niteliği, toprak kabiliyeti, işgücü yapısı gibi parametrelerin göz önünde bulundurulması gerekmektedir. Balçova için yapılan değerlendirmeden, jeotermal kaynağın konut ısıtılmasında, sera tarımında, termal turizmde ve sebze-meyve kurutulmasında kullanılabileceği sonuçları elde edilmiştir.

Jeotermal enerjinin hangi kullanımlarda değerlendirilebileceği belirlendikten sonra, bunlardan oluşturulacak senaryoların değerlendirilmesi konusu gündeme gelmektedir. Burada politik yanı ağır basan karar verme süreci başlamaktadır. Senaryoları seçerken dikkate alınacak kriterlerin ve bu kriterlerin göreli ağırlıklarının belirlenmesi ile senaryolar arasında istenilen durumu yansıtan bir sıralama elde edilebilir. Bu çalışmada Çoklu Kriterlere Göre Karar Verme Tekniklerinden birisi olan PROMETHEE metodu yardımı ile Balçova özelinde oluşturulan senaryolar değerlendirilmiştir. Sonuç olarak Balçova'da turizm ağırlıklı senaryoların, yarattıkları işgücü ve petrol eşdeğeri enerji kullanımı kriterlerindeki üstünlüğü sebebi ile ön plana çıktıkları görülmüştür.

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CHAPTER 1

INTRODUCTION

1.1 Problem Definition and the Methodology of the Study

When the issue of utilization of geothermal energy resources is examined from economic, environmental and social point of views, one could see that, if this available energy could be used in sustainable way, hypothetically, designated part of energy demand could be met without import dependent resources for many years, and this could have social and environmental effects that could increase the prosperity of the public.

It could be said that, it is impossible to evaluate the energy capacity of the geothermal energy resources with deterministic ways, as there are many parameters that present uncertainty. In case of situations in which these kind of uncertain parameters affect the overall results, the modeling of reservoir could be done by various computer softwares. By the help of these models, estimations about utilization alternatives that will provide the use of the reservoir sustainability –directly related to the probability distribution of the parameters used in the simulation- could be done. Thus, the heat load that the alternatives about the exploitation of the geothermal energy resource will bring to the system could be found and a system suitable for this could be constructed.

According to which criteria that the formed scenarios will be assessed could be qualified as an issue with the political background. Efforts is given to form methodologies in order to clarify and democratize the assessments, that could be tangible or intangible according to the criteria, of the decisions that decision makers are responsible for. By the help of this kind of methodologies, it could be discussed how much the decisions made satisfy the criteria. Additionally, it could be determined what the most suitable scenario(s) would be according to the assessment criteria of the proposed alternatives.

In this study, effort will be given to model heat energy of Balçova geothermal field reservoir with Monte Carlo simulation technique and to estimate sustainable energy capacity of it. While doing this, the result of the studies on Balçova done before will be compared with the result of the model studied in this study.

After this, it will be evaluated what the alternatives about the exploitation of this energy capacity could be, and outputs of these alternatives under the criteria Return on

Investment (ROI), employment created and Tons of Oil Equivalent (TOE) energy will be assessed. Here the aim is to measure efficiency of the scenarios according to economic, social and environmental standpoints that the decision makers would consider. The heating energy that the mentioned alternatives could demand at peak load will be determined. Additionally, it will be discussed what kind of heating system will be necessary and what it would cost.

In the study, scenarios will be formed from utilization alternatives, effort will be given to obtain the complete outrank of the scenarios in the context of the weights that the decision makers will assign to the criteria with the PROMETHEE method, one of the Multicriteria Decision Aid Techniques. Evaluation on the obtained results will be done and the effects of the assumptions on the results will be emphasized.

1.2 Content of the Study

In the first chapter, problem definition and the methodology of the study will be introduced.

In the second chapter, geothermal energy and its application fields will be introduced. Here the purpose is to inform the reader about the issue of geothermal energy. After introducing geothermal energy including technical details, the exploitation schema will be shortly mentioned.

Following this, in the third chapter, the geographical, geological and settlement structure of Balçova geothermal field will be explained. The historical evolution of Balçova geothermal district heating system –as academically most studied geothermal heating project in Turkey- will be introduced.

In the fourth chapter, the Monte Carlo Simulation Technique will be introduced. The exploration studies of petroleum and geothermal field reserve done by using Monte Carlo simulation technique will be summarized. The simulation in the study done by ITU Petroleum and Natural Gas Department, in 2002, will be introduced and evaluated. After this, the simulation done by similar data will be introduced and information about the reserve will be given.

In the fifth chapter, Multicriteria Decision Aid and its methods will be introduced. The advantage of PROMETHEE method over the other methods will be listed, and the use of the method will be explained in detail. The possible exploitation schema of Balçova Geothermal Field reserve will be determined and the economic, environmental and social benefit analysis will be done (corresponding benefits are ROI, TOE and employment created). Scenarios will be formed by proportioning the utilization alternatives of Balçova Geothermal Field reserve according to various percentages based on the peak load of the heating system. For each scenario, ROI, TOE and employment created will be calculated. Here, three drying facilities will be attached to each scenario, and effort will be given to determine how the utilization of the system in low season will affect the output of the scenarios. Following this, the scenario that will satisfy the hypothetical decision maker most –according to the weights he will assigned to the criteria- will be determined and evaluated.

In the sixth chapter, the assessments concerning the model proposed, which is about how to exploit the Balçova Geothermal Field reserve according to the scenarios, will be gathered and presented together. The strong and the weak aspects of the model proposed will be emphasized.

CHAPTER 2

GEOTHERMAL ENERGY AND APLLICATION FIELDS

2.1 Introducing Geothermal Energy

Geothermal energy, basically, is the thermal energy within the earth's interior and recognized as an important and viable source of renewable energy. It has been used for many centuries for different purposes such as space and water heating, cooking, and medicinal bathing.

The *geothermal gradient* expresses the increase in temperature with depth in the Earth's crust. Down to the depths accessible by drilling with modern technology, i.e. over 10,000 m, the average geothermal gradient is about 2.5-3 °C/100 m. For example, if the temperature within the first few meters below ground-level, which on average corresponds to the mean annual temperature of the external air, is 15 °C, then we can reasonably assume that the temperature will be about 65°-75 °C at 2000 m depth, 90°-105 °C at 3000 m and so on for a further few thousand meters. There are, however, vast areas in which the geothermal gradient is far from the average value. In areas in which the deep rock basement has undergone rapid sinking, and the basin is filled with geologically 'very young' sediments, the geothermal gradient may be lower than 1 °C/100 m. On the other hand, in some 'geothermal areas' the gradient is more than ten times the average value (WEB_1 2005).

The difference in temperature between deep hotter zones and shallow colder zones generates a conductive flow of heat from the former towards the latter, with a tendency to create uniform conditions, although, as often happens with natural phenomena, this situation is never actually attained. The mean *terrestrial heat flow* of continents and oceans is 65 and 101 mWm^{-2}, respectively, which, when really weighted, yield a global mean of 87 mWm^{-2} (Pollack et al. 1993).

The temperature increase with depth, as well as volcanoes, geysers, hot springs, etc., are in a sense the visible or tangible expression of the heat in the interior of the Earth, but this heat also engenders other phenomena that are less discernible by man, but of such magnitude that the Earth has been compared to an immense 'thermal engine'. It will be tried to describe these phenomena, referred to collectively as the *plate tectonics* theory, in simple terms, and their relationship with geothermal resources (WEB_1 2005).

The outermost shell of the Earth, known as the *lithosphere*, is made up of the crust and the upper layer of the mantle. Ranging in thickness from less than 80 km in oceanic zones to over 200 km in continental areas, the lithosphere behaves as a rigid body. Below the lithosphere is the zone known as the *asthenosphere*, 200-300 km in thickness, and of a 'less rigid' or 'more plastic' behaviour. In other words, on a geological scale in which time is measured in millions of years, this part of the Earth behaves in much the same way as a fluid in certain processes (WEB_1 2005).

Because of the difference in temperature between the different parts of the asthenosphere, convective movements and, possibly, convective cells were formed some tens of millions of years ago. Their extremely slow movement (a few centimetres per year) is maintained by the heat produced continually by the decay of the radioactive elements and the heat coming from the deepest parts of the Earth. Immense volumes of deep hotter rocks, less dense and lighter than the surrounding material, rise with these movements towards the surface, while the colder, denser and heavier rocks near the surface tend to sink, re-heat and rise to the surface once again; very similar to what happens to water boiling in a pot or kettle (WEB_1 2005).

Geothermal systems can therefore be found in regions with a normal or slightly above normal geothermal gradient, and especially in regions around plate margins where the geothermal gradients may be significantly higher than the average value. In the first case the systems will be characterized by low temperatures, usually no higher than 100 °C at economic depths; in the second case the temperatures could cover a wide range from low to very high, and even above 400 °C (WEB_1 2005).

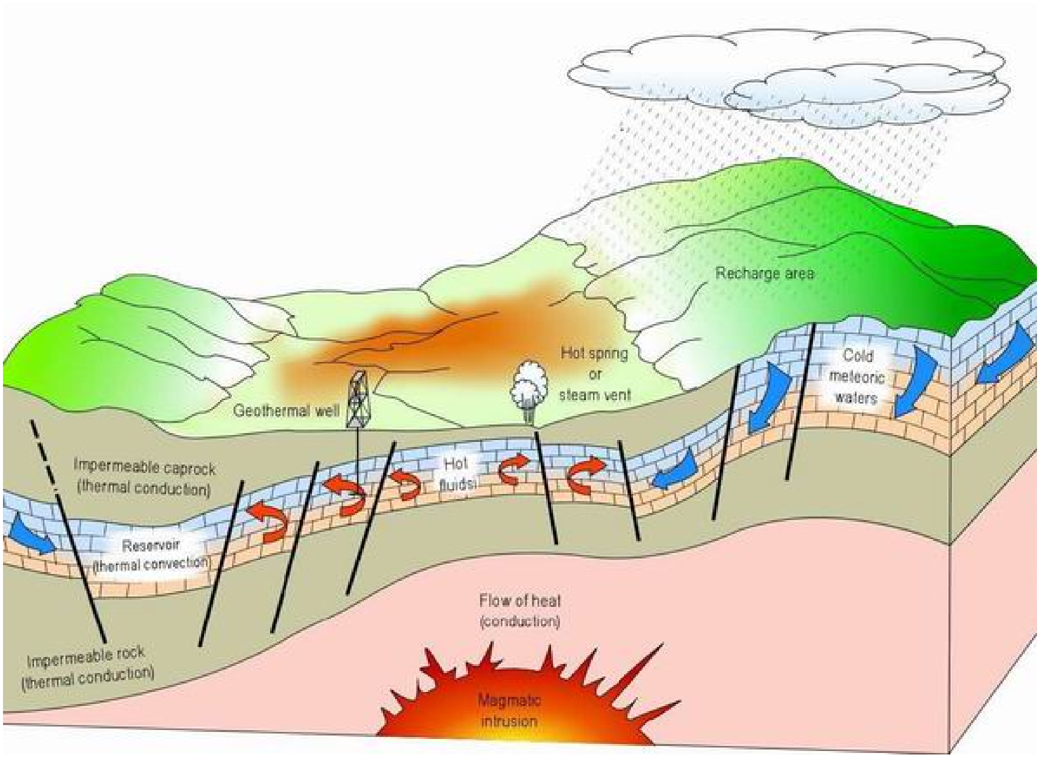
To sum up, the terms that are basic to a discussion of the nature and distribution of geothermal energy are *geothermal gradient, heat flow* and *geothermal anomaly*. *Geothermal gradient* refers to the increase of temperature as the depth increases: the deeper into the earth, the higher the temperature. Normally the temperature increases 1°C in 33 m. However, the increase may exceed 5°C in 33 m because geologic setting and rock types differ. Thermal energy moves toward the earth's surface by conduction of heat through solid rock, by movement of molten rock (magma), or by movement of water. The vertical movement of thermal energy by conduction is called *heat flow*.

In some geothermal areas, temperatures at some depths are higher or lower than temperatures in nearby terrain. This temperature irregularity, called a *geothermal anomaly*, may be limited to a small area and only a single hot spring may indicate the anomaly. On the other hand, the area may be a region of thousands of square miles. Because drilling, developing and maintaining wells that will produce warm or hot water is expensive, geothermal exploration involves locating positive geothermal anomalies with relatively high temperatures close to the surface (WEB_1 2005).

Main mechanism of the geothermal energy resources could be summarized as follow. Geothermal resources have three main components: a heat source, a reservoir, and a fluid. The heat source can be either a very high temperature (>600 oC) magmatic intrusion that has reached relatively shallow depths (5-10 km) or, as in certain low-temperature systems, the Earth's normal temperature, which is, increases with depth. Geothermal fluid is the carrier that transfers the heat. Circulating fluids extract heat from the reservoir, which is a volume of hot permeable rocks. Reservoirs may contain hot water and/or stream. In many, but not all cases, the reservoir is connected to a surface recharge area that replenishes all or part of the fluids emerging naturally (for example in springs) or extracted in wells.

High heat flow zones may be located close to the surface where convective circulation plays a significant role in bringing the heat close to the surface. Convection occurs because of the heating and consequent thermal expansion of fluids in a gravity field. Heated fluid of lower density tends to rise and to be replaced by colder fluid of high density, coming from the margins of the system. Deep circulation of groundwater along fracture zones will bring the heat to shallower levels, collecting the heat flow from a broad area and concentrating it into shallow reservoirs or discharging as hot springs. By drilling into reservoirs, the hot water and/or steam are piped to the surface. The schematic representation of an ideal geothermal system is given in the figure below. Main mechanism and the movements of the geothermal components of the geothermal reservoir could be seen in the figure.

Figure 1.Schematic representation of an ideal geothermal system



Source: WEB_1 2005

The most common criterion for classifying geothermal resources is that based on the enthalpy of the geothermal fluids that act as the carrier transporting heat from the deep hot rocks to the surface. *Enthalpy*, which can be considered more or less proportional to temperature, is used to express the heat (thermal energy) content of the fluids, and gives a rough idea of their 'value'. The resources are divided into low, medium and high enthalpy (or temperature) resources, according to criteria that are generally based on the energy content of the fluids and their potential forms of utilization. Table below reports the classifications proposed by a number of authors. A standard method of classification, as with terminology, would avoid confusion and ambiguity but, until such a method exists, it would be indicated that the temperature values or ranges involved case by case, since terms such as low, intermediate and high are meaningless at best, and frequently misleading (WEB_1 2005).

Table 1.Classification of geothermal resources (°C) (WEB_1 2005)

	(a)	(b)	(c)	(d)	(e)
Low enthalpy resources	< 90	<125	<100	≤150	≤190
Intermediate enthalpy resources	90-150	125-225	100-200	-	-
High enthalpy resources	>150	>225	>200	>150	>190

Source: (a) Muffler and Cataldi (1978).
(b) Hochstein (1990).
(c) Benderitter and Cormy (1990).
(d) Nicholson (1993).
(e) Axelsson and Gunnlaugsson (2000)

2.2 Exploration of Geothermal Energy

According to the wide literature on this subject indicates that there are nine main objectives of geothermal exploration (Lumb 1981). These are:

1. To identify geothermal phenomena.
2. To ascertain that a useful geothermal production field exists.
3. To estimate the size of the resource.
4. To determine the type of geothermal field.
5. To locate productive zones.
6. To determine the heat content of the fluids that will be discharged by the wells in the geothermal field.
7. To compile a body of basic data against which the results of future monitoring can be viewed.
8. To determine the pre-exploitation values of environmentally sensitive parameters.
9. To acquire knowledge of any characteristics that might cause problems during field development.

The relative importance of each objective depends on a number of factors, most of which are tied to the resource itself. These include anticipated utilization, technology available, economics, as well as situation, location and time, all of which affect the exploration program. For example, the preliminary reconnaissance of geothermal manifestations assumes much greater importance in a remote, unexplored area than in a well-known area; estimating the size of the resource may be less important if it is to be used in a small-scale application that obviously requires much less heat than is already discharging naturally; if the energy is to be used for district-heating or some other application needing low-grade heat, then a high-temperature fluid is no longer an important objective (Lumb 1981).

2.2.1 Exploration Methods

Geological and hydrogeological studies are the starting point of any exploration program, and their basic function is that of identifying the location and extension of the areas worth investigating in greater detail and of recommending the most suitable exploration methods for these areas. Geological and hydrogeological studies have an important role in all subsequent phases of geothermal research, right up to the siting of exploratory and producing boreholes. They also provide the background information for interpreting the data obtained with the other exploration methods and, finally, for constructing a realistic model of the geothermal system and assessing the potential of the resource. The information obtained from the geological and hydrogeological studies may also be used in the production phase, providing valuable information for the reservoir and production engineers. The duration and cost of exploration can be appreciably reduced by a good exploration program and an efficient coordination of the research (WEB_1 2005).

Geochemical surveys (including isotope geochemistry) are a useful means of determining whether the geothermal system is water- or vapor-dominated, of estimating the minimum temperature expected at depth, of estimating the homogeneity of the water supply, of inferring the chemical characteristics of the deep fluid, and of determining the source of recharge water. Valuable information can also be obtained on the type of problems that are likely to arise during the re-injection phase and plant utilization (e.g. changes in fluid composition, corrosion and scaling on pipes and plant installations, environmental impact) and how to avoid or combat them. The geochemical survey consists of sampling and chemical and/or isotope analyses of the water and gas from geothermal manifestations (hot springs, fumaroles, etc.) or wells in the study area. As the geochemical survey provides useful data for planning exploration and its cost is relatively low compared to other more sophisticated methods, such as the geophysical surveys, the geochemical techniques should be utilized as much as possible before proceeding with other more expensive methodologies (WEB_1 2005).

Geophysical surveys are directed at obtaining indirectly, from the surface or from depth intervals close to the surface, the physical parameters of deep geological formations. According to the Dickson and Fanelli (2004), these physical parameters include:

1 Temperature (thermal survey)
2 Electrical conductivity (electrical and electromagnetic methods)
3 Propagation velocity of elastic waves (seismic survey)
4 Density (gravity survey)
5 Magnetic susceptibility (magnetic survey).

Some of these techniques, such as seismic, gravity and magnetic, which are traditionally adopted in oil research, can give valuable information on the shape, size, depth and other important characteristics of the deep geological structures that could constitute a geothermal reservoir, but they give little or no indication as to whether these structures actually contain the fluids that are the primary objective of research. These methodologies are, therefore, more suited to defining details during the final stages of exploration, before the exploratory wells are sited. Information on the existence of geothermal fluids in the geological structures can be obtained with the electrical and electromagnetic prospectings, which are more sensitive than the other surveys to the presence of these fluids and to variations in temperature; these two techniques have been applied widely with satisfactory results. The magnetotelluric method, which exploits the electromagnetic waves generated by solar storms, has been greatly improved over the last few years, and now offers a vast spectrum of possible applications, despite the fact that it requires sophisticated instrumentation and is sensitive to background noise in urbanized areas. The main advantage of the magnetotelluric method is that it can be used to define deeper structures than are attainable with the electric and the other electromagnetic techniques. The Controlled Source Audiomagnetotelluric method (CSAMT) developed recently uses artificially induced waves instead of natural electro-magnetic waves. The penetration depth is shallower with this technique, but it is quicker, cheaper, and provides far more detail than the classic MT method.

Thermal techniques (temperature measurements, determination of geothermal gradient and terrestrial heat flow) can often provide a good approximation of the temperature at the top of the reservoir.

Drilling of *exploratory wells* represents the final phase of any geothermal exploration program and is the only means of determining the real characteristics of the geothermal reservoir and thus of assessing its potential (Combs and Muffler 1973). The data provided by exploratory wells should be capable of verifying all the hypotheses and models elaborated from the results of surface exploration and of confirming that the reservoir is productive and that it contains enough fluids of adequate characteristics for the utilization for which it is intended.

2.2.2 Exploration Program

Before drawing up a geothermal exploration program all existing geological, geophysical and geochemical data must be collected and integrated with any data available from previous studies on water, minerals and oil resources in the study area and adjacent areas. This information frequently plays an important role in defining the objectives of the geothermal exploration program and could lead to a significant reduction in costs (WEB_1 2005).

The exploration program is usually developed on a step-by-step basis: *reconnaissance*, *pre-feasibility* and *feasibility*. During each of these phases the less interesting areas are eliminated gradually. The methods used also become progressively more sophisticated and more detailed as the program develops. The size and budget of the entire program should be proportional to its objectives, to the importance of the resources expected to find, and to the planned forms of utilization. The program schedule should be flexible and reassessed as the results come in from the various surveys of each phase; similarly the geological-geothermal model should be progressively updated and improved. These periodic re-assessments of the program should ideally eliminate any operations that are no longer necessary and insert others, according to the results attained at each stage. Clearly any reduction in the number and size of the prospecting will lead to a decrease in costs, and also a corresponding increase in the risk of error or failure. Conversely, by decreasing the risk of error the overall cost is increased. The economic success of a geothermal exploration program hinges on finding the proper balance between the two (WEB_1 2005).

2.3 Utilization of the Geothermal Resources

Geothermal energy developments could be broken down into two distinct categories: electricity production and heating applications. Geothermal heating applications are called, variously, "direct use" or "low enthalpy". The term "direct use" serves to distinguish the applications from "indirect" electricity production and the term "low enthalpy" is used to indicate that fluids, which are employed for heating usually, have low heat content (Batik et al 2000).

The range of potential methods for utilizing from any geothermal resource mainly depends on the temperature of resources. The most important commercial thermal applications are:

1. Electricity generation
2. Heating of dwellings, hotels, offices, hospitals, campus areas and other public houses
3. Space cooling applications by using an absorption refrigeration cycle
4. Obtaining of domestic hot and cold water
5. Heat pump applications
6. Agricultural facilities like place heating, combined space and hotbed heating of greenhouses for vegetables, flowers, plants, animal farms; drying of vegetables, fishes, rice, tobacco; mushroom growing or usage in hot irrigation
7. Therapeutic (health) and recreational bathing (heating of thermal and public swimming pools)
8. Heating of aquaculture farms
9. Open field heating (heating of streets, parking areas, and sidewalks)
10. Industrial applications (in sterilization, pasteurization, evaporation, and distillation processes) (Lund 1998)

Direct utilization is the oldest and common method of utilizing the geothermal resources. For instance, space heating, agricultural, balneologic and industrial applications are widely known fields of utilization geothermal energy. On the other hand, generating electricity is required a resource having 150 ^{o}C and more temperature capacity. More systematically, Lindal (1973) determines the utilization of the geothermal resource according to its temperature as shown in table below.

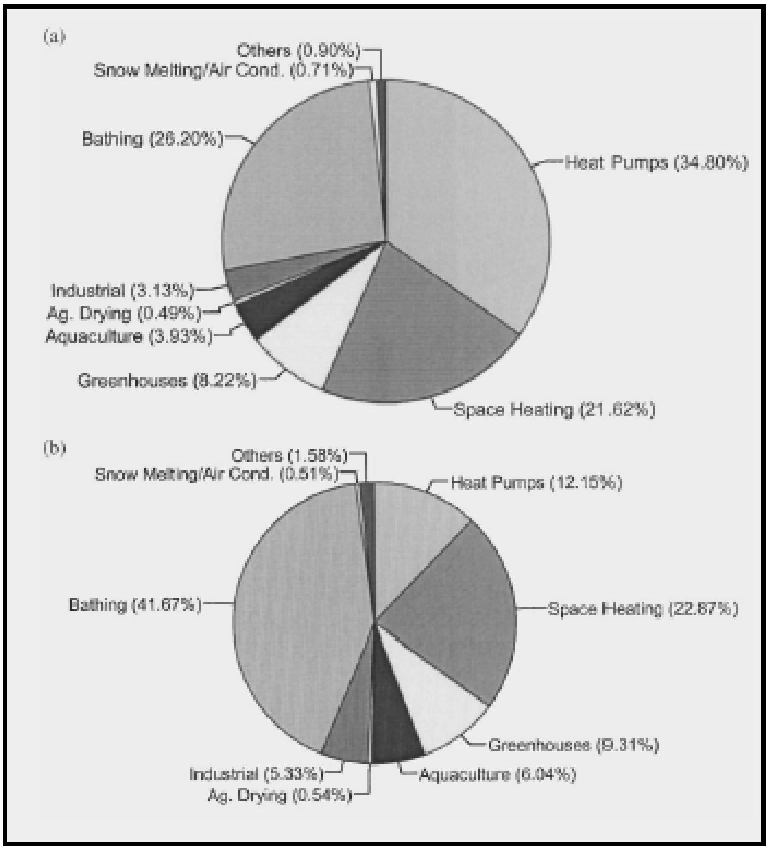
Table 2.Utilization of Geothermal Fluids (Lindal 1973)

^{0}C	Utilization Fields
180	Evaporation of highly concentrated solutions, Refrigeration by ammonia absorption, Digestion in paper pulp, kraft
170	Heavy water via hydrogen sulphide process Drying of diatomaceous earth
160	Drying of fish meal Drying of timber
150	Alumina via Bayer's process
140	Drying farm product at high rates Canning of food
130	Evaporation in sugar refining Extraction of salts by evaporation and crystallization
120	Fresh water by distillation Most multiple effect evaporations, concentration of saline solution
110	Drying and curing of light aggregate cement slabs
100	Drying of organic materials, seaweeds, grass, vegetables, etc. Washing and drying of wool
90	Drying of stock fish Intense de-icing operations
80	Space heating Greenhouses by space heating
70	Refrigeration (lower temperature limit)
60	Animal husbandry Greenhouses by combined space and hotbed heating
50	Mushroom growing Balneological baths
40	Soil warming
30	Swimming pools, biodegradation, fermentations, Warm water for year round mining in cold climates De-icing
20	Hatching of fish, fish farming

2.3.1 Geothermal Energy Utilization in the World

The levels of geothermal energy capacity and utilization fields differentiate among the countries when the whole world is considered. The most common non-electric use world-wide (in terms of installed capacity) is heat pumps (34.80%), followed by bathing (26.20%), space-heating (21.62%), greenhouses (8.22%), aquaculture (3.93%), and industrial processes (3.13%) (Lund and Freeston 2001). At the graph below, (a) shows the categories of capacity, (b) shows the categories of energy use in % for 2000.

Graph 1. Geothermal Energy Capacity and Utilization Fields in the World



Source: Lund and Freeston 2001

With 41,67 %, bathing is the most widely used field in the world. As a new trend in tourism, thermal foundations have contributed to increasing share of utilization of geothermal resources. Especially in the US, the number of spa locations has doubled in number every four years. According to the International Spa Association (ISPA-2002), health tourism has become more dominant within the all types of tourism. The reasons of this trend can be summarized by the factors: increasing the number of old age individual in especially developed countries, health problems based on old age, increasing concern on personal care and beauty. Thermal tourism have been developing especially in Germany, Japan, America, France, Italy, Austria, Hungary, Czechoslovakia, Switzerland, Spain, Greece, New Zealand and Australia (WEB_2 2002).

The countries that utilize geothermal energy to *generate electricity* are listed in Table 3, which also gives the installed geothermal electric capacity in 1995 (6833 MW_e), in 2000 (7972 MW_e) and the increase between 1995 and the year 2000 (Huttrer, 2001). The same table also reports the total installed capacity at the end of 2003 (8402

MW$_e$). The geothermal power installed in the developing countries in 1995 and 2000 represents 38 and 47% of the world total, respectively.

The utilization of geothermal energy in developing countries has exhibited an interesting trend over the years. In the five years between 1975 and 1979 the geothermal electric capacity installed in these countries increased from 75 to 462 MW$_e$; by the end of the next five-year period (1984) this figure had reached 1495 MW$_e$, showing a rate of increase during these two periods of 500% and 223%, respectively. In the next sixteen years, from 1984 to 2000, there was a further increase of almost 150%. Geothermal power plays a fairly significant role in the energy balance of some areas; for example, in 2001 the electric energy produced from geothermal resources represented 27% of the total electricity generated in the Philippines, 12.4% in Kenya, 11.4% in Costa Rica, and 4.3% in El Salvador (WEB_1 2005).

Table 3.Installed geothermal generating capacities world-wide from 1995 to 2000 and at the end of 2003 (Huttrer 2001)

Country	1995	2000	1995-2000	Increase	2003
Argentina	0.67	-	-	-	-
Australia	0.15	0.15	-	-	0.15
Austria	-	-	-	-	1.25
China	28.78	29.17	0.39	1.35	28.18
Costa Rica	55	142.5	87.5	159	162.5
El Salvador	105	161	56	53.3	161
Ethiopia	-	7	7	-	7
France	4.2	4.2	-	-	15
Germany	-	-	-	-	0.23
Guatemala	-	33.4	33.4	-	29
Iceland	50	170	120	240	200
Indonesia	309.75	589.5	279.75	90.3	807
Italy	631.7	785	153.3	24.3	790.5
Japan	413.7	546.9	133.2	32.2	560.9
Kenya	45	45	-	-	121
Mexico	753	755	2	0.3	953
New Zealand	286	437	151	52.8	421.3
Nicaragua	70	70	-	-	77.5
Papua New	-	-	-	-	6
Philippines	1227	1909	682	55.8	1931
Portugal	5	16	11	220	16
Russia	11	23	12	109	73
Thailand	0.3	0.3	-	-	0.3
Turkey	20.4	20.4	-	-	20.4
USA	2816.7	2228	-	-	2020
Total	6833.35	7972.5	1728.54	16.7	8402.21

As regards *non-electric applications* of geothermal energy, Table 4 gives the installed capacity (15,145 MW$_t$) and energy use (190,699 TJ/yr) world-wide for the year 2000. During that year 58 countries reported direct uses, compared to 28 in 1995 and 24 in 1985. The number of countries with direct uses has very likely increased since then, as well as the total installed capacity and energy use.

Table 4. Non-electric uses of geothermal energy in the world (2000): installed thermal power (in MW_t) and energy use (in TJ/yr) (Lund and Freeston 2001)

Country	Power	Energy	Country	Power	Energy
Algeria	100	1586	Israel	63.3	1713
Argentina	25.7	449	Italy	325.8	3774
Armenia	1	15	Japan	1167	26933
Australia	34.4	351	Jordan	153.3	1540
Austria	255.3	1609	Kenya	1.3	10
Belgium	3.9	107	Korea	35.8	753
Bulgaria	107.2	1637	Lithuania	21	599
Canada	377.6	1023	Macedonia	81.2	510
Caribbean	0.1	1	Mexico	164.2	3919
Chile	0.4	7	Nepal	1.1	22
China	2282	37908	Netherlands	10.8	57
Colombia	13.3	266	New Zealand	307.9	7081
Croatia	113.9	555	Norway	6	32
Czech Republic	12.5	128	Peru	2.4	49
Denmark	7.4	75	Philippines	1	25
Egypt	1	15	Poland	68.5	275
Finland	80.5	484	Portugal	5.5	35
France	326	4895	Romania	152.4	2871
Georgia	250	6307	Russia	308.2	6144
Germany	397	1568	Serbia	80	2375
Greece	57.1	385	Slovak	132.3	2118
Guatemala	4.2	117	Slovenia	42	705
Honduras	0.7	17	Sweden	377	4128
Hungary	472.7	4086	Switzerland	547.3	2386
Iceland	1469	20170	Thailand	0.7	15
India	80	2517	Tunisia	23.1	201
Indonesia	2.3	43	Turkey	820	15756
United	2.9	21	Venezuela	0.7	14
USA	3766	20302	Yemen	1	15
Total	15145	190699			

2.3.2 Geothermal Energy Utilization In Turkey

Turkey is one of the first 10 countries in the world in terms of geothermal resource potential. There are nearly 1000 warm and mineral water resources in Turkey. Main resources are presented at the table 5 below. These resources have been used for different fields such as district heating, greenhouse, bathing, refrigeration, fishing and industrial fields.

Table 5. Main Geothermal Resources in Turkey (SPO 2001)

BALIKESİR	İZMİR	GEDİZ	SANDIKLI	REŞADİYE	İNCİRLİOVA
GÖNEN	BALÇOVA	YONCALI	HEYBELİ	SİVAS	NAZİLLİ
SUSURLUK	NARLIDERE	BANAZ	ILGIN	SICAK-ÇERMİK	SALAVATLI
PAMUKÇU	SEFERİHİSAR	SARAYCIK	İSMİL	ŞANLIURFA	SULTANHİSAR
BALYA	ÇEŞME	YALOVA	ZİGA	ÇERMİK	DENİZLİ
HİSARALAN	DİKİLİ	ARMUTLU	NARKÖY	ERZURUM	SARAYKÖY
HAVRAN	ALİAĞA	KEMALPAŞA	ÇİFTEHAN	PASİNLER	GÖLEMEZLİ
SINDIRGI	GÜZELBAHÇE	AKYAZI	KIRŞEHİR	ILICA	KARAHAYIT
BİGADİÇ	BAYINDIR	KUZULUK	MAHMUTLU	KÖS	KIZILDERE
EDREMİT	ÇİĞLİ-ULUKENT	BOLU	ÇİÇEKDAĞ	TATVAN	BULDAN
GÜRE	BERGAMA	KARACASU	HAVZA	ERCİŞ	YENİCE
LAPSEKİ	MANİSA	SEBEN	HAMAMÖZÜ	DİYADİN	BUHARKENT
ÇAN	TURGUTLU	KIZILCAHAMAM	SULUSARAY	İKİZDERE	
EZİNE	AHMETLİ	AYAŞ	GÖZLEK	AYDIN	
GÜRPINAR	SALİHLİ	HAYMANA	KOZAKLI	GERMENCİK	
AYVACIK	ALAŞEHİR	ÇAVUNDUR	BOĞAZLIYAN	ALANGÜLLÜ	
TUZLA	KÜTAHYA	AFYON	SORGUN	DAVUTLAR	
KALKIM	EMET	BOLVADİN	SARIKAYA	ORTAKLAR	
	SİMAV	GAZLIGÖL	YERKÖY	SÖKE	

Geothermal district heating applications have started in 1987 in Turkey with the heating of 600 residences in Balikesir-Gonen. The investigations on geothermal energy in the country gained speed in the 1970s. However, the utilization of geothermal energy could not become widespread sufficiently due to scaling problems up to the early 1980s. Since then, important developments have been recorded in geothermal energy utilization. Recently, geothermal direct use applications have reached up to 52,000 residences equivalence of geothermal heating, and engineering design of nearly 300,000 residences equivalence geothermal district heating has been completed (Mertoğlu 2001a - 2001b; Günerhan et al 2001). Today, Balçova geothermal resource (143,3 MWt) has a capacity heating 9600 residence, and greenhouse including 100.000 m^2 space. Furthermore this resource has been used for the heating the Dokuz Eylül University campus. In Simav, 3200 dwellings have been heated with 25 MWt capacity. (SPO 2001)

Taking into consideration the current development of geothermal energy in Turkey, it may be concluded that the majority of the geothermal energy utilization occurred in direct use applications (including district heating, thermal facilities and greenhouse heating) with a total installed capacity of 493 MWt. Besides this, geothermal water has been used in 194 spas for balneological purposes with a total capacity of 327 MWt. As a result, the total installed capacity is found to be 820 MWt for direct use and 20.4 MWe for power production obtained from the only geothermal power plant of Turkey in the Denizli–Kizildere geothermal field. An annual average growth of 23% of residence connections to geothermal district heating systems has been achieved since 1983 in the country, representing a decrease of 5% in the last three years (Mertoğlu 2001a-2001b)

Parallel to the development of geothermal energy utilization in Turkey, it is projected that by the years 2010 and 2020,the total installed capacity will increase to 3500MWt (500,000 residences equivalent, which is about 30% of the total residences in the country) and 8300 MWt (1,250,000 residences equivalent) for space heating and to 500 MWe and 1000 MWe for power production, respectively (Lund and Freeston 2001; Mertoğlu 2001a-2001b).

In Turkey, 400 geothermal production wells and 300 gradient wells have been drilled until now. Of these, 305 wells were drilled by the MTA with a total well depth of nearly 120,000 m. The regional distribution of the wells drilled by the MTA is as follows (Mertoğlu, 2000; SPO, 2001) 87% in western Turkey, 11% in middle Anatolian, and 2% in eastern Turkey (Batik et al. 2000, Hepbaşlı and Çanakçı 2003).

In Turkey, the investments in geothermal heating systems have been supported by consumers due to the tariff on geothermal heat, which is held constant during the entire year. The investment cost for geothermal district heating systems per residence with a floor area of 100 m^2 is about 1500–2500 US$ (excluding heater costs in the residence), while the payback period varies between 5 and 8 years. About 30–50% of the investment costs has been paid by consumers as a connection subscription fee, like a capital investment. The heating fees (2001 heating season) were in the range of 14–29 US$ (Mertoğlu, 2000)

CHAPTER 3

INTRODUCTION OF BALÇOVA GEOTHERMAL FIELD

3.1 Balçova Geothermal Field

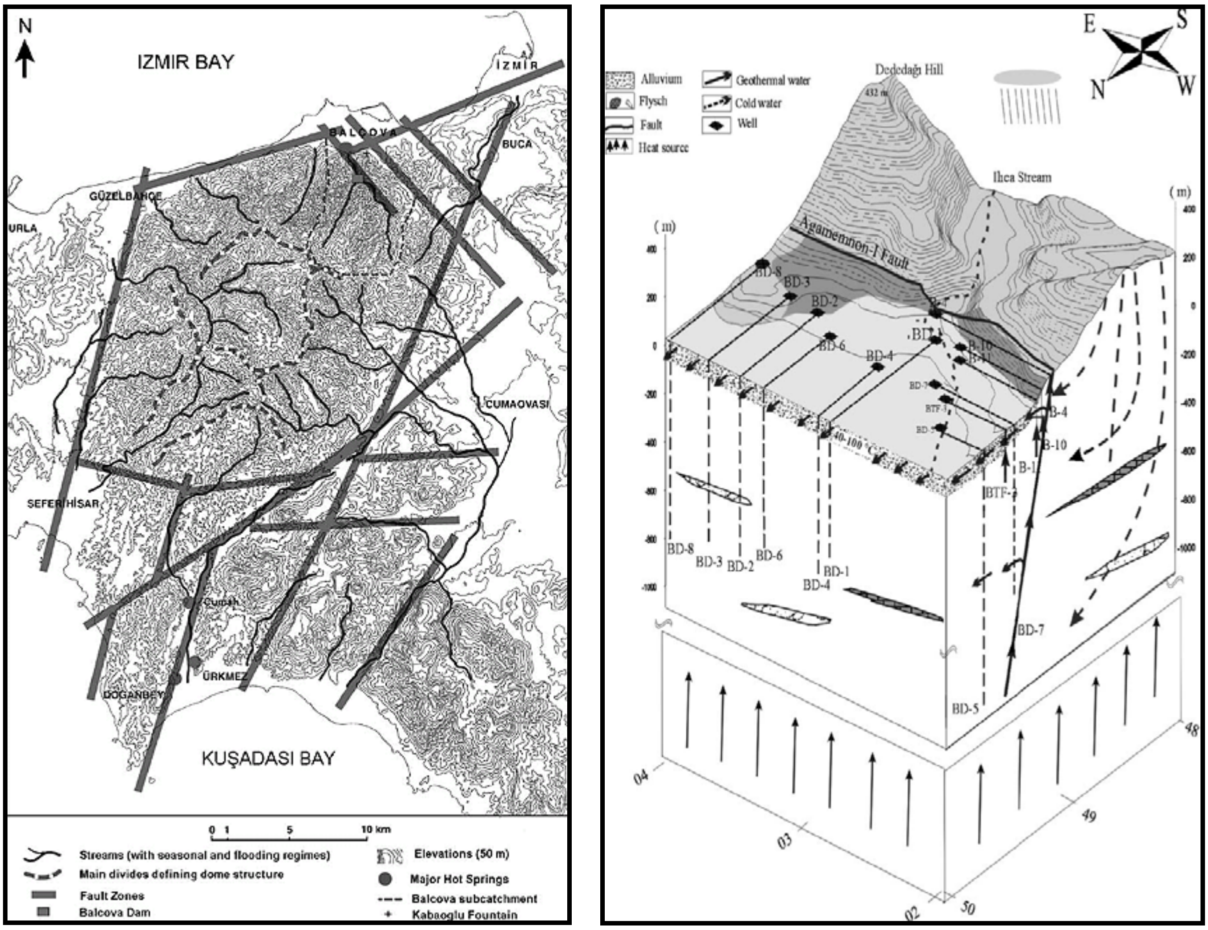
Balçova Geothermal Field that is located in the 10 km west of the İzmir city center. This field covers a total area of about 3.5 km^2 with an average thickness of the aquifer horizon of 150 m. Assuming that no feeding will occur and 25% of the fluid contained in the reservoir will be utilized, this field has a maximum yield of 810 m^3/h at a reservoir temperature of 118ºC. Balçova geothermal field or the so-called Agamemnon Spas were attractive places for settlers over the ages. Agamemnon Spas were known in antiquity for the therapeutic qualities of the water. The geothermal resource was used as a spa for hundreds of years till 1995. With the construction of Balçova Geothermal District Heating System (GDHS), the geothermal liquid was started to be exploited to obtain potable water and heating.

3.1.1 Geologic and Reservoir Characteristics of the field

As reported by Özyılmaz (1996), Hepbaşlı and Çanakçı (2003), Balçova Geothermal Field has special geology. Agamemnon Geothermal Field is located on Izmir Flysch Sequence which is in a very common zone named as Izmir-Ankara Zone. In and around this field, the outer cretaceous aged Izmir shale–sandstone is seen prevalently. This sandstone consists of stones, such as metasandstone, metamorphic rocks, limestone, serpanthenite diabase etc. The Miyosen aged Yenikoy Formation, which comes upon the Izmir shale–sandstone with discordance, consists of conglomerate, sandstone, claystone and limestone, and is very far from the thermal springs, like the pleosean aged Cumaovasi valconites. Side debris and alluvials are seen in the north of the working area, and they are Kuvantener aged. The general tectonic conduct of the Izmir shale–sandstone is northeast–southwest. The fault and crack systems in the metasandstone and limestone of the Izmir shale–sandstone have the characteristics of the basin. The alluvials and side debris that take place in the working area contain hot and cold water, but after the sounds made in the alluvial, it is seen that there is not enough feeding in the alluvial.

Since 1963, on various dates and in different locations shallow and deep wells have been drilled. Some of the wells drilled in 1995, during the time till the construction of GDHS, became unavailable because of estrepement and wrong technique applications(Satman et al 2002). A number of these wells have been repaired and reopened for use. 13 shallow and 10 deep wells are available in the field at present. It is possible to see some of these wells in the hydro geologic model below.

Figure 2.Main morpho-tectonic and hydro-geomorphologic features of the mountainous area and surroundings south of Balçova on the left and Hydrogeological model of Balçova geothermal system on the right.



Source: The figure on the left is taken from Kayan 2000; Serpen and Kayan 2001 and Serpen 2003; on the right is taken from Aksoy 2001 and Serpen 2003.

The feeding reservoir of the geothermal field is shown in the figure, too. The feeding field of Balçova Geothermal System is defined on the Seferihisar horst in the south. Although it defines only a field of 35 km^2, it is possible for the potential of this field to reach 135 km^2. Izmir Gulf is seen as the main discharge area for the reservoir. Hydrogeological model given in the figure shows the 3D illustration of the reservoir area of Balçova. The locations and the depth of the wells drilled until 2001 and other geological formations of the reservoir are shown in the figure.

3.2 Development of Balçova geothermal field

Balçova Geothermal Field is possibly the geothermal reservoir field which has been studied academically most in Turkey. Particularly, the project named “The Reservoir and Production Performance of Izmir Balçova-Narlıdere Geothermal District”, which was carried out by ITU Petroleum and Natural Gas Department in 2002, could be shown as the most extensive geothermal reserve analysis in Turkey. At the same time, in the literature many publications are available which studies the various aspects of Balçova-Narlıdere Geothermal District Heating system (GDHS).

In Turkey, initial studies on the exploitation and exploration of geothermal energy started in 1962 with the inventory of hot water springs. Dr. Serruya and K. Tezcan realized the reconnaissance and exploration studies. Dr. Serruya accomplished geologic, hydrologic study in 1962. K. Tezcan who was charged by General Directorate of Mineral Research & Exploration (MTA) has done resistivity surveys and applied the self-potential method in Balçova Geothermal Field. Three shallow wells (S1, S2, and S3) were drilled in 1963 by General Directorate of Mineral Research & Exploration after the first evaluation of geological, geophysical, and geochemical data. Depths, temperatures, and flow rates of these three wells were respectively 39 m, 124 ^{o}C, 27 l/s; 69 m, 102 ^{o}C, 11 l/s and 140 m, 101 ^{o}C, 1.25 l/s. Because of high calcite precipitation problem, the field could not be developed until 1983. Up to 1983, approximately 50 gradient, deep, and shallow wells were drilled by MTA. On the other hand, some of household and greenhouse owners drilled their own wells in this region because of the deficiency of geothermal law in those years (OGI 2001, Çanakçı 2003).

In order to utilize geothermal energy in this field for health and tourism purposes, “Termal Turizm ve Özel Eğitim İşletmeleri Ltd. Şti” (Balçova Termal Hotel) was found by the special provincial administration of İzmir. Because of the high calcite problem in Balçova Geothermal Field, “Balçova Termal Turizm ve Özel Eğitim İşletmeleri Ltd. Şti.” used downhole type heat exchangers in 1981. It was the first geothermal heating application in Turkey. The Faculty of Medicine buildings of Dokuz Eylül University and Balçova Princess Hotel were heated by geothermal water respectively in 1983 and 1994. At present, there is a large district heating system in Balçova – Narlıdere regions. (DGI 2002, Çanakçı 2003).

3.3 Balçova and Narlıdere GDHS

In 1962, in order to utilize geothermal energy in this field for health and tourism purposes, “Termal Turizm ve Özel Eğitim İşletmeleri Ltd. Şti” (Balçova Termal Hotel) was found by the special provincial administration of İzmir. Because of the high calcite problem in Balçova Geothermal Field, “Balçova Termal Turizm ve Özel Eğitim İşletmeleri Ltd. Şti.” used downhole type heat exchangers in 1981. It was the first geothermal heating application in Turkey. Following this, in 1983, wells were drilled in the geothermal field to meet the hot water need of DEU Medicine Faculty Hospital. Though there had been no serious development until 1995, the same year, the usage of the field water for district heating was given out in tender by competitive bidding. As the public showed in the process, it was suggested that Narlıdere be included in the heating system. Having the project completed in 1998, Narlıdere was started to be heated by geothermal resource. So far, geothermal resource has been generally used for household heating and the heating of the greenhouses (yet rarely). The project named “The Reservoir and Production Performance Of Izmir Balçova-Narlıdere Geothermal District”, which was carried out by ITU Petroleum and Natural Gas Department in 2002, helped to build strategies about the actions concerning the future of the field. By looking at the estimates about the thermal capacity of the field, it is thought that the system could serve a wider area. At present, ´projects are prepared to heat the households adjacent to the field (Erdoğmuş 2003).

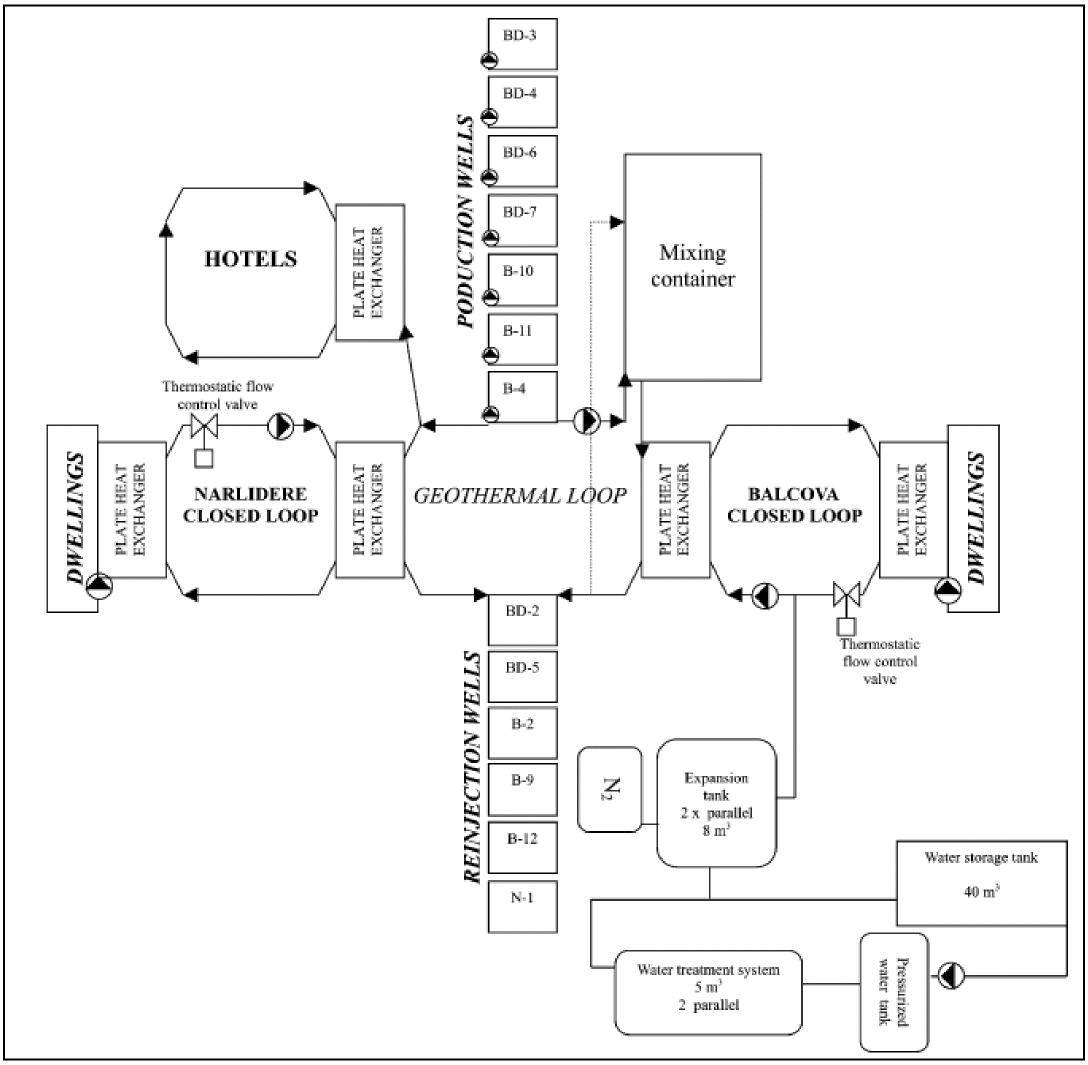
The operation concept of Balçova Geothermal District Heating System (GDHS) is based on taking the city water heated by geothermal fluid to the households and meeting household heating and potable water needs. Recently it has been thought to heat the greenhouses by the reinjection of the water obtained In the beginning of the project, Balçova GDHS was designed according to 7,500 household equivalent, whereas Narlıdere GDHS was designed for 1,500 household equivalent. The feasibility report for the first part of Balçova GDHS which covers the heating of 2,500 and the cooling of 500 households in Balçova region was prepared in October 1995. However, today, an area of 1,050,286 m^2 is heated and it is planned to increase this figure to 1,445,286 m^2 by establishing a new thermal centre in the near future (Toksoy et al. 2003). Another alternative (The Turkish Air Force Hospital, several residence areas adjacent to the Balçova and Inciraltı Dormitories) is to increase this figure to 1,900,286 m^2 (Kutluay et al. 2004).

Balçova – Narlıdere GDHS project was drawn up and constructed by a private sector company. The Balçova GDHS is designed according to 7,500 household equivalence, whereas Narlıdere GDHS is designed for 1,500 household equivalence. The feasibility report for the first part of Balçova GDHS which covers the heating of 2,500 and the cooling of 500 households in Balçova region was prepared in October 1995. The feasibility report was accepted and the contract was signed on 20 October 1995 after the competitive bidding. The construction of Balçova GDHS was started out on 25th October 1995 and was over on 20th October 1996. The first part of the system was taken into the operation on 29th October 1996. At this time, it was decided to increase the capacity to the heating of 5,000 and the cooling of 1,000 household equivalents. However, developer called off the cooling of households' contract on 26th November 1996. The heating capacity of Balçova – Narlıdere GDHS was 2,500 dwellings on 30th December 1996, but new connections continued after that time. It was decided to grow the Balçova – Narlıdere GDHS to the system with 7680 household equivalent on 1st July 1997. The contract was signed on 3rd July 1997 and construction of Balçova GDHS investment was completed on 31st December 1999. The construction of Narlıdere GDHS started in April 1997. Narlıdere GDHS has been operated since October 1998. The contractor company and "Balçova Termal Turizm ve Özel Eğitim İşletmeleri Ltd. Şti" had operated Balçova – Narlıdere GDHS until August 2000. In this period, "Balçova Termal Turizm ve Özel Eğitim İşletmeleri Ltd. Şti" was in charge of following the new connection transactions. The contractor was responsible for the operating of the system. At the beginning of August, 2000, "Balçova Jeotermal Enerji San. Tic. Ltd. Şti.", which is a local government's company, was established and took over distributing hot water and operating of the system (Hepbaşlı and Çanakçı 2001, Satman et al 2002 and Erdoğmuş 2003).

As of the end of 2001,there are 14 wells ranging in depth from 48 to 1100 m in the IBGF. Of these, seven and six wells are production and reinjection wells, respectively, while one well is out of operation. The well head temperatures of the production wells vary from 95 to 140 °C, with an average value of 118 °C while the volumetric flow rates of the wells range from 30 to 150 m^3/h. Geothermal fluid, collected from the seven production wells at an average well head temperature of 118 °C,is pumped to a mixing chamber, where it is mixed with the reinjection fluid at an average temperature of 60–62 °C, cooling the mixture to 98–99 °C. This geothermal fluid is then sent to two primary plate type heat exchangers and is cooled to about 60–62 °C, as its heat is transferred to the secondary fluid. The geothermal fluid whose heat is taken at the geothermal center is re-injected into the reinjection wells, while the secondary fluid (clean hot water) is transferred to the heating circulation water of the building by the heat exchangers of the substations. The average conversion temperatures obtained during the operation of the IBGDHS are, on average,80/57 ^{o}C for the district heating distribution network and 65/45 ^{o}C for the building circuit. By using the control valves for flow rate and temperature at the building substations, the needed amount of water is sent to each housing unit and the heat balance of the system is achieved (Hepbaşlı and Çanakçı 2002).

The schematic mechanism of the Balçova GDHS composed by Çanakçı is given below:

Figure 3. Schematic representation of Balcova–Narlıdere–Izmir geothermal district heating system



Source:Çanakçı C. 2003

From 2004 onwards, the wells which have been given in the table below have been used for production. Half of the reinjection, on the other hand, is made to BD-8 well, which was drilled in 2003. Apart from this, re-injection is made from ND-1 and other shallow wells in the field.

Table 6.Production capacity of the wells in Balçova-Narlıdere geothermal field (Kutluay et al 2004)

Wells	Date of Drilling	2000 Flow (m^3/h)	2003 Flow (m^3/h)	Temperature, °C
B-1	1982	0	140	102
B-4	1983	60	140	100
B-5	1983	0	140	102
B-7	1983	0	140	96
B-10	1989	100	250	97
B-11	1989	40	0	100
BD-1	1994	0	50	110
BD-2	1995	0	180	132
BD-3	1996	80	120	120
BD-4	1998	140	180	135
BD-5	1999	0	80	115
BD-6	1999	120	120	135
BD-7	1999	80	80	115
BD-9	2003	0	360	135
Total		**620**	**1980**	

Production of the geothermal water that the Geothermal District Heating System needs has been increased parallel to the improvement of the system. By the observation tests made in the field, it has been found that re-injection to the shallow wells is useless and that it cools the field off. As it has been detected that in some shallow wells re-injection caused a cooling that goes down to 20 °C, the re-injection strategy in the field has been changed and after the year 2002, re-injection to the 630 metre deep BD-8 well, which was drilled in the yard of Economy University, has been started. With this process, cooling in the wells has been stopped and the cooled off wells have started to heat again. In addition, in the suggestions part of the study carried out by ITU, cooling in the wells are mentioned and re-injection to the deep wells on the edges of the geothermal field is suggested as a strategy. In Narlıdere-Balçova field, nearly the half of the total production is re-injected to BD-8 well. The aim is 100% re-injection in the field. The drilling works of BD-10 well, which aims to increase the re-injection capacity, have been continuing (Kutluay et al. 2004).

In the table below, the dwelling equivalent heated areas in 1999-2004 heating seasons are given.

Table 7.Growth of Balçova-Narlıdere Geothermal District Heating in terms of dwelling's area (m^2) (Toksoy et al 2003)

Type of Load	Heating Seasons					
	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05[e]
Dwellings	454500	688449	711370	715132	815132[a]	815132
Official Buildings	17600	19400	19600	19600	19600	19600
The Princess Hotel	25000	25000	25000	25000	25000	25000
Thermal Treatment Center	13000	13000	13000	13000	13000	13000
Pools of the Hotels[b]	5611	5611	5611	5611	5611	5611
The Thermal Hotel			9543	9543	9543	9543
DEU Hospital[c]			143600	143600	143600	143600
Economy University			18800	18800	18800	18800
The Ozdilek Hotel					27000	27000
Ozdilek Shopping Center					20000	20000
Ozdilek (altitude of -6)					14000	14000
DEU Faculty of Fine Arts					20000	20000
DEU Conservatory					12000	12000
Balçova GDHS-2						302000[d]
TOTAL	515711	751460	946524	950286	1143286	1445286
Growth (%)	-	45.7	25.9	0.4	20.3	26.4

[a] In this season, nearly 100.000square meters of dwellings will be included to the heating load with the projects that started in 2002 and were applied in 2003.

[b] Four closed pools with a total volume of 1555 cubic metres and two open pools of a volume of 4050 cubic metres are available in the Termal and the Princess Hotels.. The value in the table as square metres is the approximate equivalence areas that is calculated according to the average dwelling load

[c] Structuring in Dokuz Eylül University continues. It is foreseen that its load will start to increase from the year 2004 onwards.

[d] Balçova System –2 project is planned to be applied in 2004 and to be included in the load in 2004-2005 heating season. If the foreseen reservoir studies could be done and the results are positive, it could be taken to a nearer date.

[e] Appraisal growth

It could be seen in the table that Balçova GDHS project may grow nearly three times as it was in 1999 up to present. Moreover, another alternative (The Turkish Air Force Hospital, several residential areas adjacent to the Balçova and Inciraltı Dormitories) is to increase this figure to 1,900,286 square metres (Kutluay et al. 2004). This shows that the system could be %66.2 bigger than its size in the years 2003-2004.

3.4 Economic Assessment of Balçova GDHS

In the study named "Economic Assessment of Balçova GDHS", prepared by Erdoğmuş (2003), costs and revenues of Balçova GDHS from its construction up to the year 2002 are studied. In this work, the balance between costs and revenues is analyzed, and how the balance will change/be provided is discussed in case the fix charges taken monthly are re-arranged according to different scenarios, provided that the constant connection charge remains the same. Costs and revenues net present value (NPV) is evaluated according to different interest rates, and internal rate of return (IRR) values are calculated according to different payment scenarios. Because of the up to datedness and the appropriateness of the context, Erdoğmuş's study is taken as a base in the calculations that are made about costs and revenues of geothermal direct heating system.

Cost items considered in Erdoğmuş's study:

- Capital investment costs,
- Operating costs,
- Additional investment costs (auxiliary equipment, new connections and drilling costs),
- Future Cost of Renovations,
- Depreciation Expenses.

Revenue items considered in Erdoğmuş's study:

- Fix charges,
- Connection charges,
- Charges paid according to the contract (DEU Hospital, Economy University, Princess Hotel),
- Other revenues (bank interest and bonds),
- Salvage values.

Given below are the explanations concerning these items.

Items included in capital investment costs for Balçova-Narlıdere GDHS: Construction of heat exchanger and pumping station, transport of materials, electrical equipment, installation of heating equipment used in heat exchanger and pumping station, shared installations (wellhead housing, building, and heat exchanger and pumping station connections), excavation, sanitary installations, automatic control, installation of transformer, thermal line (pipe lines and other fittings, heat exchangers, compensators, steel separator, water softening tank, pumps, actuator butterfly valves, branch valves, stainless steel materials, temperature and flow settling valves, underground valves, butterfly valves, dosage equipment (pumps, piping and other equipment), butterfly valves with gearboxes, aluminum insulation for pipes, flow meters, other adjustment equipment, strainers), materials without discount (timber, cement, sand).

Items included in operating costs for Balçova-Narlıdere GDHS: Water (tap water costs, cost of city water used in Balçova and Narlıdere heat exchanger and pumping stations), electricity (electricity consumption of wellhead housings, Balçova and Narlıdere heat exchanger and pumping stations), inhibitor (cost of inhibitor which is used in wellhead housings), other chemicals (cost of nitric acid, rock salt, NaOH and nitrogen), miscellaneous costs (cost of equipment and works that needed during the operating of systems like the rents of cranes and other vehicles), marketing (visual advertisements, commissions for credit cards, newspapers, magazines, publications, and television programs on geothermal energy), management (cost of telephone, cargo, posts, rent of vehicles, cost of visitors, stationary costs, facility rent), wages of personnel (operational personnel, management board, advisors)

Future Cost of Renovations: Because of the corrosion and leakage problem in energy distribution network, a renovation will be required in pipelines. It is assumed that 75 % of pipe network installed in Balçova and Narlıdere region will be changed after 5 years while the remaining 25 % of pipes will be changed after 10 years, because most of the piping network had been constructed for 5 years at the end of 2001. It is considered that CTP + PUR + CTP pipes will be installed instead of Steel 37 + PUR + CTP pipes. It is assumed that all pumps will be changed after 10 years. (Erdoğmuş 2003).

Depreciation Expenses: The declining balance method allocates for depreciation a fixed fraction of initial book balance each year. In other words, it involves applying a depreciation rate against the undepreciated balance, rather than to the original cost (Erdoğmuş 2003).

Fix charges: These are the use charge that the users pay each month. It consists of an agreement between the customer and the system operator on the monthly sum paid for the provided energy per unit volume. Customers pay charges according to household equivalents of their residence. This charge is 44 YTL (33 USD) for 100 m^2 dwelling for the year 2005.

Connection charges: These charges are collected at the beginning of the subscription in Balçova – Narlıdere GDHS. Each customer must pay house connection fees in order to connect their individual heating system to the district heating system. This charge is equal to 1250 USD for 100 m^2 dwelling for the year 2005

Charges paid according to the contracts: Medicine Faculty and Hospital of Dokuz Eylül University, Izmir Economy University and hotels pay their bills according to their contracts

Salvage value: The estimated value of an asset (approximately %5 of its original value) at the end of its useful life. Equipments and other assets of the Balçova GDHS could be accounted in revenue side.

Table 8.End of 2002 value of all cash flows in US $ (Erdoğmuş 2003)

		End of 2002 value (in US $)
CAPITAL INVESTMENT COSTS		-23,598,820
1.	Balçova GDHS	-18,272,162
2.	Narlıdere GDHS	-1,997,269
3.	Well Drilling Costs	-2,485,024
4.	Additional Investments	-844,366
a.	2001 Investments	-311,970
b.	2002 Investments	-532,396
OPERATING COSTS		-3,462,096
REVENUES		11,039,167
1.	Connection	5,584,181
2.	Fix	5,254,183
3.	Other	200,803
TAXES		-82,547
NET CASH FLOWS AFTER TAX		-16,104,295

In the table above costs, revenues and balance value of Balçova GDHS from 2002 onwards are given. As it could be seen in the table, end of 2002 value is −16,104,295 USD. Assuming that operating cost will continue with end of 2002 value in the following years, it is stated that with the fix charge applied at present and with additional connection charges, 2021 balance of the project (without interest) will be - −51,502,098 USD (after deprecation costs are added). It is shown in Table 10. the future value of the derreciation and renovation costs calculated as to different interest rates are given in Tbale 9. These values are calculated by Erdoğmuş (2003) based on the book values of the investments. The renovation costs of the Balçova GDHS are considerably high because of damage occurred in the insulation material of the pipeline resulting from high water temperature pumped to the pipeline.

Table 9.Future value of depreciation and renovation charges (end of 2021 values as to different interest rates) (Erdoğmuş 2003)

Year	End of year 2021 value (with different interest rates)		
	3%	5%	7%
2002	421,353	618,996	902,770
2003	6,704,255	9,661,397	13,827,225
2004	3,969,822	5,611,880	7,881,502
2005	2,448,884	3,395,889	4,680,148
2006	2,183,100	2,969,661	4,016,229
2007	1,543,838	2,060,074	2,734,010
2008	1,286,099	1,683,462	2,192,432
2009	1,074,226	1,379,344	1,762,791
2010	899,493	1,132,981	1,420,877
2011	1,196,968	1,478,957	1,820,098
2012	1,223,220	1,482,605	1,790,483
2013	746,322	887,350	1,051,587
2014	617,071	719,700	836,965
2015	511,425	585,122	667,741
2016	521,771	585,589	655,782
2017	392,360	431,961	474,698
2018	325,182	351,184	378,715
2019	270,148	286,193	302,860
2020	224,950	233,771	242,761
2021	1,454,147	1,482,383	1,510,619
Total	**28,014,635**	**37,038,499**	**49,150,293**

Table 10.Net cash flows in case the utilization price is US $17 (Erdoğmuş 2003)

r	Year	Net cash flow (A_r) (in US $)
0	2002	-16,337,588
1	2003	-4,519,775
2	2004	-3,028,285
3	2005	-2,178,048
4	2006	-4,662,139
5	2007	-1,687,364
6	2008	-1,546,696
7	2009	-1,427,928
8	2010	-1,327,319
9	2011	-2,717,197
10	2012	-1,606,623
11	2013	-1,268,426
12	2014	-1,183,554
13	2015	-1,112,268
14	2016	-1,133,408
15	2017	-1,034,885
16	2018	-985,352
17	2019	-943,656
18	2020	-908,469
19	2021	-1,878,115
Total		-51,502,098

Operating cost of the year 2002 is accepted by Erdoğmuş (2003) as a balance cost which is likely to continue in the following years. Operating cost of 2002 is 1,121,218. The heated area is accepted as 1,150,000 m^2 (815,132 m^2 dwellings) in Balçova and Narlıdere regions. It is also important to note that by the end of year 2004, the monthly fix cost increased from $17 to $33 for 100 m^2 dwelling.

End of 2021 net future balance values of the GDHS is given below by employing different interest rates to costs and revenues (in USD) in Balçova and Narlıdere region as seen in Table 11.

Table 11.End of 2021 net future balance value of the GDHS with different interest rates (Modified from Erdoğmuş 2003)

Year	n	Cost	Revenue	Balance	2%	4%	5%
2002	20	16,337,588		-16,337,588	-24,276,796	-35,797,667	-43,348,485
2003	19	4,944,561	1901472	-3,043,089	-4,433,206	-6,411,329	-7,689,733
2004	18	3,453,070	1901472	-1,551,598	-2,216,064	-3,143,252	-3,734,105
2005	17	2,602,833	3466526	863,693	1,209,378	1,682,387	1,979,600
2006	16	5,086,924	3466526	-1,620,398	-2,224,460	-3,034,976	-3,537,126
2007	15	2,112,149	3466526	1,354,377	1,822,813	2,439,156	2,815,652
2008	14	1,971,481	3466526	1,495,045	1,972,680	2,588,934	2,960,086
2009	13	1,852,714	3466526	1,613,812	2,087,638	2,687,116	3,043,083
2010	12	1,752,104	3466526	1,714,421	2,174,301	2,744,844	3,078,854
2011	11	3,141,982	3466526	324,543	403,529	499,620	555,079
2012	10	2,031,409	3466526	1,435,117	1,749,400	2,124,324	2,337,654
2013	9	1,693,212	3466526	1,773,314	2,119,274	2,523,979	2,750,992
2014	8	1,608,339	3466526	1,858,186	2,177,162	2,543,056	2,745,388
2015	7	1,537,054	3466526	1,929,472	2,216,357	2,539,054	2,714,961
2016	6	1,558,193	3466526	1,908,332	2,149,092	2,414,649	2,557,348
2017	5	1,459,671	3466526	2,006,855	2,215,730	2,441,645	2,561,312
2018	4	1,410,138	3466526	2,056,388	2,225,900	2,405,683	2,499,552
2019	3	1,368,442	3466526	2,098,084	2,226,503	2,360,059	2,428,794
2020	2	1,333,255	3466526	2,133,271	2,219,455	2,307,346	2,351,931
2021	1	2,533,011	3466526	933,514	952,185	970,855	980,190
Total				2,945,752	-3,229,129	-13,114,518	-19,948,972

Despite the augmentation made in fix charge in 2004, end of 2021 balance values with different interest rates still have negative values and they may need another augmentation in the following years. Erdoğmuş (2003) has analyzed, under different payment scenarios, that fix charge of GDHS should be increased to $55.5 without changing operating costs and connection charge in order to get zero IRR value.

CHAPTER 4

APPLICATION OF MONTE CARLO SIMULATION TECHNIQUE FOR DETERMINATION OF THE ENERGY RESERVE OF BALCOVA GEOTHERMAL FIELD

4.1 Monte Carlo Simulation Technique and Its Procedure

Simulation means imitating or estimating how events might occur in a real situation. It can involve complex mathematical modeling, role playing without the aid of technology, or combinations. The value lies in the placing you under realistic conditions, that change as a result of behavior of others involved so you cannot anticipate the sequence of events or the final outcome. W. S. Gossett, who published under the pen name “Student,” randomly sampled from height and middle finger measurements of 3,000 criminals to simulate two correlated normal distributions (WEB_3 2005). This is supposed to be the first version of the simulation which is used in statistics as “t distribution”, and being used in determination of the confidence interval of the small samples’ distribution which is assumed to have normal distribution.

By the help of the improvement in computer technology, random number generators are used in modeling real life situations. As the most popular method in the last decade, Monte Carlo Simulation technique has been used widely in the experimental sciences. Credit for inventing the Monte Carlo method often goes to Stanislaw Ulam, a Polish born mathematician who worked for John von Neumann on the United States’ Manhattan Project during World War II. Ulam is primarily known for designing the hydrogen bomb with Edward Teller in 1951. He invented the Monte Carlo method in 1946 while pondering the probabilities of winning a card game of solitaire.

Monte Carlo Simulation technique can be defined as a computerized technique which is the basis for probabilistic risk analysis, and which replicates real life occurrences by mathematically modeling a projected event. Monte Carlo simulation uses pre-defined probability distributions of risk variables to perform random modeling over many "simulations" or computer trials. The results are probabilistic (they form a probability distribution) and therefore yield an expected value (mean) and a standard deviation, as well as cumulative probabilities (zero to 100 percent) which express total likelihood (probability) at any level of variable outcome (WEB_4 2005).

Monte Carlo Simulation process could be defined as follows:

- Determination of the statistical distribution of each uncertain variable. It can be extracted by past experiments or information, or by professional expressions,
- Determination of how many times should the simulation be done depending on the number of variables. This could be determined by using the procedures that are applied for statistically paired samples.
- Obtaining cumulative distribution function concerning each uncertain variable by the help of the computer, and making necessary manipulations according to the desired model.
- Making the sensitivity analysis of the results of the simulation that are obtained. The most popular methods for this are regression analysis and calculation of the correlation coefficient. Although these two methods are related with each other, the former is used to find the elasticity between variables and simulation result while the latter is used to measure the degree of co-variation tendency (the degree of association within variables, and between variables and results of the simulation).

4.2 Use of Monte Carlo Simulation Technique

Monte Carlo Simulation technique could be used to calculate geothermal energy reserve, particularly, in which uncertain variables could play an important role in the calculations made. It is also frequently used in petroleum reservoir modeling studies that are strictly related with the issue of determination of reservoir capacity. This technique is used to determine the cumulative probability distribution curve of the variables such as reservoir thickness, area of the geothermal field, the productivity and the thickness of the reservoir, temperature, density, porosity, specific heat of both the fluid and the hot rock, salinity of the fluid, etc, which offer uncertainty in studies about geothermal reservoir

Before the simulation techniques were used, deterministic methods were preferred in researches, and the reservoir was modeled with the most probable values assigned to unspecified variables. As Satman et al. (2002) has mentioned, these kind of deterministic models do not mention the uncertainty emerging while determining the features of rock and fluid. For example, while porosity, volume, specific heat and the density of the fluid and the hot rock, production factor etc. possibly alter in a wide range, they are taken as a single value in deterministic models. Considering that nearly all the parameters and data mentioned are about the underground, uncertainties about these could consequently lead to important mistakes (Satman et al. 2002).

While applying the technique, the researcher should make predictions about how the statistical distribution corresponding the nature of each variable will be in the first stage. Methods generally used while making these predictions could be as using personal experiences, using the values in the previous studies, and if there are no previous studies, using the data of regions that has been studied before and that shows similar geological features. For example, if the fluid of desired heat and flow is found in the wells drilled before in a geothermal field between 600 m and 1100 m minimum, these depths could be used as upper and lower limits while making predictions about the possible well depth. The distribution generally used in the models produced about the reservoir is triangular distribution. The reason for using this distribution is that when there are very few data about the variable, it produces better results compared to the other distributions (Newendorp 1975). There are three parameters that has to be determined in triangular distribution - the minimum (below that value occurrence probability of the variable is zero), the maximum (below that value occurrence probability of the variable is zero) and the most probable value of the variable. Furthermore, simulations could be formed by using distributions such as normal distribution (mean value and the standard deviation), Binomial distribution (the number of "successes" (p) in n independent trials), exponential distribution (mean value), lognormal random distribution (mean, standard deviation), Poisson distribution (mean) and uniform distribution (upper and lower limit) etc.

By using cumulative probability distribution curve that belongs to the model produced by simulation data, thresholds concerning the costs of the project could be obtained. Namely, feasibility of the project could be discussed according to the most probable result seen in cumulative probability, or cumulative probability corresponding the minimum benefit that is expected to be obtained from the project is found, and following this, it could be decided whether the project will be done. If it is needed (if the benefit that is expected to be obtained from the project falls into an interval which causes a risk perception), the consequences of the project could be assessed by risk analysis and decisions could be made.

By making sensivity analysis of the data obtained from the simulation (regression or calculation of correlation coefficients) the effects of the variables in the model (elasticity of the variables) on the result obtained could also be found. Thus variables that cause the maximal change on cumulative probability curve could be determined and simulation parameters could be reformulated. In reservoir models, it is seen that simulation data about volume (the area and the thickness of the reservoir) are generally the variables with the maximum elasticity. The reason for this is that generally the distribution interval of these variables is wide as it is expressed in terms of metres, and this situation may cause serious jumps in the result of the model. In addition, variables such as productivity and recovery factor, in which the shift interval is big, may also affect the results of the model seriously (Satman et al. 2002). It can be seen as a wise attitude for the project appliers to focus on the researches that will limit the shift interval of the variables with the maximum elasticity in their models.

4.3 Balçova Geothermal Field Simulation Model Made by ITU, Petroleum and Natural Gas Department

When the stochastic reservoir model presented in the chapter named "Heat Potential of the Balçova Geothermal Resource" in the project prepared by Satman et al. (2002) is examined, it could be seen that the general equation used is as follows:

$$Reserve\ of\ the\ Field(kW_t) = \frac{Heat\ Energy(kJ) \times Production\ Factor \times Recovery\ Output}{Load\ of\ the\ Station \times Load\ Factor} \text{ .... } (4.1)$$

In order to calculate *Heat Energy (kJ)* in the equation above:

$$H_{Total} = H_r + H_f = (1-\phi).c_r.\rho_r.V.(T_r - T_a) + \phi.c_f.\rho_f.V.(T_f - T_a) \text{ .... } (4.2)$$

could be used, where:

H is heat energy in kJ

ϕ is porosity

c is specific heat in kJ/kg-°C

ρ is density in kg/m^3

V is hot rock volume in m^3

T is temperature in °C

and subscripts *r, f* and *a* stand for rock, fluid and leaving respectively.

In the case of individual structures the independent variables are sampled and the accessible geothermal energy is computed by using the volumetric equation above (Muffler and Cataldi 1979; Serpen 2000):

If the variables given above are examined item by item:

Heat Energy (H; in kJ): It defines the heat energy that the geothermal resource has, and it is the basic value desired to be calculated by simulation model. In order to find the total heat energy, the equation is handled in two parts as heat energy of the hot rock and the fluid, and the total value is calculated by adding these two values.

Production Factor: As noted by Satman et al. (2002), it may be the most critical parameter in the model and represents producible portion/amount of the heat energy. The predictable interval for this parameter, discussed by many researcher, changes between 7% and 25% (White and Williams 1975; Muffler and Cataldi 1978; Sorey et al. 1982, Nathenson and Muffler 1975, Satman et al 2002). Triangular distribution with 18% most probable value is used for this variable.

Recovery Output: This parameter shows the amount of the heat that passes to the distribution system from the main system in which the fluid circulates, and for this parameter triangular distribution is formed. According to the data taken from Balçova Geothermal Ltd. Co., for this variable the minimum value is 70%, the maximum value is 93% and the most probable value is %85 (Satman et al. 2002).

Table 12.Heat produced from Balçova Field and its recovery output to secondary cycle (Satman et al. 2002)

Months	Heat Produced (kCal) x 10^9	Recovery Output (%)
October	2.52	80.0
November	6.19	70.6
December	12.24	92.4
January	17.64	92.6
February	18.33	65.7
March	17.60	43.2
April	15.35	66.8
Total	89.87	-

Load of the Station: It represents the estimated life for the constructed heating station to be used in full capacity. In the model, this value is taken constant and a 25-year load is estimated, which equals 7.88x10^8 secs (Satman et al. 2002).

Load Factor: This value, which enters the model as constant, is determined by an approximation of the number of the days the station is operated. From the data collected it is calculated that the station operates for nearly 150 days in a year, and this is 41% of a year (Satman et al. 2002).

Porosity (ϕ): It is a measure of the water-bearing capacity of subsurface rock. With respect to water movement, it is not just the total magnitude of porosity that is important, but the size of the voids and the extent to which they are interconnected, as the pores in a formation may be open, or interconnected, or closed and isolated. For example, clay may have a very high porosity with respect to potential water content, but it constitutes a poor medium as an aquifer because the pores are usually so small (WEB_5 2005). Values of the porosity distribution are obtained from well log data and the karots. Based on these values, it is assumed that the values concerning the field display triangular distribution, and the minimum value is taken as 0.275, maximum value as 0.7 and the most probable value as 0.05.

Specific Heat (c; in kJ/kg-°C): This value is a descriptive coefficient that varies from material to material. Specific heat value for hot rock is 0.9 kJ/kg-°C, and for fluid it is 4.18 kJ/kg-°C. These values are used as constants in the model.

Density (ρ; in kg/m^3): This is a value which varies from material to material. Densities of the hot rock and the fluid change according to the heat of the material. In the model, it is estimated that the density of the fluid will show triangular distribution. The minimum, maximum and the most probable values of the fluid density are respectively estimated as 921.7, 986.7 and 930.6. It is stated that density of the hot rock shows uniform distribution and it will take values as 2600, 2700 and 2650 (Satman et al. 2002).

Volume (V; in m^3): this defines the volume of the hot rock in the geothermal field. In the model, this value is obtained by multiplying the field area by thickness. In the triangular distribution formed for the field area and thickness, the minimum-the maximum and the most probably values are accepted respectively as $5x10^5$, $2x10^6$ and $9x10^5$, and 250, 1000 and 350 (Satman et al. 2002).

Temperature (T; °C): This value includes three different values as rock, fluid and leaving. Among these, only leaving temperature -not the atmospheric temperature- is taken as 80 °C, which is the leaving temperature of the secondary cycle of the GDHS fluid. In the triangular distribution formed for the temperature of the fluid, the minimum, maximum and the most probable values are stated respectively as 100, 145 and 135. These values are the temperatures of the fluid brought out in Balçova geothermal field (Satman et al. 2002).

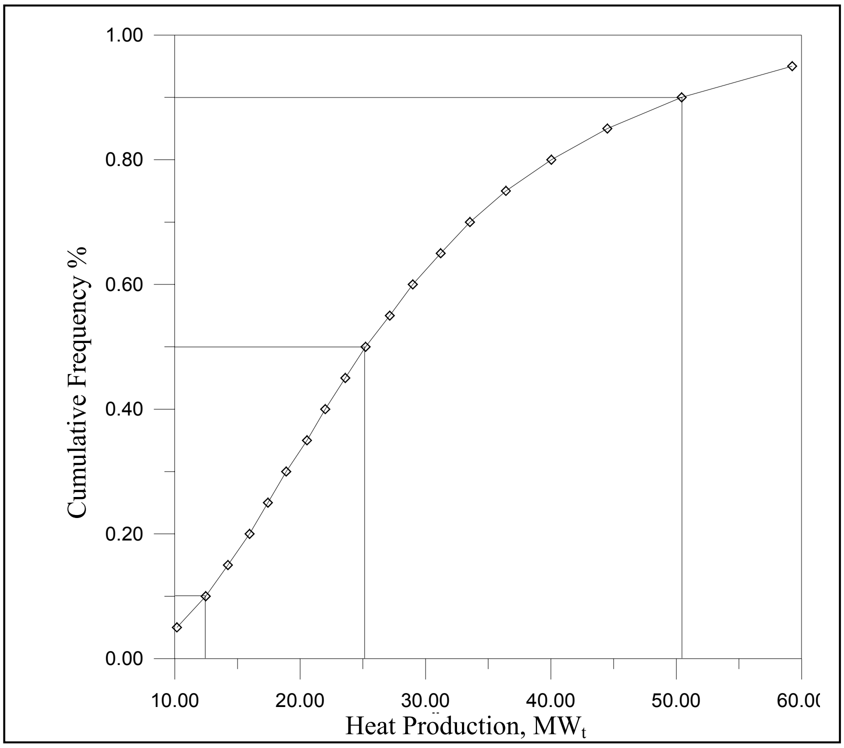
The parameters stated above are given collectively in Table 13.

Table 13.Entries for Monte Carlo Simulation applied in Balçova Reservoir Model (Satman et al. 2002)

Parameters	The Most Probable Value	Probability Distributions		
	(Model)	Type	Minimum	Maximum
Leaving Temperature, ^{o}C	80	Constant	-	-
Spe.Heat of Hot Rock, kJ/kg ^{o}C	0.9	Constant	-	-
Spe.Heat of Fluid, kJ/kg ^{o}C	4.18	Constant	-	-
Porosity, %	0.05	Triangular	0.0275	0.7
Temperature, ^{o}C	135	Triangular	100	145
Production Factor, %	0.18	Triangular	0.07	0.24
Recovery Output, %	0.85	Triangular	0.70	0.93
Load Factor, %	0.41	Constant	-	-
Load of the Station, sn	7.88E8	Constant	-	-
Field Area, m^2	0.9x10^6	Triangular	0.5x10^6	2x10^6
Thickness, m	350	Triangular	250	1000
Density of Hot Rock, kg/m^3	2650	Uniform	2600	2700
Density of Fluid, kg/m^3	930.6	Triangular	921.7	986.7

After having 10,000 simulations done, cumulative probability distribution curve seen in the figure below is obtained.

Graph 2.Cumulative probability distribution curve for heat production



Source: Satman et al. 2002

As it can be observed in the figure, the potential of the field is 12.5 MW$_t$ with 90% probability, 50.5 MW$_t$ with 10% probability, and most important of all, the expected value is 25.5 MW_t. The most probable obtained value of 25.5 MW_t should be taken as the potential of the known part of the field in which the reserve spreads with isotherms till the depth of 1000 m. According to this model, heat production is made for 150 days with a constant flow of nearly 21.5x10^6 kCal/h. However, as it can be seen in the figure above, production actually occurs in a normal distribution. Therefore, the total production of 77.4x10^9 kCal at the end of 150th day with a flow of 21.5x10^6 kCal/h remains a little below the sum used for heating in the system (89.87x10^9, Satman et al. 2002).

According to the sensivity analysis the parameters that affect the results the most are respectively thickness and field, in other words volume. This is natural as the method is volumetric. The other following input variables that the simulation is sensitive to are producibility and temperature. These inputs and variables are either measured or determined parameters except producibility (Satman et al. 2002).

A simulation showing the probable potential of the field is done by using TOUGH2 3D geothermal simulator in ITU Petroleum and Natural Gas Engineering department. With this simulation a number of values are found, and these values are compared to the simulation values above. The aim of the modeling study is to answer two of the important questions that are desired to be answered. That is, the aim is to determine the sustainable and renewable production potential of the field and to determine the life of the field in case of a specific annual production-injection difference

Based on the stored heat in 3D heat distribution model, the producible, observable power is 66 MW_t. It is estimated that the genuine producible heat potential is a value between 25.5 MW_t (which comes from Monte Carlo simulation above) and 66 MW_t (Satman et al. 2002).

If deeper wells are drilled and it is determined that Balçova geothermal field extends to deeper layers, and if geophysical studies are done and it is determined that the geothermal field extends to a wider area, the 3D model and the model applied in this chapter could be updated, new estimations could be done and they could be used for economic risk analysis (Satman et al. 2002).

4.4 Application of Monte Carlo Simulation to calculate Balçova Geothermal Field potential

Within the context of this study, the simulation done by ITU Petroleum and Natural Gas Department, given in the previous chapter, is applied again with the same functional form and parameters. This chapter aims to compare the obtained results with the results obtained in the previous chapter.

The function concerning the calculation of the geothermal reserve is given below so as to make a reminder.

$$Reserve\ of\ the\ Field(kW_t) = \frac{Heat\ Energy(kJ) \times Production\ Factor \times Recovery\ Output}{Load\ of\ the\ Station \times Load\ Factor} \ldots\ldots\ldots\ldots (4.1)$$

In order to calculate *Heat Energy (kJ)* in the equation above:

$$H_{Total} = H_r + H_f = (1-\phi).c_r.\rho_r.V.(T_r - T_a) + \phi.c_f.\rho_f.V.(T_f - T_a) \ldots\ldots\ldots\ldots (4.2)$$

could be used, where:

H is heat energy in kJ

ϕ is porosity

c is specific heat in kJ/kg-°C

ρ is density in kg/m^3

V is hot rock volume in m^3

T is temperature in °C

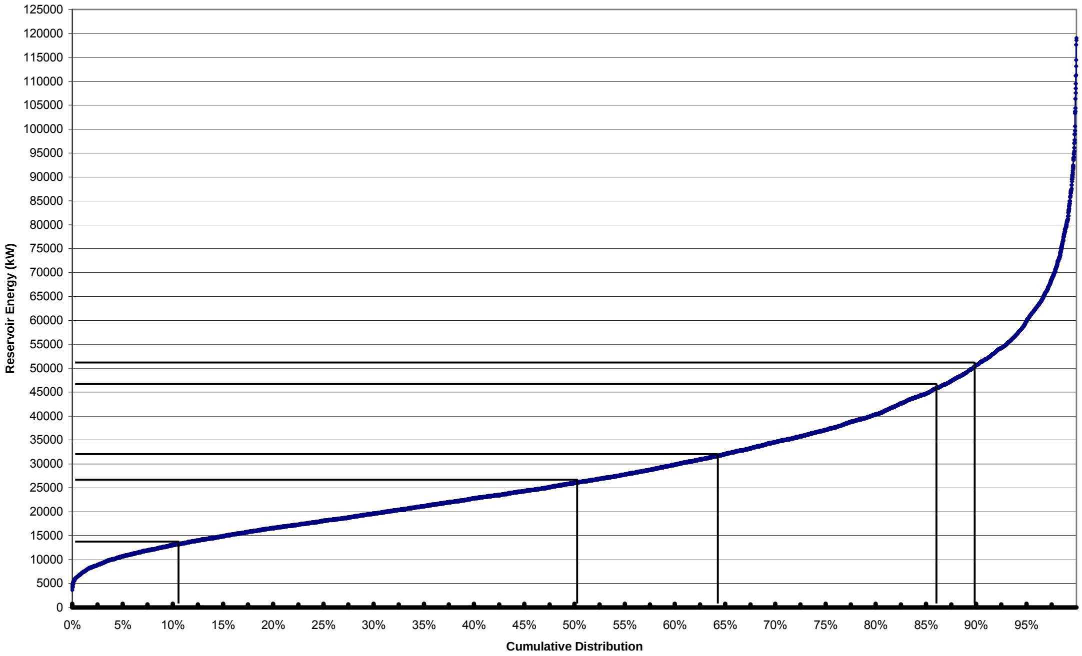
and subscripts *r, f* and *a* stand for rock, fluid and leaving respectively.

The distribution table mentioned under the previous heading could be used for the distribution of the parameters in the function and the estimated limits.

MS Excel 2003 spreadsheets are used to make Monte Carlo Simulation. Although special programs written for simulation are available, there are also simulation tools as “add-in” in the widely used MS Excel program. In this study, Simtools add-in, prepared by Roger Myerson, is used. Simtools adds statistical functions and procedures for doing Monte Carlo simulation and risk analysis in spreadsheets. Formlist, another add-in coming with Simtools, is a simple auditing tool that adds procedures for displaying the formulas of any selected range (WEB_6 2005).

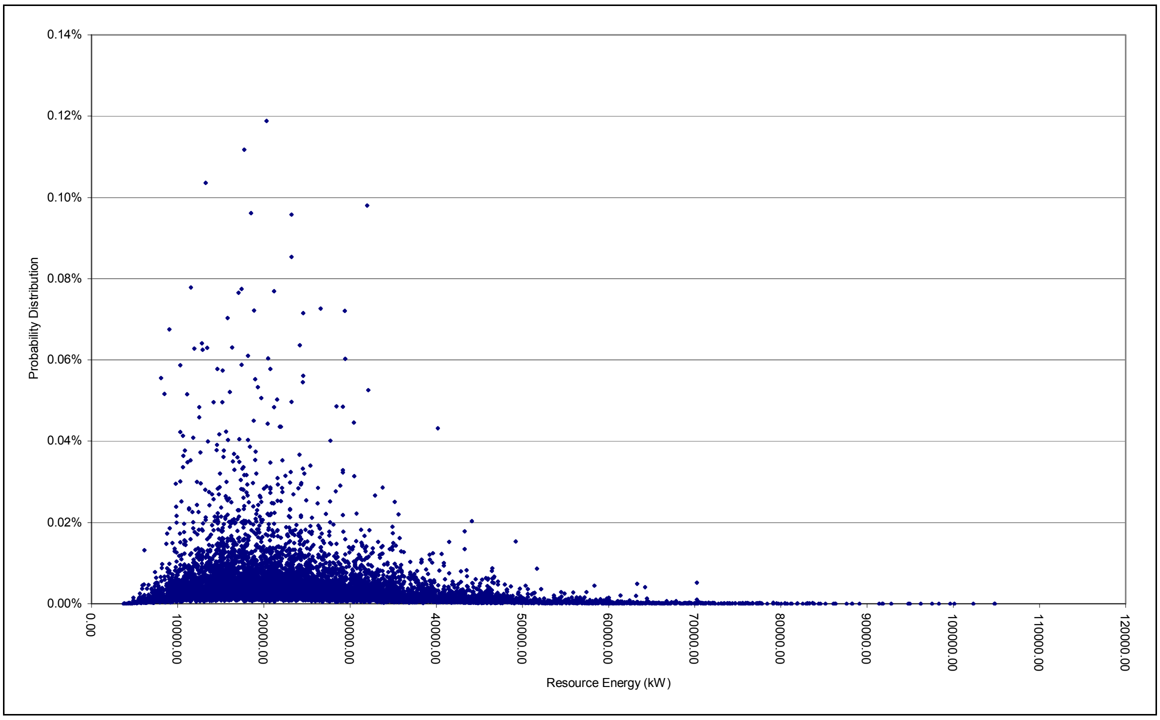
In the first step, parameters and its distributional forms are introduced into the cells in Excel spreadsheet. Then the functions used for the statistical distributions of parameters are written into corresponding cells in the spreadsheet. Following this, these statistical functions are copied into the columns as many as the number of the simulations to be done (in this study 10,000 cells are seen as enough). In the next stage, the necessary calculations are done according to the function above, and the simulation results concerning the geothermal reserve are obtained. The data generated by the model could be find in Appendix B.

Graph 3. Cumulative distirbution curve of the simulation



As expected the results of the two of the models are similar. When cumulative probabilities are studied, it is expected for the resource to be 50.6 MWt with 10%, 13 MWt with 90% and most probably 26.02 MWt as seen in Graph 3.

Graph 4.Distribution of the output of model



In Graph 4, the mean value of the simulation is 26.2 MWt and the standard deviation is 13.8, distribution of the simulation could be named left skewed normal distribution.

It is calculated by the authorities that, in February 2001, 24.1x10^6 kkal/st (≅ 28 MW_t) heat was given to the system from Balçova Heating Centre. The heat mentioned above is used to heat the dwellings and to meet the hot water needs of the dwellings (Satman et al. 2002).

It is also reported by Satman et al. (2002) that all through February 2001, 18.33x10^9 kcal heat was given to the system. It is equal to 31.7 MWt.

Two values (28 MWt and 31.7 MWt) are greater than probable heat energy value acquired from the results of the simulations (25.5 MWt and 26.02 MWt by Satman et al. (2002) and this study, respectively).

According to this it is possible to obtain more energy than modeled from geothermal resource. It could be suggested that the functional form of the model be reconsidered, and maybe the simulation be retried with another functional form including effect of the reinjection .

CHAPTER 5

EVALUATION OF THE GEOTHERMAL RESOURCE EXPLOITATION SCHEMAS OF BALÇOVA GEOTHERMAL FIELD BY USING MULTICRITERIA DECISION AID TECHNIQUE

5.1 Multicriteria Decision-Aid Technique

One can say that, the ethical and logical accuracy of the decisions made in an organization is always a controversial issue. It can be asserted that behind the decisions that the decision-makers make lies related issues such as individual, corporate and social needs, their priorities and measuring the efficiency of the results after making the decision. These issues are related to the quality of the organization that they take place in. One of the methods which is created to evaluate these decisions from logical and ethical points of view is Multicriteria Decision-Aid.

Multicriteria Decision-Aid (MCDA) or Multiple Criteria Decision Making methods are mainly evaluated in the areas of operations research and decision theory but one cannot ignore the links which exist between other fields of research such as the theory of social choice, voting procedures, decision in a context of uncertainty, the theory of fuzzy sets, negotiation and expert systems.

The book titled "Multicriteria Decision-Aid", which is formed by Vincke (1992) by collecting the important publications about the subject, can be shown as an important reference. In this book, definitions about the subject and classifications can be found within a general frame.

As its name indicates, MCDA aims to give the decision-maker some tools in order to enable him to advance in solving a decision problem where several –often contradictory- points of view must be taken into account. The first fact which should be noted when dealing with this type of problem is that there does not exist, in general, any decision (solution, action) which is the best simultaneously from all points of view. Therefore, the word "optimization" doesn't make any sense in such a context; in contrast to the classical techniques of operations research, multicriteria methods do not yield "objectively best" solutions (such solutions do not exist). This is why the word "aid" seems essential to define this methodology. The evolution of multicriteria methods illustrates this point of view perfectly: aggregation into a unique criterion (in order to bring the multicriterion problem back to an optimization problem) was contested and progressively replaced by more flexible, less mathematicized (some will say less rigorous) methods; similarly, interactivity has played an ever-increasing part in the proposed procedures.

Specialists in MCDA have a tendency of dividing the methods into three great families, even if the boundaries between these families are rather fuzzy:

1. multiple attribute utility theory,
2. outranking methods,
3. interactive methods.

The first family, of American inspiration, consists in aggregating the different points of view into a unique function which must subsequently be optimized. It is also directly connected to the utility theory in economics, in particular, school of theorists which allege the utility could be stated as a quantity. The work related to this family studies the mathematical conditions of aggregation, the particular forms of the aggregating function and the construction methods.

The second family, of French inspiration, aims first to build a relation, called an outranking relation, which represents the decision-maker's strongly established preferences, given the information at hand. The latter relation is therefore, in general, neither complete nor transitive. The second step will consist in exploiting the outranking relation in order to help the decision-maker solve his problem.

The third and the most recent family propose methods which alternate calculation steps (yielding successive compromise solutions) and dialogue steps (sources of extra information on the decision-maker's preferences). Though they are mostly developed in the frame of multiple objective mathematical programming, some of these methods can be applied to more general cases.

The methods that MCDA families mentioned above include are stated below with their definitions.

5.1.1 Multiple Attribute Utility Theory

Multiple attribute utility theory (MAUT) is based on a relatively simple idea. The fundamental axiom is that any decision maker is unconsciously or implicitly trying to maximize some function

$$U = U(g_1, g_2, \ldots, g_n) \qquad (5.1)$$

where g_i, is the measure of attribute a_i that aggregates all the different points of view taken into account. If the decision maker is asked about his/her preferences, the answers will be coherent and consistent with that certain unknown function *U*. The key here is that more than one criterion affects the decision maker's utility. In a sense, the utility function is based on the criteria as a whole rather than on individual utilities. Having said that, convenient additive utility functions occur under certain assumptions, the analysts' role with these techniques is to try to discover the nature of that function, *U*, by asking the decision maker some well-chosen questions.

Two types of problem are studied in the frame of this theory:

- Decision maker's preferences must fulfill, so the properties can be reasonably represented by a function *U* with an analytical form, such as the additive, multiplicative, mixed and other forms
- The other is to build such a function, identify its analytical form and estimate its parameters.

5.1.2 The Additive Model

The most simple and the most common analytical form is additive form

$$U(a) = \sum_{j=1}^{n} U_j(g_j(a)) \qquad (5.2)$$

where $g_j(a)$ means the value of the action a corresponding to criterion j and the U_j's are strictly increasing real (utility) functions and their only purpose is to transform the criteria in order for them to follow the same scale: This avoids problems of units and ensures that summation makes sense.

It is important to note that in order to evaluate utility function reasonably and to get comparable results from the differences of them (eg. $U(a)-U(b)$) utility independence between criteria should be provided.

Two type of method constituting the additive model mentioned in the work of Vincke (1992) could be summarized as below:

First, direct method consists of several different methods. Some of these methods suggest that utility function could be formed by dialogue with the decision maker on determining mid points of the best and the worst values of the criteria and going further by taking midpoint of the best-mid, mid-the worst so on. The others, on the other hand, suggest assigning probabilities to the best and the worst state of the criteria to find probabilistic mid points of the function while there are methods that suggest finding the common points according to the points of view of the decision-makers and comparing these with the answers of the others.

Second, indirect methods could be used for building the additive model. These methods of building the function *U* consist in estimating it on the basis of the global judgments made by the decision-maker on set *A*, set of all possible actions or plans. In essence, these methods are the generalization of the *U* function by discriminant analysis. The indirect method, which is also called UTA (Utilité Additive), consists in first determining and optimizing utility function through linear programming and then performing a sensitivity analysis. It assumes the criteria are expressed in numerical form. Then, the interval of the best and the worst states in the set of all possible states divided into r_j equidistant intervals. The utility of each action can be determined by interpolation. Linear programming is applied to minimize the errors that will be found hypothetically in the assumptions about the best values of each action. This step yields a function *U* which is the sum of partial piecewise linear utility function. If the sum of the error associated with the estimation is greater than 0 (this shows that the utility function will be changed according to the criterion that the decision-maker has chosen), the smallest number obtained in the previous step being greater than the sum of errors is added to the constraints set, and thus a set of utility functions which are suitable for the representation of the decision-maker’s preferences is obtained. PREFCALC software can be used to solve UTA problems (Vincke 1992).

5.1.3 The Multiplicative Form

The additive model can be made into multiplicative one which is also related to the functional form of the utility equation (e.g. logarithmic relationships between criteria). By letting,

$$U'(a) = e^{U(a)} \quad \text{...} (5.3)$$

$$U'_j(g_j(a)) = e^{U_j(g_j(a))} \quad \text{..} (5.4)$$

and we get

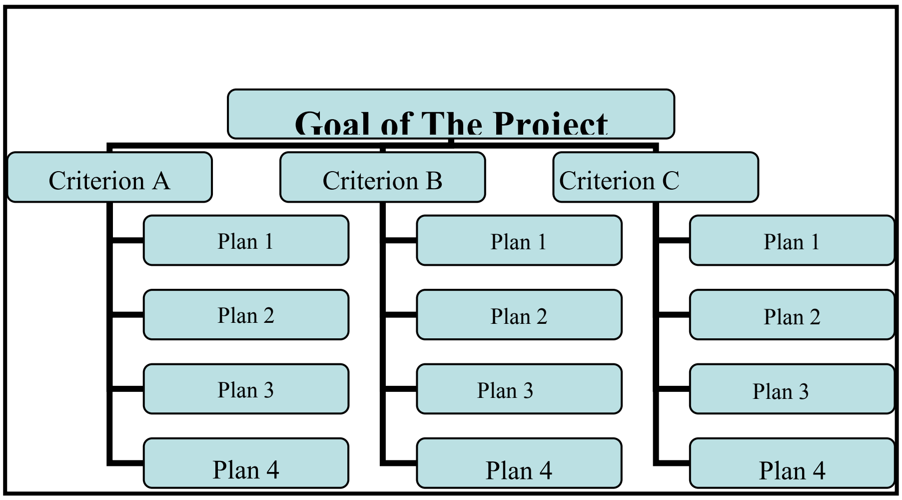
$$U'(a) = \prod_{j=1}^{n} U'_j(g_j(a)) \quad \text{..} (5.)$$

The converse is also true that by using logarithm multiplicative model could be converted to additive one. Multiplicative form which is convertible into the additive form utility functions could be solved by using the appropriate additive method.

5.1.4 The Analytical Hierarchy Process (AHP)

Another MAUT method suggested by Saaty (1980) is AHP. It is possible to explain this method in three steps. In the first step, the decision problem is represented as a hierarchy in which the top vertex is the main goal of the problem, the bottom vertices are the actions or plans and the intermediate vertices represent the criteria. The figure below shows hierarchic representation of the AHP problem.

Graph 5.Hierarchic representation of the AHP problem



Source: Yoe 2002

At the second step, at each level of the hierarchy, a pairwise comparison of the vertices is performed from the point of view of their contribution to each of the higher-level vertices to which they are linked. These comparisons are made in terms of "preference ratios" (if they are actions) or "importance ratios" (if they are criteria) evaluated on a numerical scale. The computation of the eigenvalues of this matrix of pairwise comparisons, allows the calculation of the value to be given to each comparisons. At the last step the global contribution of each action to the main goal is calculated by an aggregation of the weighted average type (Saaty 1980).

5.2 Outranking Methods

Methods based upon MAUT lead to a function allowing the ranking of all actions from best to worst. The large amount of information contained in the result is due to the theory's strong assumptions (existence of function *U*, additivity etc.). However, it is necessary to go that far in the frame of decision aid, for example, if it is known that some action *a* is better than *b* and *c*, it becomes irrelevant to analyze preferences between *b* and *c*. The underlying idea of the outranking methods is thus that it is better to accept a result less rich than the one yielded by MAUT, if one can avoid introducing mathematical hypotheses which are too strong and asking the decision-maker questions which are too intricate. The outranking methods can be sorted as follows:

5.2.1 The ELECTRE I Method

This method's aim is to obtain a subset *N* of actions such that any action which is not in *N* is outranked by at least one action of *N*. According to the weight assigned to each criterion, a concordance index that shows the preference of each plan over the other plans, and discordance indexes that show the incomparability or tie state are formed (to form the discordance indexes, discordance conditions are defined, for example, if the difference between two actions, say cost difference, exceeds x units, an outranking relation between them cannot be found). Then, the outranking relation is defined according to the weight value that is chosen between them. An outranking relation might not be formed between some actions(because of discordance conditions or tie state) (Vincke 1992).

5.2.2 The ELECTRE II Method

Different from ELECTRE I, ELECTRE II aims to rank the actions from the best to the worst (ranking problem). In this method new constraints are brought concordance and discordance indexes that take place in the previous method. These constraints are as defining concordance thresholds and grouping the outranking relations as “strong” and “weak” relations. By selecting the weak actions from the strong ones a set is formed, and another set is formed by selecting the strong ones from the weak actions. Then, they are compared to see whether they are the same or not. If the sets that are formed are not the same, for example, if a certain action doesn’t outrank any other and is itself outranked by no other action, or the data too divergent is able to build an acceptable ranking, robustness analysis is necessary (Vincke 1992).

5.2.3 The ELECTRE III Method

The valued outranking relation of the ELECTRE III method is characterized by the definition of an outranking degree *S(a,b)* associated with each ordered pair *(a,b)* of actions, representing the more or less great outranking credibility of *a* over *b*. Here concordance index pseudo-criteria is formed according to the weights assigned. The mentioned pseudo-criteria could take the value representing indifference till a threshold value that will be determined, and could take a certain preference value (which is generally 0 or 1) after reaching the threshold value, or it could be linear between indifference and preference thresholds. Discordance index is formed by introduction veto threshold. This index, as explained in pseudo-criteria above, is formed by veto values that are assigned according to the threshold values. Then, the degree of the outranking of the actions is defined by pairwise comparison:

$$S(a,b) = \begin{cases} c(a,b) \ \ if \qquad D_j(a,b) \le c(a,b), \forall j, \\ c(a,b), \prod_{j \in J(a,b)} \dfrac{1 - D_j(a,b)}{1 - c(a,b)}, \end{cases} \qquad \text{.........................(5.6)}$$

where *c(a,b)* is the concordance index, $D_j(a,b)$ is the discordance or veto index, *J(a,b)* is the set of criteria for which $D_j(a,b)>c(a,b)$ and *j* is the number of criteria *(1,2,3,…., j)* (Vincke 1992).

5.2.4 The ELECTRE IV Method

The ELECTRE IV method is based upon the consideration of a family of pseudo-criteria, it aims to rank the actions, but without introducing any weighing of the criteria. Instead of the weighing the criteria, two relations are built (strong and weak) on the basis of "common sense" considerations compatible with the lack of information on the relative importance of the criteria. The exploitation is performed as in ELECTRE III but is made simple by the fact that there are only two outranking levels. One determines the subset of actions which have the largest qualification in all actions for strong relation. If the number of the element in this set is only one, qualifications start again in the remaining actions in the largest qualification subset. When there are more than one element in the former qualified set, same procedure is applied inside this set but on the basis of weak relation. Second direction is built by and ascending procedure as mentioned above (Vincke 1992).

The subsequent outranking methods involve (in) an importance relation on the criteria.

5.2.5 The MELCHIOR Method

This method involve (in) an importance relation on the criteria. A family of *n* pseudo-criteria is at hand, provided with a relation *T* such that *iTj* means: criterion i is at least as important as criterion j. The basic idea is to say that a outranks b is the criteria which are unfavorable to the latter assertion are "hidden" by those which are in its favor and if no criterion j exists such that $g_j(b)>g_j(a)+v_j$ (means state of action b according to criterion j is greater than state of action a according to criterion j plus a veto threshold).

It remains to define (1) criteria which are in favor of the outranking of *b* by *a*, (2) criteria which are unfavorable to the outranking of *b* by *a*, (3) to hide (Vincke 1992).

5.2.6 Trichotomic Segmentation

The procedure description of this method was built in order to help a decision-maker who must, during the process of discovering the actions, decide to which category he will assign them among several defined in respect of the treatment they will receive later; this kind of situation occurs, for example, in loan allocation problems, when launching new products or research projects, and so on. This procedure is limited to the case where there are three categories considered: K^+, K^-, *and* $K^?$ (in the example of loan allocation, they correspond to “accepting”, “refusing” and “awaiting extra information”).

First of all, the “high profile” (values that the decision-maker will accept without any hesitation) and “low profile” (values that the decision-maker will refuse without any hesitation) of each criterion are defined as vectors. If an action has a state over the high profile of a criterion, it is assigned to K^+, if it has a state below, it is assigned to K^- and finally if it has a state between the high and the low profile, it is assigned to $K^?$. After this, outranking indexes are formed by pairing high and low profiles and the state of actions (it is calculated as in ELECTRE III) (Vincke 1992).

5.2.7 The PROMETHEE Method

Just as ELECTRE III, this method consists in building a valued outranking relation, but this time trying to involve concepts and parameters which do have physical interpretation easily understandable by the decision-maker. Procedure of this method is summarized as: having assigned to each criterion a weight p_j, increasing with the importance of the criterion, the outranking degree of each ordered pair of actions *(a,b)* is computed by introducing six types of criterion form which are offered the decision-maker to make a choice (detailed information about the types of criterion will be given in this chapter).

Outranking degree of the PROMETHEE method is quite similar to the concordance index in the ELECTRE III method; they are even identical if all functions F_j (preference intensity of the criterion which is represented in a graphical form) are of linear pseudo-criterion form mentioned above. On the other hand, there is no discordance concept is introduced to PROMETHEE. According to the outranking degree, each action is compared first as *(a,b),* and then as *(b,a),* and their “outgoing flow” and “ingoing flow” are found respectively. Their intersection yields the partial preorder of the

PROMETHEE I method. The PROMETHEE II method consists in ranking the actions following the decreasing order of numbers which is sum of outgoing flow and ingoing flow. The software called PROMCALC, DECISION LAB and GAIA is used to operate the PROMETHEE method with analytical and graphical tools (Vincke 1992).

5.3 Interactive Methods

An interactive method consists of alternating computation steps and dialogue with the decision-maker. The first computation step provides a first solution which is presented to the decision-maker, who reacts giving extra information about his preferences. Injecting the latter information into the model allows a new solution to be built (Vincke 1992).

Any decision aid method includes some kind of dialogue with the decision-maker, if only to define sets of actions and criteria. However, in order for it to be classified as an interactive method, that dialogue must be one of the principle investigation tools, meaning that the decision-maker brings a direct contribution towards the elaboration of a solution by intervening in the procedure and not only in the definition of the problem.

For generalization, those methods firstly act from Multiple Attribute Utility Theory, and multiobjective linear programming methods are used. The extreme points of the utility function are modified according to the weights that the decision-maker puts. The optimized “ideal point” is presented to the decision-maker. If the decision-maker is satisfied with the result, he can end the process. If not, according to the method that will be chosen, questions – such as whether the decision-maker wants to improve any criterion, whether concession will be given to any criterion, or whether there are criteria that he wants to relax or restrict – are asked to the decision-maker. Information about the possible consequences of the changes that will be made is given, and the process is carried to the end and it is checked whether the changes that the decision-maker has made converge an action (Vincke 1992).

The purpose of an interactive method is essentially to find a “satisfactory compromise solution”. Supporting to decision-maker is one of the most important aspects of an interactive method. The role of a method is not to decide for decision-maker, but to enlighten him on his problem (learning-oriented conception): what is possible, what are the consequences of a certain choice, how can an aspect be improved, and so on (Vincke 1992).

5.4 Selecting PROMETHEE

In the work of Goumas et al. (1999), which has been mentioned before as the inspiration for this study, the reasons for the election of PROMETHEE as multicriteria decision aid methods are given. These are shortly listed as the simplicity of the method and the limited amount of input data that is required. By simplicity of the method the intent is to say that it is easy to follow even for persons with no expert training in the multicriteria analysis. The users can better estimate the parameters required to express their own preferences and evaluate the results. Limited amount of input data can be put forward as a general reason of preference of outranking methods, mentioned above, by the users.

The following steps are required for the implementation of the method.

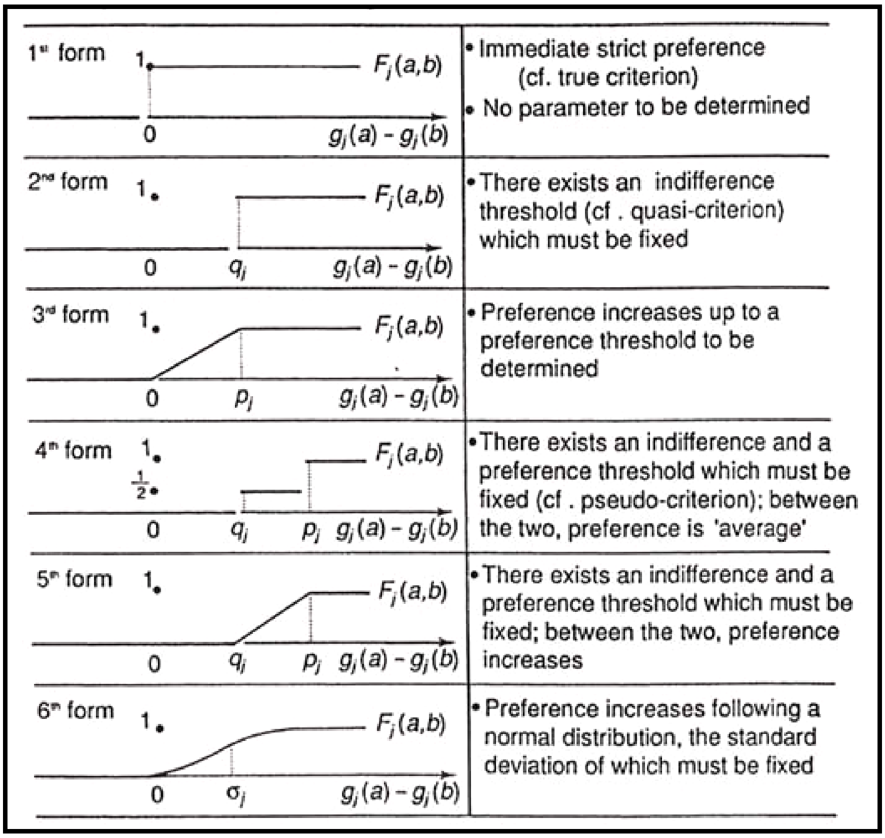
1. Having assigned to each criterion a weight p_j, increasing with the importance of the criterion, the outranking degree $\pi(a,b)$ of each ordered pairs of actions $(a.b)$ is computed. The computation is made as follows:

$$\pi(a,b) = \frac{1}{P}\sum_{j=1}^{n} p_j F_j(a,b) \text{ where } P = \sum_{j=1}^{n} p_j \text{ ....}(5.7)$$

   and where $F_j(a,b)$ is a number between 0 and 1 which increases if $g_j(a)-g_j(b)$ is large and equals zero if $g_j(a) \leq g_j(b)$ (where $g_j(a)$ is the state of the action a evaluated by criterion j)

2. In order to estimate $F_j(a,b)$'s, the decision-maker is offered a choice, for each criterion, between the six forms of curves presented below. According to the way his preference increases with the difference $g_j(a)-g_j(b)$, the decision-maker sets, for each criterion, the form of F_j and the associated parameters.

Figure 4. Six form of the preference intensity in the PROMETHEE



Form	Description
1st form	• Immediate strict preference (cf. true criterion) • No parameter to be determined
2nd form	• There exists an indifference threshold (cf . quasi-criterion) which must be fixed
3rd form	• Preference increases up to a preference threshold to be determined
4th form	• There exists an indifference and a preference threshold which must be fixed (cf . pseudo-criterion); between the two, preference is 'average'
5th form	• There exists an indifference and a preference threshold which must be fixed; between the two, preference increases
6th form	• Preference increases following a normal distribution, the standard deviation of which must be fixed

Source: Vincke 1992

a and b actions has states according to criterion *j*. In the figure above, when the 5th form is chosen for criterion *j*, difference between the states of the actions *a* and *b* according to criterion j is tie till threshold -indifference- value (q_i); over that threshold, action *a* is preferred linearly to action *b*, and at the preference threshold, *a* is preferred to *b*. Index takes a value in [0, 1] interval between these two threshold values. For example, if the criterion is determined as the total profit, it is asked to the decision-maker to what extend he wants the actions that he has to be the indifferent, and from what point on it will result in definite preference of one of these actions to the other one. ıf we suppose these thresholds as, for example, 200 and1000, this means that if the difference between action *a* and *b* is 200 and less, actions are indifferent; if the difference is more than 1000, then the action which causes the difference is preferred to the other one. however, if, for example, the difference is 600, preference intensity index value will be 0.5, if it is 400, this value will be 0.25, and if the difference is 900, then it will be 0.875.

3. For each ordered pairs of actions, $\pi(a,i)$ value given above (where i is the all actions except a) is found. By using the sum of these values ϕ^+ (outgoing flow) value can be found. When the same procedure is calculated for $\pi(i,a)$ and these values are added up, ϕ^- (ingoing flow) value is found.

$$\phi^+(a) = \sum_{i \in A} \pi(a,i) \text{ and } \phi^-(a) = \sum_{i \in A} \pi(i,a) \text{ ....(5.8)}$$

where A is the set of all actions. $\phi^+(a)$ value shows the general superiority of action a to the other actions.

4. When evaluating the results conditions given below should be satisfied:

a outranks *b* if:

$$\phi^+(a) \geq \phi^+(b) \text{ and } \phi^-(a) \leq \phi^-(b) \text{ ....(5.9)}$$

a and *b* are incomparable if:

$$\phi^+(a) > \phi^+(b) \text{ and } \phi^-(a) > \phi^-(b) \text{ or vice versa. ....(5.10)}$$

PROMETHEE I may not give the complete order of actions because it only emphasize outranking relations as *a* outranks *b*, or *a* is tie with *b*, or *a* is incomparable with *b*. It does not compare conflicting actions.

While the process to be followed for PROMETHEE I method is as stated above, in PROMETHEE II, the ordering of the actions can be made by adding up $\phi^+(a)$ $\phi^-(a)$ values.

$$\phi\ (a) = \phi^+(a) + \phi^-(a) \text{ ....(5.11)}$$

It gives complete order of the actions.

When the decision-maker is not able or does not want to allocate precise weights to criteria, it is possible to specify intervals of possible values rather than one fixed value for each weight. In this case, the PROMETHEE VI procedure can be used to indicate whether the problem is *soft* or *hard*. It is *soft* when the decision axis π always remains in the same general direction for the weight distributions that are compatible with the intervals. It is *hard* when opposite directions are possible depending on the actual values of the weights. In the case of a *hard* problem, the decision-maker should concentrate on more precise values of the weights (WEB_7 2005).

It is often the case that several alternatives have to be selected and that additional constraints must hold. In this case a (0-1) linear program can be associated to the problem, the solution of which gives the best selection of *r* actions among *n*. The PROMETHEE V procedure allows investigating such problems (WEB_7 2005).

5.5 Exploitation Possibilities of Geothermal Resource in Balçova

At present district heating (main system) is generally utilized as a resource for greenhouse heating and thermal spa uses. In addition to these utilizations, small scale fruit and vegetable drying facility is presented in this study. The evaluation of the mentioned utilizations in terms of economy, return on investment (ROI) and employment are studied as follows.

It could be said that the model prepared by Monte Carlo Simulation technique underestimates the resource. The value of 25.5 MWt obtained from the model is a little below February 2001 value of 31.7 MWt. The simulation done by TOUGH2 shows that the resource of the field might have a capacity of 66 MWt. In this study, the average of these two values is taken, and it is assumed that the resource of the field could have a power of 45.75 MWt. This value equals to 14% cumulative probability value of the geothermal resource modeled by Monte Carlo Simulation technique as seen in Graph 3.

The difference between the value of 45.75 MWt taken as probable value and February 2001 value of 31.7 MWt is nearly 14 MWt. This difference value is assumed as the resource value to be exploited in the subsequent calculations. ROI, tons of oil equivalent (TOE) value and annual working days are chosen as criteria.

ROI is used to evaluate the efficiency of economic investments, and it is equal to the ratio of net benefit and investment. For example, if a project has an ROI of 300%, the net benefits derived from that project are three times those of the expected total costs to implement the project. As such, the ROI calculation represents the relative value of the project's cumulative net benefits (benefits minus costs) over the analysis period, divided by the project's cumulative total costs, and expressed as a percentage.

Another criterion is TOE (tons of oil equivalent). TOE defines the oil equivalent quantity of the energy obtained from an energy resource other than oil, and it equals to 10^7 kcal (41.860 GJ). The use of oil increases parallel to the economic growth. It is categorized as export product. The need for oil as energy raw material increases oil import dependency and causes environmental problems.

Annual working days calculates the annual working days that the jobs possible to be created by proposed alternatives would create.

While calculating ROI, the existing GDHS cost-benefit and the cost-benefit of alternatives, in which assumed additional capacity of 14 MWT will be evaluated, are calculated together. Here the basic attitude is to analyze the cost-benefit to the local economy and to calculate its ROI. For the alternatives, cost items are evaluated as investment, operating and depreciation. Revenue is handled as production benefits.

TOE is calculated by using the degree day procedure. The general relation for fuel calculations using the degree day procedure is as follows [26]:

$$F = \frac{24(DD)C_D\dot{q}}{\eta_h(T_i - T_o)H} \quad \text{..} (5.12)$$

where *F* is the quantity of fuel required for the period desired (the units depend on H),*DD* is the degree days for the period desired in ºC day, C_D is the interim correction factor for degree days based on 18 ºC (Mc Ouiston and Parker, 1994) or based on various outdoor design temperatures (Lund and Lineau 1997), $\dot{q}$ is the total calculated heat load based on design conditions in W, η_h is the average heating system efficiency in percent, *H* is the heating value of the fuel in kWh per unit volume or mass and T_i and T_o are the indoor and outdoor design temperatures in ºC, respectively (Üner and İleri 2000).

Annual working days are calculated taking into consideration full-time – seasonal and with shift – without shift types of employment.

There are other criteria of interest in problems concerning renewable energy exploitation projects, such as the environmental impact, the risk of the enterprise and the acceptance by the local community. Their evaluation is not straight forward; however, a comparative index e.g. a grade in a scale 0-10 can be applied. In this example these three additional criteria were not included in the evaluation because the five options that were ranked exhibit approximately equal performance for the criteria of environmental impact and risk. The criterion of acceptance by the local community was not considered independent as it mostly depends on the creation of new jobs and the environmental impact. Thus, its effect can be taken into consideration by properly adapting the weighting factors of other criteria. Although theoretically there is no limit to the number of independent criteria that can be considered, it is a good practice to avoid extending the analysis by including criteria that are not expected to influence the ranking. The omission or elimination of criteria, when justified, reduces the required decision parameters keeping the decision process simple and unambiguous (Goumas et al. 1999).

The criteria values of all alternatives are calculated for the period till the end of the year2021.Aannual interest rate of 5% is used for calculation of net end of year 2021 value.

5.6 Exploitation scenarios proposed for Balçova geothermal field

5.6.1 District Heating

Following electricity production, geothermal energy is exploited most for district heating systems. District heating is heating residential areas by using geothermal fluid that transfers heat directly to the heating system of the dwelling or that is used for secondary fluid.

The main reasons for geothermal being more convenient than other energy sources are discussed below.

1. As the selling price of geothermal heat is held constant for the whole year, geothermal heating projects are more attractive to consumers. The cost of geothermal heating, including hot sanitary water, varies from 14 to 33 US$/ month for a 100 m^2 residence, relative to existing geothermal district heating systems. As this cost remains the same throughout the year in Turkish lira and is not affected by currency variations, it is more economically attractive to the consumer than fossil fuel-driven schemes.
2. Existing heating systems can be connected directly to geothermal district heating systems.
3. Previous radiator models, designed for the 90/70°C temperature intervals of conventional heating systems, have not caused any problems when used with temperature intervals of 80/40°C, 80/45°C or 70/50°C, which are typical of geothermal systems. This suggests that the radiator heating surface was originally of a larger design than necessary.

4. The investment costs per residence of geothermal district heating systems varied between 1250 and 1800 US $ (excluding installation of radiators). These investment costs are currently being paid back commercially in 5–8 years. The GDHS have relatively low initial and operational costs and the sales price of the heat is also low compared to conventional fuels (coal, oil, etc.).
5. About 40–50% of the investment costs were paid by the consumers in the form of a connecting fee, like cash in capital. As a result, the economy of GDHS investments is improving. (Mertoglu et al. 2003)

Table 14. City based geothermal district heating systems installed in Turkey (Batık et al. 2000, Mertoğlu 2001a, Hepbaşlı and Çanakçı 2003)

Location	**Province**	**Capacity (MW_t)**	**Geothermal fluid temperature (°C)**	**Year commissioned**	**District heating distribution network supply/return temperatures (°C)[a]**	**Installed Capacity (residence)/Number of dwellings heated**
Gönen	Balıkesir	32	80	06.1987	-	4500/3400
Simav	Kütahya	25	120	10.1991	65/50	6500/3200
Kırşehir	Kırşehir	18	54-57	03.1994	48/42	1800/1800
Kızılcahamam	Ankara	25	80	11.1995	-	2500/2500
Izmir-Balçova (Narlıdere)	Izmir	72	115	10.1996	85/60	20000/6849
Kozaklı	Nevşehir	11.2	90	1996	-	1250/1000
Afyon	Afyon	40	95	10.1996	60/45	10000/4000
Sandıklı	Afyon	45	70	03.1998	70/40	5000/1700
Diyadin	Ağrı	42	78	09.1998	78/45	2000/1037
Salihli	Manisa	142	94		-	20000[b]

[a] Average values are given

[b] Target capacity

In Table 14, city based geothermal district heating system installed could be seen. As seen in the table, İzmir-Balçova GDHS is the biggest geothermal district heating system in Turkey. Afyon, Salihli, Simav have important geothermal energy reserve that is utilized or planned to utilized by the SPO and the local authorities.

The biggest district heating system in Turkey is Balçova GDHS. One of the main considerations in this study is how economic balance would change when estimated potential geothermal capacity is exploited in district heating system. The items listed below are main evaluation criteria that are used to make decision on proposed exploitation schemas.

- Increase in investment cost

- Increase in operating cost
- Change in depreciation cost
- Benefits to be obtained
- Potential of the system to create employment
- TOE value of the system

The calculation of these parameters is based on the values in the study of Erdoğmuş (2003). Besides this, calculations of customer benefit and heat load based on the design condition made by Toksoy and Çanakçı (2001) are used in the calculation of TOE value of the district heating system. It is assumed that 1 m^2 area will create an employment of 0.02607 days/yr. From the year 2004 on, a fix charge of 33 $ have been collected.

5.6.2 Thermal Tourism

Recently the interest in thermal tourism has increased as, particularly, the aged population has increased and as it has lower costs to treat orthopedic and blood circulation diseases by thermal therapy.

One of the alternatives that the Ministry of Culture and Tourism suggests to widen the scale of tourism service is thermal tourism. Given table below are the places determined by the Ministry that have this kind of tourism potential.

Table 15.Alternative Tourism Investment Areas and Thermal Tourism Centers (WEB_8 2005, Ministry of Culture and Tourism)

Thermal Tourism Center	Area	Beds Available	Beds Planned	Total Beds	Thermal Capacity (Lt/ Sec)	Thermal Fluid Prod. (Lt/ Sec)	Thermal Fluid Consump (Lt/ Sec))	Temp. of the Fluid (^{o}C)
Afyon-Gazlıgöl	73,0	287	1950	2.237	15,5	30,0	12,0	50-75
Afyon-Bolvadin Heybeli	262,0	500	12300	12.800	89,2	55,0	29,0	57
Afyon-Ömer Gecek	1.300,0	1000	9000	10.000	69,5	100,0	80,0	50-95
Afyon-Sandıklı Hüdai	126,5	1500	5000	6.500	45,1	175,0	52,0	45-70
Ağrı-Diyadin	280,0	-	-	-	-	6,0	6,0	45-75
Amasya-Terziköy	-	-	-	-	-	-	-	-
Ankara-Seyhamamı	78,5	502	2000	2.502	17,4	21,0	21,0	43
Balıkesir-Gönen	72,5	520	1120	1.640	11,4	100,0	28,0	40-45
Balıkesir-Edremit Güre	98,7	82	2766	2.848	11,4	45,0	2,0	50-60
Bolu-Karacasu	30,0	500	1500	2.000	13,7	33,7	17,6	40-45
Bursa-Kükürtlü	18,0	133	967	1.100	7,8	14,8	6,6	90-110
Çanakkale-Ezine Kestanbol	312,5	600	6000	6.600	46,0	65,0	15,0	60-75
Diyarbakır-Çermik	73,0	1634	1160	2.794	19,5	10,0	5,0	45-50
Erzurum-Pasinler	18,7	66	704	770	5,4	220,0	15,0	47
Eskişehir-Sarıcakaya	13,4	500	1000	1.500	10,4	9,0	9,0	50
İzmir-Balçova	64,2	1004	-	1.004	-	100,0	12,0	45-140
İzmir-Seferihisar Doğanbey	470,0	500	12000	12.500	86,9	90,0	-	78
Kütahya-Emet	25,2	200	900	1.100	7,4	17,0	5,9	40-45
Kütahya-Gediz Ilıcası	17,7	770	2500	3.270	22,7	225,0	15,8	65-75
Kütahya-Gediz Muratdağı	36,0	84	3500	3.584	24,3	45,2	5,4	42
Kütahya-Ilıca Harlek	15,0	302	1750	2.052	15,0	36,0	27,0	43
Kütahya-Simav Eynal	51,0	411	1500	1.911	13,3	200,0	15,2	97
Kütahya-Yoncalı	123,4	450	1400	1.850	12,9	65,0	63,5	41
Niğde-Çiftehan	31,6	1765	2000	3.765	26,1	21,0	14,0	53
Niğde-Narlıgöl	245,2	-	7615	7.615	53,0	110,0	-	65
Osmaniye-Haruniye	27,0	-	-	-	-	15,0	15,0	33
Rize-Çamlıhemşin Ayder	-	665	-	665	-	17,0	14,0	55
Samsun-Havza & 25 Mayıs	313,0	814	1760	2.574	18,0	70,0	21,0	52
Sivas-Kangal Balıklıçermik	24,2	240	360	600	5,0	50,0	-	36
Sivas-Sıcak Çermik	63,8	356	1600	1.956	0,5	200,0	39,0	45-50
Yalova	90,0	704	780	1.484	0,3	18,0	18,0	66
Yozgat-Bahariye Cavlak	87,0	-	2600	2.600	18,1	511,0	35,0	35-40
Yozgat-Sarıkaya	10,5	233	1590	1.823	11,3	28,0	15,0	45-50
TOTAL	**4.451,6**	**16.322**	**87.322**	**103.644**	**677,1**	**2.702,7**	**614,0**	**-**

Ministry of Culture and Tourism plans to direct alternative tourism investment to these districts given in the table below. As seen in the table, Izmir-Balçova district has 1004 bed avaible and there is no bed accrual planned.

The Balçova Thermal Hotel located in Balçova is one of the pioneer facilities in thermal tourism. The numbers of the visitors till the year 2003 are given in the table below. In particular, Scandinavian visitors prefer the Thermal Hotel, because health insurance firms at these countries have contract with the hotel.

Table 16. Visitors of the Balçova Thermal Hotel by nations (WEB_9 2005)

Nationality	1999	2000	2001	2002	2003
Turkish	2386	2200	2125	2457	3148
Norwegian	1175	1235	1403	1482	1321
Denmark	575	520	475	450	275
Other Nations	450	600	615	520	410
TOTAL	**4586**	**4555**	**4618**	**4909**	**5154**

The therapy alternatives that this facility offers are balneotherapy, hydrotherapy, electrotherapy, kinesytherapy, paraffin wax and mud, massage, dental treatment. The number of the personnel related with thermal therapy is 64 (WEB_9 2005).

In Balçova, other than Balçova thermal hotel, thermal therapy service is given in two more five-star hotels – the Crowne Plaza and the Princess Hotel. The information about the hotels located in Balçova, nearby the geothermal resource is given in the table below.

Table 17. Hotels in Balcova

	Area	Rooms	Beds
Princess Hotel	25,000	278	556
Crowne (Özdilek) Plaza	27,000	219	333
Balçova Thermal Cure Center	13,000	215	435
Izmir University of Economics (former Grand Plaza)	18,800	200	380
Pools of the Hotels	5,611	0	0
AVERAGE	20,950	228	426

When the average of the areas of these hotels is taken, a value of nearly 21,000 m^2 is obtained. All of the hotels have 200 or more beds. The number of the personnel working in this kind of five-star hotels could change between 290 and 320 (WEB_10 2005).

In this study, while economic assessment of this kind of hotels is made, 2001 statistics collected by DIE are used. According to this, the statistics between the values of bed number and input, output and value added are as follows.

Table 18. Number of establishments, input, output and value added by number of beds (DIE 2001)

Number of bed's groups	Number of establishments	Input	Output	Value added
		in million TL		
-10	6	2,261,376	4,843,748	2,582,372
11-25	1437	14,332,561	33,665,933	19,333,372
26-50	3767	121,939,080	243,970,625	122,031,545
51-75	2119	300,205,908	582,622,628	282,416,720
76-100	1133	109,162,997	245,307,035	136,144,038
101-150	902	168,571,102	407,577,000	239,005,898
151-200	330	97,453,759	217,983,056	120,529,297
201+	807	1,631,211,173	3,759,110,383	2,127,899,210
Total	10501	2,445,137,956	5,495,080,408	3,049,942,452

The hotels in Balçova are in 201+ bed number group, and the biggest portion per facility as added value belongs to this group.

While calculating the construction costs of the hotels and the therapy centers, the table of minimum construction costs determined annually by the Ministry of Public Works and Settlements is used (The Official Newspaper 2004). It is estimated that, in Balçova, the cost of a facility with a total area of 21,000 m^2 hotel and thermal therapy center could be 17.3 million YTL. The decision of an investment of this magnitude could be seen as rather risky when it is examined in terms of the opportunity cost of the money, risk of the tourism market and risk of the investment.

Moreover, the tourism parcels which will enable investments in this scale in Balçova zoning ordinance are not currently available.

It is assumed that, value added of a five-star hotel which will be heated by geothermal energy and give therapy service will be 8% more than that of the other hotels. These values are obtained directly from DIE statistics. It is assumed that the investment will be completed in two years, and in the first year 33% and in the second year 66% of the total construction cost will be spent.

Working days calculation is made by assuming that320 personnel will be working full-time with shifts and its value is equal to 107200 days/yr.

TOE is taken as 1800 tons/yr approximately by applying degree day procedure. The maximum thermal requirement for this facility is calculated as 1,586 $MW_{t.}$

5.6.3 Agricultural greenhouse production

Agricultural greenhouse production could be summarized as providing the agricultural crops that the market needs in seasons when the climatic conditions are not suitable through artificial environments.

A number of commercial crops can be raised in greenhouses, making geothermal resources in cold climates particularly attractive; however, growth can even be optimized in warmer climates. These include vegetables, flowers (potted and cut), house plants, and tree seedlings. The use of geothermal energy for heating can reduce operating costs (which can amount for up to 35 percent of the product cost) and allows operation in colder climates where commercial greenhouses would not normally be economical. In addition, greenhouses are suited to large quantities of relatively low-grade heat. Furthermore, better humidity control can be derived to prevent condensation (mildew), botritis, and other problems related to disease control. (Schmitt 1981).

Some of the advantages of using geothermal energy are (WEB_11 2002):

- Good correlation between the sites of greenhouse production area and low-enthalpy geothermal resources,
- Low-enthalpy geothermal resources are common in many countries,
- Geothermal energy requires relatively simple heating installations, but advanced computerized installations can later be added for total conditioning of the inside climate in the greenhouses,
- The economic competitiveness of geothermal energy for greenhouse heating, especially in colder climates,
- Strategic importance of energy sources that are locally available for food production, and
- Using a geothermal resource in combination with and existing fossil fuel system for peak heating.

In recent years, it can be observed that, especially in the Balkan states, studies about making greenhouse production by using geothermal energy have increased. The issue of using low-enthalpy geothermal resources in greenhouse production is especially considered.

Based on papers for the WGC2000 and more recent communications, the following estimates are made for the top countries using geothermal energy for greenhouse and soil heating:

Table 19. Top countries using geothermal energy for greenhouse and soil heating (Rafferty 2000)

Countries	**Greenhouse using geothermal energy**
Tunisia	102 ha
Hungary	90 ha
China	69 ha
Italy	50 ha
USA	50 ha
Romania	43 ha
Japan	40 ha
Russia	32 ha
Iceland	29 ha
Bulgaria	22 ha

The amount of energy use varies from 15 to 23 TJ/yr/ha, and thus, using an average of 19 TJ/yr/ha, this would estimate that there are around 940 ha presently using geothermal energy for heating. Of course, the energy use is a function of location, number of heating days, solar radiation, type of construction, wind, etc. (WEB_11 2002).

The equations suggested by Bakos et al. (1999) to calculate the heat loss when constructing greenhouse heating system are given below.

Heat loss during the night takes place through the cover material, the soil and as a result of the entry of cold air into the greenhouse.

The heat loss resulting from the thermal conductivity of the cover material is given as follows:

$$Q_1 = K_{cov} A_{cov} \Delta t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.13)$$

where Δt is the temperature difference inside and outside the greenhouse; A_{cov} is the total surface area of the cover material, including the sides and roof.

The total surface area of the cover material is increased by 18.8% because of corrugations in the material (Lienau 1978). In the event of strong winds, K_{cov} could increase by up to 40%, with a relative increase of heat loss (Kiritsis 1982; Lund 1996).

The heat loss due to soil thermal conductivity is expressed as follows (Kiritsis, 1982):

$$Q_2 = K_{soil} A_{soil} \Delta t' \qquad (5.14)$$

where K_{soil} =1.86 W/(m^{2o}C) and, for a well-heated greenhouse during the night (when soil temperature is greater than the air inside the greenhouse), is $\Delta t \cong \Delta t'$. The calculation of $\Delta t'$ is very complicated and depends on the soil water concentration, greenhouse width and the heating system selected.

The following equation describes the heat loss caused by entry of cold air into the greenhouse:

$$Q_3 = CVn\,\Delta t \qquad (5.15)$$

where C is air specific heat [0.2 kcal/(m^3°C)]; V is greenhouse volume; n is air changes per h (mean value n = 2).

In the presence of strong wind, the above loss is increased by approximately 34.5%.

According to Kiritsis (1982), the cover material heat loss through radiation was estimated at approximately 20-25% of the total loss. (Bakos et al. 1999)

The maximum thermal requirement per 1000 m^2 was estimated as approximately 170,000 kcal/h.

Greenhouse heating can be accomplished by (1) circulation or air over finned-coil heat exchangers carrying hot water, often with the use of perforated plastic tubes running the length of the greenhouse in order to maintain uniform heat distribution, (2) hot-water circulating pipes or ducts located in (or on) the floor, (3) finned units located along the walls and under benches, or (4) a combination of these methods. A fifth approach is using hot water for surface heating.

The most efficient and economical greenhouse development consists of large structures covering 0.2 - 0.4 ha. A typical size would be 36 by 110 m constructed of fiberglass with furrow-connected gables. Heating would be from a combination of fan coils connected in series with a network of horizontal pipes installed on outside walls and under benches. A storage tank would be required to meet peak demand and for recirculation of the geothermal water to obtain the maximum temperature drop. Approximately 6.3 L/s of 60°C - 82°C water will be required for peak heating. The average is much less. Fortunately, most crops require lower nighttime than daytime temperatures. Greenhouse construction and outfitting will run from \$54 to \$108 per m^2 (WEB_11 2002).

In the study of Bakos (1999), various heating systems are tried. The first one of these alternatives is heating the geothermal fluid by auxiliary oil-burning installation on cold windy days, and heating the greenhouse by the help of fan units. This alternative is marked as a method that increases the costs considerably. In order to adjust this, the fluid could be heated at the outlet, but more pipes would be needed. The pipes should be of heavy duty steel in order to minimize any corrosion caused by water flow. Yet, the heavy duty steel pipes used in this method have not been able to pull the costs down to a reasonable level.

The second method offers a choice between two different options: (a) greenhouse heating using water of high temperature (95°C) and (b) greenhouse heating using water of low temperature and, in the case of maximum thermal demands, direct use of the geothermal fluid

The first heating option consists of 521 m of heavy-duty steel pipes (5 cm diameter) for a 25°C temperature reduction from 95 to 75°C, and four auxiliary air fan-coils to reduce the water outlet temperature from 75°C to approximately 50°C (Bakos 1999).

The second heating option involves the use of low-temperature water together with the direct use of geothermal fluid during periods of maximum thermal requirements. For a water temperature of 50°C, the on-the-soil pipe installation was the most economic and most efficient heating system since the plastic pipes run close to the cultivated plants. Plastic pipes of 20 mm and 25 mm diameter and efficiency of 30-40 kcal/(h m), placed one pipeline per m, can be used. In this case, the heavy-duty steel pipes cost more without improving the heating system performance. The air fan-coils, furthermore, cost four times more than plastic pipes of similar efficiency.

Furthermore, the direct use of geothermal fluid can provide fast space-heating, especially where there is a maximum thermal requirement. As far as installation and operation costs are concerned, the proposed method is cheaper than using heavy-duty steel pipes. Heating by means of plastic pipes positioned near the cultivated plants is also a more efficient method. One of the disadvantages of this method, however, is that a large part of the soil is covered by the plastic pipes (approximately 15%), which are sometimes destroyed or damaged by inexperienced cultivators. As a result the pipes have to be removed and replaced annually, leading to increased labor and pipe costs (Bakos 1999).

Because of lower cost, (b) option of the second method could be used for greenhouse heating system in Balçova assuming an efficiency of 30 kcal/h m. It was calculated that 6500 m of plastic pipes (25 mm diameter) would be needed.

The greenhouse production in İzmir is considerably high compared to the overall agricultural production of Turkey. Distribution of the agricultural lands according to their allocation in İzmir by districts is shown in Table 20.

Table 20. Distribution of the Agricultural Lands According to Their Allocation in İzmir, 2004, (in hectare) (WEB_12 2004)

Districts	Agr. Field	Vegetables	Floriculture	Vineyard	Fruits	Citrus Fruits	Olive	Popler Grove	Fallowing Land	Vacant Land Allocable to Agriculture	Total Agr. Land
BALÇOVA	5	99	67.6	10	5	160	130	-	-	68	**543**
BORNOVA	95	97	0.4	265	160	-	650	-	125	1,145	**2,537**
BUCA	909	73	-	125	132	-	555	-	560	556	**2,910**
ÇİĞLİ	970	37	-	6	6	-	1	-	7	712	**1,739**
GAZİEMİR	32	9	-	-	-	-	115	-	63	26	**245**
GÜZELBAHÇE	42	99	23.9	118	13	127	572	-	494	637	**2,125**
KARŞIYAKA	29	19	-	-	12	5	100	-	-	266	**431**
KONAK	4	32	-	365	30	-	60	-	-	77	**568**
NARLIDERE	29	31	7.6	2	11	200	90	-	-	28	**399**
TOTAL	2,115	496	99.4	891	368	492	2,273	-	1,249	3,514	**11,497**

The agricultural structure of the districts of Izmir, according to 2004 statistics of Provincial Agriculture Administration (PAA) is summarized in the table above.

Table 21. Greenhouse production in Izmir (WEB_12 2004)

	Type of Greenhouse	Area in hectare or Number	Balçova	Province Central	Province General
			Total	Total	Total
Vacant	Glass	7	27	44	58
	Made from Plastic	20			
	High Tunnel	-			
	Low Tunnel	-			
	Number of Families Working	-			
Fruit and Vegetable	Glass	10	56	121.3	7586.9
	Made of Plastic	43			
	High Tunnel	3			
	Low Tunnel	-			
	Number of Families Working	20 families			
Floriculture	Glass	98	634.5	952.2	3541.6
	Made of Plastic	536.5			
	High Tunnel	-			
	Low Tunnel	-			
	Number of Families Working	175 families			
Grand Total	Glass	115	717.5	1117.5	11186.5
	Made of Plastic	599.5			
	High Tunnel	3			
	Low Tunnel	-			

In Table 21, the greenhouse production in İzmir is shown and fruit and vegetable production takes the greatest stake (68%). 67% of the floriculture production in İzmir is made in Balçova.

Table 22. Cultivation, production, output and production value of the floriculture agriculture in Izmir (WEB_12 2004)

Species	**GREENHOUSE+FIELD**				**PRICE (TL/ unit)**	**OUTPUT (YTL/1000 m^2)**
	CULTIVATED (x1000 m^2)	**PRODUCTION (unit)**	**OUTPUT (unit/1000 m^2)**	**PRODUCTION VALUE (YTL)**		
LILY	54.0	2,060,000	38,148	2,884,000	1,400,000	**53,407**
GERBERA	207.0	29,450,000	142,271	7,215,250	245,000	**34,856**
STARLICYA	35.0	970,000	27,714	1,212,500	1,250,000	**34,643**
ÇITIR	30.0	15,000,000	500,000	750,000	50,000	**25,000**
CARNATION	1,692.4	286,419,000	169,238	38,666,565	135,000	**22,847**
ROSE	767.5	113,700,000	148,143	17,055,000	150,000	**22,221**
TULIP	2.0	40,000	20,000	40,000	1,000,000	**20,000**
PANJUR	12.0	2,880,000	240,000	201,600	70,000	**16,800**
LISIANTHUS	5.0	450,000	90,000	83,250	185,000	**16,650**
GYPSOPHILLA	21.5	1,779,000	82,744	355,800	200,000	**16,549**
FREZIA	67.0	6,940,000	103,582	763,400	110,000	**11,394**
CHRYSANTHEMUM	330.7	26,278,000	79,462	3,678,920	140,000	**11,125**
WALLFLOWER	6.0	180,000	30,000	40,500	225,000	**6,750**
LIMONIUM	3.0	270,000	90,000	18,900	70,000	**6,300**
CYCLAMEN	2.0	75,000	37,500	11,250	150,000	**5,625**
HYACINTH	3.4	61,000	17,941	18,300	300,000	**5,382**
GLADIOLUS L	83.0	2,180,000	26,265	327,000	150,000	**3,940**
SOLIDAGO	1.0	30,000	30,000	3,000	100,000	**3,000**
HYACINTH	146.0	3,297,500	22,586	263,800	80,000	**1,807**
DAFFODYL	1,375.0	25,010,500	18,189	2,125,893	85,000	**1,546**
CUPRESSUS	1.0	1,500	1,500	210	140,000	**210**
TOTAL	**4,844.5**	**-**	**-**	**75,715,138**	**-**	

As production conditions in Balçova are compatible with the climate and as it is close to Izmir flower market, floriculture takes the greatest place in greenhouse agriculture.

As it is noted by Coşkun (2000), greenhouses are not able to work with the desired efficiency and profitability because of the structural deficiencies. It is possible to improve the greenhouses to the desired condition by solving these kinds of problems, and by using geothermal energy for heating. In this way, it will be possible to raise crops that are sensitive to heat and light, and expensive.

In this study, it is analyzed what the costs, benefits, ROI and job creation will be in case of heating a 1000 m^2 greenhouse by geothermal energy. Costs are grouped into three categories: investment (cover and structure, irrigation system, heating pipes, shadow curtain, lights, measurement equipments, planting and control equipments, heat exchanger, water depot and pumps), operating (seeds, fertilizers, sand, turf, perlit, agri. chemicals, disinfection chemicals, seedbed, seedling viol, regulatory chemicals, electricity, water , transportation , manpower, geothermal energy) and depreciation costs.

When production value is calculated, it is assumed that the most profitable four species of flowers will be grown with an efficiency exceeding 1/3 of regular output because of proper temperature and humidity conditions of the greenhouses heated by geothermal energy.

In greenhouse production, cost of manpower is tried to be minimized by generally employing members of a household. Still, seasonal manpower could be employed in high seasons or as the greenhouse gets bigger. In this study, it is also assumed that a 1000 m^2 greenhouse will create 546 working days annually.

TOE is taken as approximately 258.1 by applying degree day procedure. The maximum thermal requirement per 1000 m^2 of greenhouse is ($T_i=19°C$ *and* $T_o=0°C$) estimated as approximately 186 kW.

5.6.4 Dehydration of Fruit and Vegetables

Dehydration (or drying) of fruit or vegetables is one of the oldest forms of food preservation methods known to man. The process involves the slow removal of the majority of water contained in the fruit or vegetable so that the moisture contents of the dried product is below 20%. In the Mediterranean countries the traditional technique of vegetable and fruit drying (including tomatoes) is by using the sun, a technique that has remained largely unchanged from ancient times. However, on an industrial scale, most fruit is dried using sun (or sometimes solar drying), while most vegetable are dried using continuous forced-air processes. Dried fruits and vegetables can be produced by a variety of processes. These processes differ primarily by the type of drying method used, which depends on the type of food and the type of characteristics of the final product (Mujundar 1988; Nijhuis et al. 1998, Andritros et al 2002):

1. Sun drying. It is limited to climates with hot sun and dry atmosphere with strong winds. Typical areas with such climates are most of the Mediterranean regions, and most of the Aegean islands. Solar drying can be also used.
2. Atmospheric dehydration by passing heated air over the food to be dried.
3. Sub-atmospheric dehydration
4. Freeze-drying, for added value products, such as coffee.
5. Electromagnetic drying (e.g. microwave drying).
6. Drying using the osmotic phenomenon.

Drying of agricultural products is probably the most important industrial application of low or medium-temperature geothermal energy (40-150^{o}C). Fresh or recycled air is forced to pass through an air-water converter and to be heated to temperatures in the range 40-100^{o}C. The hot air passes through or above trays or belts with the raw products, resulting in the reduction on their moisture content. In geothermal drying, electric power is used to drive fans and pumps. Agricultural products that are dried using geothermal energy include (Lienau 1998; Lund 2000): onions, garlic, various fruits (apple, mango, pear, bananas, pineapple), alfalfa, grain, coconut meat, seaweed, timber, etc (Andritsos et al. 2002).

Recently, researches about small scale vegetable and fruit drying have increased. Studies concerning the improvement of the methods about making productions with high surplus value and increasing agricultural variety play an important role in this. Information about a small scale tomato drying facility which is tried in Greece could be used in the context of this study.

Andritsos et al (2002) introduces the technical details of this facility as follows:

In any tomato drying technique the required time for drying the product depends on many parameters such as tomato variety, the soluble solids content (brix) of the fresh product, the air humidity, the size of the tomato segments, the air temperature and velocity and the efficiency of the drying system. The rate of drying affects the end quality of the dried product.

In general, dried tomatoes undergo the following process steps: predrying treatments, (such as size selection, washing and tray placing), drying or dehydration, and postdehydration treatments, such as inspection, screening and packaging.

Traditional sun-drying has the advantages of simplicity and the small capital investments, but it requires long drying times that may have adverse consequences to the product quality: the final product may be contaminated from dust and insects or suffer from enzyme and microbial activity. On the other hand, industrial drying under high temperatures (~90°C) suffers from quality losses regarding color and aroma and may lead to case hardening (the formation of a hard outer shell), impeding the drying of the interior part of the product. It is obvious that the ideal conditions for drying tomatoes are mild temperatures between 45 and 55°C, which enable the dried product to retain its nutrients (including vitamins and lycopene, the nutrient responsible for the deep-red color of tomatoes) and flavors (Andritsos et al. 2002).

The complete tomato dehydration process can be divided into three stages: a pre-drying preparation step (pretreatment), the drying step, and the postdrying treatment. The predrying treatment prepares the raw tomatoes for the dehydration process. This step involves initially the selection of the tomatoes, regarding their maturity and soundness. About 40-70% of the tomatoes are selected to proceed for drying depending mainly upon the climatic condition during tomato growth and harvesting. The sorting of the tomatoes into two sizes is followed: tomatoes above 90 g and tomatoes of lower weight. The raw tomatoes are then placed in crates, washed to remove dust, dirt, plant parts etc, cut into two halves and placed into stainless steel trays (mesh type, 100×50 cm^2). It is noted that blanching of the raw tomatoes is not required because of the richness of tomatoes in antioxidants substances. The drying step is carried out in a tunnel drier (Andritsos et al. 2002).

Drying system equipments could be summarized as finned-tube coil air-water heat exchanger (having a capacity of 300,000 kcal), two fan units totaling a rated power of 7 kW, 14 m long rectangular drying tunnel (width 1 m and height 2 m, constructed of polyurethane aluminum panels), measuring instruments (thermocouples) (Andritsos et al. 2002).

The 'cold' air enters the heat exchanger at atmospheric conditions (20-35°C) and leaves the exchanger at an almost constant temperature of 55°C. The incoming geothermal water a temperature is 59°C, while the temperature of the water at the outlet is 51-53°C. The mean water flow rate used during the first two drying periods was about 25 m^3/h. The air flow rate in the tunnel was 10,000-12,000 m^3/h and the superficial air velocity in the tunnel (without the trays loaded with product) was 1.7 m/s.

The postdehydration step involves inspection and screening (the removal of dehydrated pieces of unwanted size, of foreign materials etc.) and packaging in glass jars with olive or sunflower oil, wine vinegar, salt, garlic and various herbs (Andritsos et al. 2002).

The solids contents of the tomatoes range between 8 to 10% w/w and the moisture content of the final product is estimated to be about 10%. Accordingly, the weight of the processed product reduced about 10-12 times after drying. The removal of the moisture content appears to be faster at the first half part of the tunnel (Andritsos et al. 2002).

In this study, probable costs and revenues of the facility mentioned above are estimated by using corresponding local prices. It is assumed that this facility will work five months in a year because of high prices of the products cultivated in the greenhouse in the market that makes the facility unprofitable. Cool rooms into the facility could provide reasonable costs, because vegetables could be purchased with the lower price in the summer season and be stored for production till the season when the prices of the greenhouse products begin getting higher. This situation is also included into the cost calculations of the facility. The months of June, July, August, September, and October are selected as production season of the facility. The important point that must be emphasized is that these months do not match the heating season of the GDHS and this facility could be operated in the low-load season of the heating station. As an opportunity, three facilities are suggested in this work to analyze the help of these facilities to overall balance of the heating system.

Calculation of the costs are made as a base of investment (tomato paste machine, office room, heat exchanger, fan units, drying tunnel, trays, thermocouples, packaging machine, tables and panels, other equipments, construction, cooling rooms), operating (vegetables, electricity, water, geothermal energy, auxiliary materials, transportation, manpower) and depreciation costs.

In this study, selected raw material (vegetable) is tomato. By the help of the production methods explained above, value of the production is tried to be determined an accordance with the local market prices.

Working day calculation is made by assuming that seasonal manpower will be used. According to this, it is possible for such a facility to create 1050 working days annually.

TOE is taken as 28.8 approximately by applying degree day procedure. The maximum thermal requirement for this facility is calculated as 116.2 kW_t.

5.6.5 Application of the PROMETHEE Method for Different Scenarios

As emphasized previous section, one of the Multicriteria Decision Aid Technique, PROMETHEE, will be used to evaluate different scenarios by different point of views of the decision-makers. First, alternative exploitation scenarios will be defined as to corresponding criterion values. Common point of all scenarios is that three vegetable drying facilities will be constructed to utilize potential energy of the low heating season. These scenarios are given below:

Scenario #1: In this scenario all of the available geothermal resource will be allocated to district heating system that will heat 219,290 m^2 dwelling equivalent area. Three dehydration units will be attached to the system.

Scenario#2: Available resource will be allocated to a hotel, 10 hectares of greenhouse and the rest will be used for district heating system (approximately 165,314 m^2 dwelling equivalent area).

Scenario#3: Geothermal resource will be distributed equally to tourism, district heating and greenhouse uses. It means that three hotel, 72,525 m^2 dwelling and 2.48 hectares greenhouse will be heated.

Scenario#4: As being tourism weighted scenario, resource will be used for heating of hotel and rehabilitation center as much as possible, and the rest will be allocated to district heating system. Eight hotel and 20,550 m^2 dwelling could be heated in this scenario.

Scenario#5: Resource will be apportioned to greenhouse and district heating system which is equal to 3.76 hectares greenhouse, and 109,645 m^2 dwelling.

Scenario#6: After allocation of the resource to two hotels, the rest of the energy will be utilized for district heating purpose. Total dwelling area heated by this schema is equal to 169,606 m^2.

In order to present alternative exploitation schemas clearly, the table given below is prepared:

Table 23.Allocation of the resources according to the scenarios proposed

Scenarios	District Heating	Greenhouse	Tourism Establishment	Drying Facility
1	219,290 m^2	-	-	3
2	165,314 m^2	10 ha	1	3
3	72,525 m^2	2.48 ha	3	3
4	20,550 m^2	-	8	3
5	109,645 m^2	3.76 ha	-	3
6	169,606 m^2	-	2	3

Three evaluation criteria, employment created, TOE and ROI will be employed in this study. According to these criteria, corresponding performance values are given in the table below:

Table 24 Performance of six alternative options for the exploitation of a geothermal resource for three criteria

	Performance criteria		
Scenarios	**Employment created**	**TOE**	**ROI**
1	8,867	5,275	1.11
2	120,120	6,016	0.40
3	340,260	7,814	0.27
4	861,286	14,973	0.25
5	26,560	3,501	0.36
6	221,972	7,699	0.36

First step of the PROMETHEE method is that having assigned to each criterion a weight p_j, increasing with the importance of the criterion, the outranking degree *π(a,b)* of each ordered pairs of actions *(a.b)* is computed. In order to make apparent the steps of the method, the difference tables for each criterion could be examined.

Table 25. Analysis of differences of the scenarios according to employment created criterion

	1	2	3	4	5	6
1	-	n/a	n/a	n/a	n/a	n/a
2	111,133	-	n/a	n/a	93,560	n/a
3	331,393	220,140	-	n/a	313,700	118,288
4	852,419	741,166	521,026	-	834,726	639,314
5	17,693	n/a	n/a	n/a	-	n/a
6	213,105	101,852	n/a	n/a	195,412	-

Table 26. Analysis of differences of the scenarios according to TOE criterion

	1	2	3	4	5	6
1	-	n/a	n/a	n/a	1,774	n/a
2	735	1	n/a	n/a	2,515	n/a
3	2,539	1,798	-	n/a	4,313	115
4	9,698	8,957	7,159	-	11,472	7,271
5	n/a	n/a	n/a	n/a	-	n/a
6	2,424	1,683	n/a	n/a	4,198	-

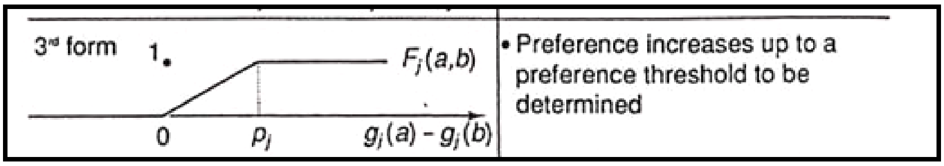
Table 27. Analysis of differences of the scenarios according to ROI criterion

	1	2	3	4	5	6
1	-	0.71	0.84	0.86	0.75	0.75
2	n/a	-	0.13	0.15	0.04	0.04
3	n/a	n/a	-	0.02	n/a	n/a
4	n/a	n/a	n/a	-	n/a	n/a
5	n/a	n/a	0.90	0.11	-	0.00
6	n/a	n/a	0.90	0.11	0.00	-

These tables are prepared by taking differences of the each scenario corresponding performance values with the other performance values. When the difference is smaller than zero, not available abbreviation (n/a) is noted to table cells.

In this study the *third form of preference intensity* in the PROMETHEE method will be used. This form has only one threshold value which is upper limit (lower limit is equal to zero) of the differences between different scenarios under the same criterion. Hypothetical decision makers are asked for determination of these upper limits. This upper limits are: 120,000days/yr for employment created, 2000 tons/yr for TOE, and 0.2 for ROI value.

Figure 5. The third form of preference intensity in the PROMETHEE method



Source: Vincke, 1992

After determination of the upper limits for difference values of the performance values, differences tables given above are converted according to selected form of preference intensity. Converted tables are given below:

Table 28. Converted form of differences of the scenarios according to employment created criterion

	1	2	3	4	5	6
1	-	0.00	0.00	0.00	0.00	0.00
2	0.92	-	0.00	0.00	0.78	0.00
3	1.00	1.00	-	0.00	1.00	0.98
4	1.00	1.00	1.00	-	1.00	1.00
5	0.15	0.00	0.00	0.00	-	0.00
6	1.00	0.85	0.00	0.00	1.00	-

Table 29.Converted form of differences of the scenarios according to TOE criterion

	1	2	3	4	5	6
1	-	0.00	0.00	0.00	0.89	0.00
2	0.37	1.00	0.00	0.00	1.00	0.00
3	1.00	0.90	-	0.00	1.00	0.06
4	1.00	1.00	1.00	-	1.00	1.00
5	0.00	0.00	0.00	0.00	-	0.00
6	1.00	0.84	0.00	0.00	1.00	-

Table 30. Converted form of differences of the scenarios according to ROI criterion

	1	2	3	4	5	6
1	-	1.00	1.00	1.00	1.00	1.00
2	0.00	-	0.65	0.75	0.20	0.20
3	0.00	0.00	-	0.02	0.00	0.00
4	0.00	0.00	0.00	-	0.00	0.00
5	0.00	0.00	0.45	0.55	-	0.00
6	0.00	0.00	0.45	0.55	0.00	-

In order to find *π (a, b)* values, hypothetical decision makers are asked again to determination of the weight assigned to each criterion. The criterion weights given by these three decision makers are listed below:

Table 31.Criterion weights given to each criterion by hypothetical decision makers

	Employment created	**TOE**	**ROI**
Decision Maker #1	30%	20%	50%
Decision Maker #2	33%	33%	34%
Decision Maker #3	50%	30%	20%

By the help of these information, π *(a, b)* values could be determined. The computation is made as follows:

$$\pi(a,b) = \frac{1}{P}\sum_{j=1}^{n} p_j F_j(a,b) \text{ where } P = \sum_{j=1}^{n} p_j \text{ ....}(5.7)$$

and where $F_j(a,b)$ is a number between 0 and 1 which increases if $g_j(a)$-$g_j(b)$ is large and equals zero if $g_j(a) \leq g_j(b)$ (where $g_j(a)$ is the state of the action *a* evaluated by criterion *j*). Calculated π *(a, b)* values according to the weight distribution of the first decision maker are listed below:

π (1 , 2) = 0.3 * (0) + 0.2 * (0) + 0.5 * (1) = 0.500

π (1 , 3) = 0.3 * (0) + 0.2 * (0) + 0.5 * (1) = 0.500

π (1 , 4) = 0.3 * (0) + 0.2 * (0) + 0.5 * (1) = 0.500

π (1 , 5) = 0.3 * (0) + 0.2 * (0.9) + 0.5 * (1) = 0.678

π (1 , 6) = 0.3 * (0) + 0.2 * (0) + 0.5 * (1) = 0.500

π (2 , 1) = 0.3 * (0.92) + 0.2 * (0.4) + 0.5 * (0) = 0.350

π (2 , 3) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.65) = 0.325

π (2 , 4) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.75) = 0.375

π (2 , 5) = 0.3 * (0.78) + 0.2 * (1) + 0.5 * (0.2) = 0.534

π (2 , 6) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.2) = 0.100

π (3 , 1) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500

π (3 , 2) = 0.3 * (1) + 0.2 * (0.9) + 0.5 * (0) = 0.480

π (3 , 4) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.1) = 0.050

π (3 , 5) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500

π (3 , 6) = 0.3 * (0.98) + 0.2 * (0.06) + 0.5 * (0) = 0.306

$\pi(4,1) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500$

$\pi(4,2) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500$

$\pi(4,3) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500$

$\pi(4,5) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500$

$\pi(4,6) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500$

$\pi(5,1) = 0.3 * (0.15) + 0.2 * (0) + 0.5 * (0) = 0.045$

$\pi(5,2) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0) = 0.000$

$\pi(5,3) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.45) = 0.225$

$\pi(5,4) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.55) = 0.275$

$\pi(5,6) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0) = 0.000$

$\pi(6,1) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500$

$\pi(6,2) = 0.3 * (0.85) + 0.2 * (0.84) + 0.5 * (0) = 0.423$

$\pi(6,3) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.45) = 0.225$

$\pi(6,4) = 0.3 * (0) + 0.2 * (0) + 0.5 * (0.55) = 0.275$

$\pi(6,5) = 0.3 * (1) + 0.2 * (1) + 0.5 * (0) = 0.500$

By using the sum of these values ϕ^+ (outgoing flow) value can be found. When the same procedure is calculated for $\pi(i,a)$ and these values are added up, ϕ^- (ingoing flow) value is found.

$$\phi^+(a) = \sum_{i \in A} \pi(a,i) \text{ and } \phi^-(a) = \sum_{i \in A} \pi(i,a) \text{ ....(5.8)}$$

where A is the set of all actions. $\phi^+(a)$ value shows the general superiority of action a to the other actions.

By using PROMETHEE II, the ordering of the actions can be made by adding up $\phi^+(a)$ $\phi^-(a)$ values.

$$\phi\ (a) = \phi^+(a) + \phi^-(a) \text{ ....(5.11)}$$

It gives complete order of the actions.

The procedure explained above is repeated for the weights assigned to each criterion by the second and the third decision makers. Outgoing and ingoing flow of the method, and the sum of them as to assigned weights to criteria by decision makers are given below:

Table 32.Outgoing and ingoing flow and the sum of these flows according to the first decision maker

Scenarios	$\phi^+(a)$	$\phi^-(a)$	$\phi\ (a)$
1	2.678	1.895	0.783
2	1.684	1.903	-0.219
3	1.836	1.775	0.061
4	2.5	1.475	1.025
5	0.545	2.712	-2.167
6	1.923	1.406	0.517

Table 33.Outgoing and ingoing flow and the sum of these flows according to the second decision maker

Scenarios	$\phi^+(a)$	$\phi^-(a)$	$\phi\ (a)$
1	1.9937	2.4552	-0.4615
2	1.6251	2.1847	-0.5596
3	2.3242	1.5015	0.8227
4	3.3	1.309	1.991
5	0.3895	3.2691	-2.8796
6	2.2177	1.4112	0.8065

Table 34.Outgoing and ingoing flow and the sum of these flows according to the third decision maker

Scenarios	$\phi^+(a)$	$\phi^-(a)$	$\phi\ (a)$
1	1.267	2.046	-0.779
2	1.621	2.447	-0.826
3	2.898	1.31	1.588
4	5	0.77	4.23
5	0.275	3.597	-3.322
6	2.477	1.548	0.929

By using these tables complete order of the scenarios could be obtained

Table 35.Complete order of the scenarios

Decision Makers	Order of the scenarios
The first decision maker	**4>1>6>3>2>5**
The second decision maker	**4>3>6>1>2>5**
The third decision maker	**4>3>6>1>2>5**

When the order of the scenarios examined, one could say that scenario#4 dominates all other scenarios. Scenario#2 and Scenario#5 may be evaluated as the scenarios with the least performance based on the criteria selected and the weights assigned to them by the decision makers.

CHAPTER 6

RESULTS AND DISCUSSION

The considerations of this study could be listed as the following:

- Modeling of geothermal resource by simulation, and determination of its heat energy on the basis of probability distribution,
- Forming exploitation alternatives by this heating energy, and calculating their performances according to the criteria that the decision maker will select,
- Evaluating the scenarios that will be formed from the obtained alternatives by employing PROMETHEE method and determining which scenario could be the best.

The first consideration is that, having done studies about the simulation, it is concluded that the reservoir will most probably have energy of 25.5 MWt. However, as the energy given to the system in February 2001 is 37.1 MWt, and as it is asserted in the study done by ITU that 66 MWt energy could be produced, it is assumed that the simulation underestimates the real energy potential of the reservoir. Due to this, the average of the values 25.5-66 MWt is take, and 45.75 MWt is assumed as the heating capacity of the reservoir. Additionally, 14 MWt the difference between the average value (45.75 MWt) and 37.1 MWt, is assumed as the reserve quantity that could be added to the system.

Two assessments could be done about the simulation. The first one is that the model is accurate and the real value of the sustainable heating capacity is 25.5 MWt. The second one is that the result could be misleading because of the equation selected. In the functional form selected, there exists no parameter related to the sustainability of the reserve. In addition there are no parameters concerning the suggested reinjection to increase the sustainability of the geothermal field. Yet, estimation could be done by introducing the model the data abut the reinjection in TOUGH2 model done by ITU. In this case, it could be asserted the result, that is the real heating value of the reservoir could be 25.5 MWt, becomes insignificant. If so, the reservoir could be re-simulated by another functional form.

The second consideration in the study is the determination of the utilization alternatives of the estimated 14 MWt energy. These alternatives are specified as dwelling heating, thermal tourism, greenhouse production and dehydration of fruit and vegetable, by evaluating the conditions specific to Balçova. Apart from this, alternatives such as electricity generation, fishing or industrial raw material production are considered. However, as the resource falls into the low enthalpy resources category, it is thought that the cost of electricity generation could be high. Fishing is not preferred because of the sea pollution it will create and its closeness to the recreation areas within the city. The chemical materials in the fluid do not have the concentration to make raw material production.

Efforts is given to find the heat demand for the alternatives mentioned above from the lowest temperature value to the comfort (or production) temperature value. According to the data gathered from the various resources, these values are taken as 54.93 kcal/h m^2 for dwellings, 160 kcal/h m^2 for greenhouses, 65 kcal/h m^2 for tourism establishment, and 116.2 kWt for dehydration of vegetables. At the same time, these values are used in degree day procedure. By this way, TOE values of the alternatives are obtained. These values are found as 0.0237 ton/yr m^2, 0.0857 ton/yr m^2 and 0.0218 ton/yr m^2 for dwellings, hotels and greenhouses respectively.

The construction and operating costs of the heating station that will be constructed to utilize 14 MWt additional capacity are calculated by using the data from Erdoğmuş (2003). (Data about this could be found in Appendix A). Here, three assumptions are made. First, the amount of the investment per square meter could be found by dividing the end of 2002 investment costs of Balçova GDHS by the dwelling equivalent heated that year (1,150,000 m^2). In addition, it is assumed that the operating costs of the year 2002 will continue in the following years without changing, and operating cost per square meter is calculated. Finally, it is assumed that depreciation costs of the Balçova GDHS could be used for new heating system on the basis of same future periods.

It is found that, 219,290 m^2 dwelling area could be heated with such a heating system, and it is calculated that it will cost 4.5 million USD to construct a suitable heating station. Net future value of overall costs of 2021 is equal to 11.3 million USD. This value is calculated separately for the six scenarios formed, and ROI calculations are also used. ROI values for 1 m^2 dwelling, 1,000 m^2 greenhouse, 21,000 m^2 hotel and drying facility are 0.16, 0.18, 0.25 and 0.08, respectively.

Employment created value of each alternative is calculated by various data sources, such as DIE statistics, agriculture and tourism related web sites. Employment created value of 1 m^2 dwelling, 1,000 m^2 greenhouse, 21,000 m^2 hotel and a drying facility equal respectively to 0.026 days/yr, 546 days/yr, 107,200 days/yr and 1,050 days/yr.

For the third consideration, that is finding the outranking relations of the scenarios formed by using PROMETHEE method, hypothetical decision makers are designed. It is assumed that, they select the third form as the preference intensity of the criteria and structural form of this preference.

Upper limits of the preference intensity according to criteria TOE, ROI and employment created are also assumed as 2,000 tons/yr, 0.2 and 120,000 days/yr, respectively. The weights, hypothetically, assigned to these criteria are given in the table below:

Table 31.Criterion weights given to each criterion by hypothetical decision makers

	TOE	ROI	Employment created
Decision Maker #1	20%	50%	30%
Decision Maker #2	33%	34%	33%
Decision Maker #3	30%	20%	50%

Economic and social aspects of the exploitation scenarios could have special weight for the decision makers. Difference in the weights of, in particular, ROI and employment created criteria is formed in order to take these political aspects into consideration.

When the PROMETHEE method is employed, the outranking order of the scenarios is formed as follow:

Table 35.Complete order of the scenarios

Decision Makers	Order of the scenarios
The first decision maker	4>1>6>3>2>5
The second decision maker	4>3>6>1>2>5
The third decision maker	4>3>6>1>2>5

When the order of the scenarios is examined, one could say that Scenario#4 dominates all other scenarios. Scenario#2 and Scenario#5 may be evaluated as the scenarios with the least performance based on the criteria selected and the weights assigned to them by the decision makers. For the first decision maker, first and third scenarios become second and fourth and this is the only difference between the outranking order of the second and the third decision makers.

The reason for the situation is that TOE and employment created of the eight hotels suggested for the fourth scenario are very high. Insomuch as that, the superiority of the fourth scenario which has the lowest ROI value, according to weights that the decision makers assign, continuous. It could be said that the difference between orders of the first and the second-third decision makers results form the performance values of the first and the third scenarios according to ROI and employment created criteria. Particularly, ROI value of the first scenario is the greatest value compared to the values of other scenarios, but it has the smallest value of employment created (ROI: 1.11 and employment created: 8,867 days/yr).

CHAPTER 7

CONCLUSION

The results that will be concluded from the study could be listed as follows:

- There exists a serious difference between the values obtained from the simulation and the values of the modeling done by employing TOUGH2 by ITU. The possible reason for this is that, the functional form assigned for Monte Carlo Simulation might have underestimated energy capacity of the reservoir.
- PROMETHEE results show that tourism investment, in particular, stands out because of high TOE and employment created values. Yet, it could be asserted that, this might not be a correct preference because of high investment costs and market risks.
- The decision makers, scenarios and selected criteria are hypothetical, and this brings out the results that PROMETHEE method is not tried with the real life problems. As the criteria of the decision makers and especially weights assigned to these criteria could change the results considerably.
- The alternative concerning to dehydration of the fruit and the vegetable is formed by a number of assumptions. With the improvement of the sector related to this, clearer cost and revenue values could be obtained. Small scale facilities could be especially suggested for rural areas because of their low operating costs.
- The indirect effects caused by the exploitation alternatives are ignored. These indirect effects are dwelling price and the increase in the rents, the increase in the commercial activities related to thermal therapy facilities (beauty salons, physical rehabilitation offices, and offices of the doctors), the increase in the tourism revenues, expansion in the product range of the greenhouses, noise pollution that may occur during the operations of the drying facilities and the increase in the real estate taxes etc. Taking these effects into consideration could change the performances of the alternatives.
- Land use data obtained from scenarios could be used in physical development plans. By this way, relation between development plan and the local economic development could be established.

- Investment and depreciation costs of the geothermal heating systems could be decrease gradually by the help of advance in the geothermal technology created locally.

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APPENDIX A

Table 36.Cost items for the tomato drying facility

Investment Items	Cost (YTL)
Tomato Paste Machine	60000
Office	11000
Heat Exchanger	11970
Fan Units	3000
Drying Tunnel	3000
Trays	8800
Thermocouples	2000
Packeting Machine	34000
Tables and Panels	2000
Other Eqipments	8000
Construction (240 m2)	46710
Cool Rooms (120 m2)	33960
TOTAL	224440

Depreciation	n	Cost (YTL)
Maintenance	Annual	1330
Thermocouple	3 yrs	1900
Fan units	4 yrs	2850
Trays	7 yrs	8360

Operating Costs	YTL
Raw Material (tomato)	78240
Jar	20779
Water Cons.	1750
Electricity	2500
Olive Oil	87273
Garlic	831
Transportation	3600
Geothermal Energy	1500
Labor	21000

NOTE: This costs are calculated based on seasonal operations of the facility for five-month

Table 37.Cost items for the 1,000 m^2 greenhose

Investment Costs	**YTL**
Cover and structure	33000
Irrigation system	4500
Heating pipes	3300
Shadow curtain	5500
Measurement Equipments	20000
Planting and control equipment	18500
Heat exchanger	12000
Water depot and pumps	4500
Total	101300

Depreciation and Salvage	**n**	**YTL**
Cover Material	3 yrs	10345.5
Irrigation system	5 yrs	4275
Shadow curtain	3 yrs	5225
Maintanence	annual	1500
Heating pipes	2 yrs	3135

Operating Costs	**YTL**
Seeds	2100
Fertilizer (natu. and chem.)	2900
Sand	300
Torf	1800
Perlit	800
Agri. Chemicals	1500
Disinfection chemicals	1000
Seedbed	1700
Seedling viol	1000
Regulatory chemicals	500
Electricity	960
Water	1500
Transportation works	1000
Manpower	11200
Geothermal	720
Total	28980

Table 38. Input, output and value added data for one thermal tourism establisment

Number of bed's groups	Number of establishments	Input	Output	Value added
		in million TL		
-10	6	2,261,376	4,843,748	2,582,372
11-25	1437	14,332,561	33,665,933	19,333,372
26-50	3767	121,939,080	243,970,625	122,031,545
51-75	2119	300,205,908	582,622,628	282,416,720
76-100	1133	109,162,997	245,307,035	136,144,038
101-150	902	168,571,102	407,577,000	239,005,898
151-200	330	97,453,759	217,983,056	120,529,297
201+	807	1,631,211,173	3,759,110,383	2,127,899,210
Total	10501	2,445,137,956	5,495,080,408	3,049,942,452

Table 39.Economic analysis of 1 m^2 of dwelling

Year	Total Cost	Revenues acuired by the firm	Balance	n	Net Future Value of year 2021 in USD (i=5%)	Net Future Value of Costs of year 2021 in USD (i=5%)
2005	20.521		0.000	17	0.000	46.267
2006	1.395	16.470	16.470	16	35.952	17.127
2007	1.395	3.960	3.960	15	8.233	16.056
2008	1.395	3.960	3.960	14	7.841	14.986
2009	1.395	3.960	3.960	13	7.467	13.915
2010	1.395	3.960	3.960	12	7.112	12.845
2011	3.152	3.960	3.960	11	6.773	12.829
2012	2.186	3.960	3.960	10	6.450	11.126
2013	1.892	3.960	3.960	9	6.143	9.870
2014	1.818	3.960	3.960	8	5.851	8.742
2015	1.756	3.960	3.960	7	5.572	7.626
2016	4.040	3.960	3.960	6	5.307	7.307
2017	1.689	3.960	3.960	5	5.054	5.430
2018	1.646	3.960	3.960	4	4.813	4.334
2019	1.610	3.960	3.960	3	4.584	3.245
2020	1.579	3.960	3.960	2	4.366	2.160
2021	2.622	3.960	3.960	1	4.158	1.136
					125.676	195.003

employment	**0.026**	**days/yr**
TOE	**0.024**	**tons/yr**
ROI	**0.16**	

Table 40. Economic analysis of the small scale drying facility

Year	Total Cost	Revenues	Balance	n	Net Future Value of year 2021 (i=5%)	Net Future Value of year 2021 in USD (i=5%)	Net Future Value of Costs of year 2021 in USD (i=5%)
2005	442,363	259,740	-182,623	17	-418,575	-314,718	762,334
2006	219,253	259,740	40,487	16	88,378	66,450	359,851
2007	219,253	259,740	40,487	15	84,170	63,286	342,715
2008	221,153	259,740	38,587	14	76,400	57,444	329,224
2009	222,103	259,740	37,637	13	70,970	53,361	314,894
2010	219,253	259,740	40,487	12	72,709	54,668	296,050
2011	221,153	259,740	38,587	11	65,997	49,622	284,396
2012	227,613	259,740	32,127	10	52,332	39,347	278,765
2013	222,103	259,740	37,637	9	58,388	43,900	259,064
2014	221,153	259,740	38,587	8	57,011	42,865	245,672
2015	219,253	259,740	40,487	7	56,969	42,834	231,963
2016	219,253	259,740	40,487	6	54,257	40,794	220,917
2017	224,003	259,740	35,737	5	45,611	34,294	214,956
2018	219,253	259,740	40,487	4	49,212	37,002	200,379
2019	227,613	259,740	32,127	3	37,191	27,963	198,113
2020	221,153	259,740	38,587	2	42,542	31,987	183,324
2021	222,103	259,740	37,637	1	39,519	29,714	175,345
			427,551		533,082	400,813	4,897,963

employment	**1,050**	**days/yr**
TOE	**28.80**	**tons/yr**
ROI	**0.08**	

Table 41. Economic analysis of 1000 m^2 of greenhouse

Year	Total Cost	Revenues	Balance	n	Net Future Value of year 2021 (i=5%)	Net Future Value of year 2021 in USD (i=5%)	Net Future Value of Costs of year 2021 in USD (i=5%)
2005	130280	53,577.90	-76,702.10	17	-175,803	-132,182	224,514
2006	30480	53,577.90	23,097.90	16	50,420	37,910	50,026
2007	33615	53,577.90	19,962.90	15	41,501	31,204	52,544
2008	46050.5	53,577.90	7,527.40	14	14,904	11,206	68,554
2009	33615	53,577.90	19,962.90	13	37,643	28,303	47,659
2010	34755	53,577.90	18,822.90	12	33,803	25,416	46,929
2011	49185.5	53,577.90	4,392.40	11	7,512	5,648	63,251
2012	30480	53,577.90	23,097.90	10	37,624	28,289	37,330
2013	33615	53,577.90	19,962.90	9	30,969	23,285	39,209
2014	46050.5	53,577.90	7,527.40	8	11,121	8,362	51,156
2015	37890	53,577.90	15,687.90	7	22,074	16,597	40,086
2016	30480	53,577.90	23,097.90	6	30,953	23,273	30,711
2017	49185.5	53,577.90	4,392.40	5	5,606	4,215	47,199
2018	30480	53,577.90	23,097.90	4	28,076	21,110	27,856
2019	33615	53,577.90	19,962.90	3	23,110	17,376	29,258
2020	50325.5	53,577.90	3,252.40	2	3,586	2,696	41,717
2021	33615	53,577.90	19,962.90	1	20,961	15,760	26,538
			177,106.74		224,061.27	168,467	924,537

employment	**546**	**days/yr**
TOE	**21.80**	**tons/yr**
ROI	**0.18**	

Table 42. Economic analysis of the thermal tourism establisment that would be constructed in Balçova

Year	Investment	Input	Output	Balance	n	Net Future Value of year 2021 (i=5%)	Net Future Value of year 2021 in USD (i=5%)	Net Future Value of Costs of year 2021 in USD (i=5%)
2005	5,193,000			-5,193,000	17	-11,902,451	-8,949,211	8,949,211
2006	12,117,000			-12,117,000	16	-26,449,891	-19,887,136	19,887,136
2007		2,021,327	4,658,129	2,636,802	15	5,481,722	4,121,595	3,159,545
2008		2,021,327	4,658,129	2,636,802	14	5,220,688	3,925,329	3,009,090
2009		2,021,327	4,658,129	2,636,802	13	4,972,083	3,738,409	2,865,800
2010		2,021,327	4,658,129	2,636,802	12	4,735,318	3,560,389	2,729,333
2011		2,021,327	4,658,129	2,636,802	11	4,509,826	3,390,847	2,599,365
2012		2,021,327	4,658,129	2,636,802	10	4,295,073	3,229,378	2,475,586
2013		2,021,327	4,658,129	2,636,802	9	4,090,545	3,075,598	2,357,701
2014		2,021,327	4,658,129	2,636,802	8	3,895,757	2,929,141	2,245,429
2015		2,021,327	4,658,129	2,636,802	7	3,710,245	2,789,658	2,138,504
2016		2,021,327	4,658,129	2,636,802	6	3,533,567	2,656,817	2,036,671
2017		2,021,327	4,658,129	2,636,802	5	3,365,302	2,530,302	1,939,686
2018		2,021,327	4,658,129	2,636,802	4	3,205,049	2,409,812	1,847,320
2019		2,021,327	4,658,129	2,636,802	3	3,052,428	2,295,059	1,759,353
2020		2,021,327	4,658,129	2,636,802	2	2,907,074	2,185,770	1,675,574
2021		2,021,327	4,658,129	2,636,802	1	2,768,642	2,081,686	1,595,785
						21,390,977	16,083,441	63,271,090

employment	**107,200**	**days/yr**
TOE	**1,800**	**tons/yr**
ROI	**0.25**	

Table 43.Overall performance of the Scenario#1 according to criteria selected

ASPECTS OF THE SCENARIOS		
EMPLOYMENT	TOE	ROI
8,867	5,275	1.11

0	X 1000 m^2 of greenhouse
3	drying facilities
0	tourism establisment
219290	m^2 dwelling

Table 44.Overall performance of the Scenario#2 according to criteria selected

ASPECTS OF THE SCENARIOS		
EMPLOYMENT	TOE	ROI
120,120	6,016	0.40

10	X 1000 m^2 of greenhouse
3	drying facilities
1	tourism establisment
165314.4	m^2 dwelling

Table 45. Overall performance of the Scenario#3 according to criteria selected

ASPECTS OF THE SCENARIOS		
EMPLOYMENT	TOE	ROI
340,260	7,814	0.27

24.8	X 1000 m^2 of greenhouse
3	drying facilities
3	tourism establisment
75525	m^2 dwelling

Table 46.Overall performance of the Scenario#4 according to criteria selected

ASPECTS OF THE SCENARIOS		
EMPLOYMENT	TOE	ROI
861,286	14,973	0.25

0	X 1000 m^2 of greenhouse
3	drying facilities
8	tourism establisment
20550.6	m^2 dwelling

Table 47.Overall performance of the Scenario#5 according to criteria selected

ASPECTS OF THE SCENARIOS		
EMPLOYMENT	TOE	ROI
26,560	3,501	0.36

37.64	X 1000 m^2 of greenhouse
3	drying facilities
0	tourism establisment
109645	m^2 dwelling

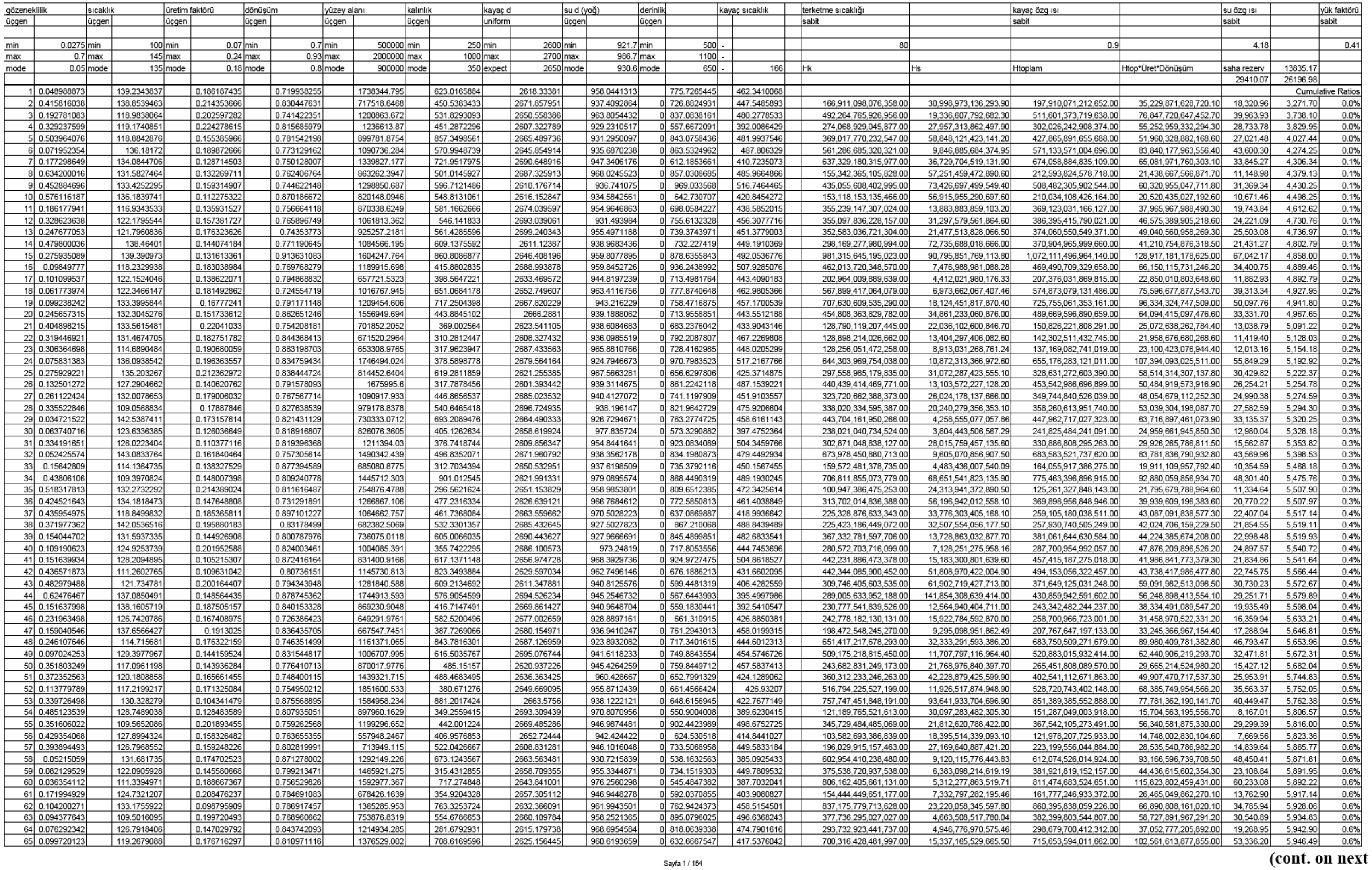
Table 48.Overall performance of the Scenario#6 according to criteria selected

ASPECTS OF THE SCENARIOS		
EMPLOYMENT	TOE	ROI
221,972	7,699	0.36

0	X 1000 m2 of greenhouse
3	drying facilities
2	tourism establisment
169606.2	m^2 dwelling

APPENDIX B

Table 49. First and last five pages of the print-out of the Monte Carlo Simulation model used in this study



gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
1	0.048988873		139.2343837		0.186187435		0.719938255		1738344.795		623.0165884		2618.33381		958.0441313		775.7265445		462.3410068							Cumulative Ratios	
2	0.415816038		138.8539463		0.214353666		0.830447631		717518.6468		450.5383433		2671.857951		937.4092864	0	726.8824931		447.5485893		166,911,098,076,358.00	30,998,973,136,293.90	197,910,071,212,652.00	35,229,871,628,720.10	18,320.96	3,271.70	0.0%
3	0.192781083		118.9838064		0.202597282		0.741422351		1200863.672		531.8293093		2650.558386		963.8054432	0	837.0838161		480.2778533		492,264,765,926,956.00	19,336,607,792,682.30	511,601,373,719,638.00	76,847,720,647,452.70	39,963.93	3,738.10	0.0%
4	0.329237599		119.1740851		0.224278615		0.815685979		1236613.87		451.2872296		2607.322789		929.2310517	0	557.6672091		392.0086429		274,068,929,045,877.00	27,957,313,862,497.90	302,026,242,908,374.00	55,252,959,332,294.30	28,733.78	3,829.95	0.0%
5	0.503964076		118.8842876		0.155385966		0.781542198		899781.8754		857.3498561		2665.489736		931.2950097	0	843.0758436		481.9937546		369,017,770,232,547.00	58,848,121,423,141.20	427,865,891,655,688.00	51,960,328,882,168.60	27,021.48	4,027.44	0.0%
6	0.071952354		136.18172		0.189872666		0.773129162		1090736.284		570.9948739		2645.854914		935.6870238	0	863.5324962		487.806329		561,286,685,320,321.00	9,846,885,684,374.95	571,133,571,004,696.00	83,840,177,963,556.40	43,600.30	4,274.25	0.0%
7	0.177298649		134.0844706		0.128714503		0.750128007		1339827.177		721.9517975		2690.648916		947.3406176	0	612.1853661		410.7235073		637,329,180,315,977.00	36,729,704,519,131.90	674,058,884,835,109.00	65,081,971,760,303.10	33,845.27	4,306.34	0.1%
8	0.634200016		131.5827464		0.132269711		0.762406764		863262.3947		501.0145927		2687.325913		968.0245523	0	857.0308685		485.9664866		155,342,365,105,828.00	57,251,459,472,890.60	212,593,824,578,718.00	21,438,667,566,871.70	11,148.98	4,379.13	0.1%
9	0.452884696		133.4252295		0.159314907		0.744622148		1298850.687		596.7121486		2610.176714		936.741075	0	969.033568		516.7464465		435,055,608,402,995.00	73,426,697,499,549.40	508,482,305,902,544.00	60,320,955,047,711.80	31,369.34	4,430.25	0.1%
10	0.576116187		136.1839741		0.112275322		0.870186672		820148.0946		548.8131061		2616.152847		934.5842561	0	642.730707		420.8454272		153,118,153,135,466.00	56,915,955,290,697.60	210,034,108,426,164.00	20,520,435,027,192.60	10,671.46	4,498.25	0.1%
11	0.186177941		116.9343533		0.135931527		0.756664118		870338.6249		581.1662666		2674.039597		954.9646863	0	698.0584227		438.5852015		355,239,147,307,024.00	13,883,883,859,103.20	369,123,031,166,127.00	37,965,967,988,490.30	19,743.84	4,612.62	0.1%
12	0.328623638		122.1795544		0.157381727		0.765896749		1061813.362		546.141833		2693.039061		931.493984	0	755.6132328		456.3077716		355,097,836,228,157.00	31,297,579,561,864.60	386,395,415,790,021.00	46,575,389,905,218.60	24,221.09	4,730.76	0.1%
13	0.247677053		121.7960836		0.176323626		0.74353773		925257.2181		561.4285596		2699.240343		955.4971188	0	739.3743971		451.3779003		352,583,036,721,304.00	21,477,513,828,066.50	374,060,550,549,371.00	49,040,560,958,269.30	25,503.08	4,736.97	0.1%
14	0.479800036		138.46401		0.144074184		0.771190645		1084566.195		609.1375592		2611.12387		938.9683436	0	732.227419		449.1910369		298,169,277,980,994.00	72,735,688,018,666.00	370,904,965,999,660.00	41,210,754,876,318.50	21,431.27	4,802.79	0.1%
15	0.275935089		139.390973		0.131613361		0.913631083		1604247.764		860.8086877		2646.408196		959.8077895	0	878.6355843		492.0536776		981,315,645,195,023.00	90,795,851,769,113.80	1,072,111,496,964,140.00	128,917,181,178,625.00	67,042.17	4,858.00	0.1%
16	0.09849777		118.2329938		0.183038984		0.769768279		1189915.698		415.8802835		2688.993878		959.8452726	0	936.2438992		507.9285076		462,013,720,348,570.00	7,476,988,981,088.28	469,490,709,329,658.00	66,150,115,731,246.20	34,400.75	4,889.46	0.1%
17	0.101099537		122.1524046		0.138622071		0.794868832		657721.5323		398.5647221		2633.469572		944.8197239	0	713.4981764		443.4090183		202,964,009,889,639.00	4,412,021,980,176.33	207,376,031,869,815.00	22,850,010,803,648.60	11,882.93	4,892.79	0.2%
18	0.061773974		122.3466147		0.181492862		0.724554719		1016767.945		651.0684178		2652.749607		963.4116756	0	777.8740648		462.9805366		567,899,417,064,079.00	6,973,662,067,407.46	574,873,079,131,486.00	75,596,677,877,543.70	39,313.34	4,927.95	0.2%
19	0.099238242		133.3995844		0.16777241		0.791171148		1209454.606		717.2504398		2667.820229		943.216229	0	758.4716875		457.1700539		707,630,609,535,290.00	18,124,451,817,870.40	725,755,061,353,161.00	96,334,324,747,509.00	50,097.76	4,941.80	0.2%
20	0.245657315		132.3045276		0.151733612		0.862651246		1556949.694		443.8845102		2666.2881		939.1888062	0	713.9558851		443.5512188		454,808,363,829,782.00	34,861,233,060,876.00	489,669,596,890,659.00	64,094,415,097,476.60	33,331.70	4,967.65	0.2%
21	0.404898215		133.5615481		0.22041033		0.754208181		701852.2052		369.002564		2623.541105		938.6084683	0	683.2376042		433.9043146		128,790,119,207,445.00	22,036,102,600,846.70	150,826,221,808,291.00	25,072,638,262,784.40	13,038.79	5,091.22	0.2%
22	0.319446921		131.4674705		0.182751782		0.844368413		671520.2964		310.2812447		2608.327432		936.0985519	0	792.2087807		467.2269808		128,898,214,026,662.00	13,404,297,406,082.60	142,302,511,432,745.00	21,958,676,680,268.60	11,419.40	5,128.03	0.2%
23	0.306364698		114.6890484		0.190680059		0.883198703		653308.9765		317.9623947		2687.433563		965.8810766	0	728.4162985		448.0205299		128,256,051,472,258.00	8,913,031,268,761.24	137,169,082,741,019.00	23,100,423,076,944.40	12,013.16	5,154.18	0.2%
24	0.075831383		136.0938542		0.196363557		0.834759434		1746494.024		378.5898778		2679.564164		924.7946673	0	970.7983523		517.2167766		644,303,969,754,038.00	10,872,313,366,972.60	655,176,283,121,011.00	107,394,093,025,511.00	55,849.29	5,192.92	0.2%
25	0.275929221		135.203267		0.212362972		0.838444724		814452.6404		619.2811859		2621.255385		967.5663281	0	656.6297806		425.3714875		297,558,985,179,835.00	31,072,287,423,555.10	328,631,272,603,390.00	58,514,314,307,137.80	30,429.82	5,222.37	0.2%
26	0.132501272		127.2904662		0.140620762		0.791578093		1675995.6		317.7878456		2601.393442		939.3114675	0	861.2242118		487.1539221		440,439,414,469,771.00	13,103,572,227,128.20	453,542,986,696,899.00	50,484,919,573,916.90	26,254.21	5,254.78	0.2%
27	0.261122424		132.0078653		0.179006032		0.767567714		1090917.933		446.8656537		2685.023532		940.4127072	0	741.1197909		451.9103557		323,720,662,388,373.00	26,024,178,137,666.00	349,744,840,526,039.00	48,054,679,112,252.30	24,990.38	5,274.59	0.3%
28	0.335522846		109.0568834		0.17887846		0.827638539		979178.8378		540.6465418		2696.724935		938.196147	0	821.9642729		475.9206604		338,020,334,595,387.00	20,240,279,356,353.10	358,260,613,951,740.00	53,039,304,198,087.70	27,582.59	5,294.30	0.3%
29	0.034721522		142.5387411		0.173157614		0.821431129		730333.0712		693.2089476		2664.490333		926.7294671	0	763.2774725		458.6161143		443,704,161,950,266.00	4,258,555,077,057.86	447,962,717,027,323.00	63,716,897,461,073.90	33,135.37	5,320.25	0.3%
30	0.063740716		123.6336385		0.126036649		0.818916807		826076.3605		405.1262634		2658.619924		977.835724	0	573.3290882		397.4752364		238,021,040,734,524.00	3,804,443,506,567.29	241,825,484,241,091.00	24,959,661,945,850.30	12,980.04	5,328.18	0.3%
31	0.334191651		126.0223404		0.110377116		0.819396368		1211394.03		376.7418744		2609.856347		954.8441641	0	923.0834089		504.3459766		302,871,048,838,127.00	28,015,759,457,135.60	330,886,808,295,263.00	29,926,265,786,811.50	15,562.87	5,353.82	0.3%
32	0.052425574		143.0833764		0.161840464		0.757305614		1490342.439		496.8352071		2671.960792		938.3562178	0	834.1980873		479.4492934		673,978,450,880,713.00	9,605,070,856,907.50	683,583,521,737,620.00	83,781,836,790,932.80	43,569.96	5,398.53	0.3%
33	0.15642809		114.1364735		0.138327529		0.877394589		685080.8775		312.7034394		2650.532951		937.6198509	0	735.3792116		450.1567455		159,572,481,378,735.00	4,483,436,007,540.09	164,055,917,386,275.00	19,911,109,957,792.40	10,354.59	5,468.18	0.3%
34	0.43806106		109.3970824		0.148007398		0.809240778		1445712.303		901.012545		2621.991331		979.0895574	0	868.4490319		489.1930245		706,811,855,073,779.00	68,651,541,823,135.90	775,463,396,896,915.00	92,880,059,856,934.70	48,301.40	5,475.76	0.3%
35	0.518317813		132.2732292		0.214389024		0.811616487		754876.4788		296.5621624		2651.153829		958.9853801	0	809.6512385		472.3425614		100,947,386,475,253.00	24,313,941,372,890.50	125,261,327,848,143.00	21,795,679,788,964.60	11,334.64	5,507.90	0.3%
36	0.424521643		134.1818473		0.147648808		0.731291891		1266867.106		477.2316334		2626.639121		966.7684612	0	772.5850813		461.4038849		313,702,014,836,388.00	56,196,942,012,558.10	369,898,956,848,946.00	39,939,609,196,383.60	20,770.22	5,507.97	0.3%
37	0.435954975		118.8499832		0.185365811		0.897101227		1064662.757		461.7368084		2663.559662		970.5028223	0	637.0869887		418.9936642		225,328,876,633,343.00	33,776,303,405,168.10	259,105,180,038,511.00	43,087,091,838,577.30	22,407.04	5,517.14	0.4%
38	0.371977362		142.0536516		0.195880183		0.83178499		682382.5069		532.3301357		2685.432645		927.5027823	0	867.210068		488.8439489		225,423,186,449,072.00	32,507,554,056,177.50	257,930,740,505,249.00	42,024,706,159,229.50	21,854.55	5,519.11	0.4%
39	0.154044702		131.5937335		0.144926908		0.800787976		736075.0118		605.0066035		2690.443627		927.9666691	0	845.4899851		482.6833541		367,332,781,597,706.00	13,728,863,032,877.70	381,061,644,630,584.00	44,224,385,674,208.00	22,998.48	5,519.93	0.4%
40	0.109190623		124.9253739		0.201952588		0.824003461		1004085.391		355.7422295		2686.100573		973.24819	0	717.8053556		444.7453696		280,572,703,716,099.00	7,128,251,275,958.16	287,700,954,992,057.00	47,876,209,896,526.20	24,897.57	5,540.72	0.4%
41	0.151639934		128.2094895		0.105215307		0.872416164		831400.9166		617.1371148		2656.974728		968.3929736	0	924.9727475		504.8618527		442,231,886,473,378.00	15,183,300,801,639.60	457,415,187,275,018.00	41,986,841,773,379.30	21,834.86	5,541.64	0.4%
42	0.436571873		111.2602765		0.109631042		0.80736151		1145730.813		823.3493884		2629.597034		962.7496146	0	676.1886213		431.6602095		442,344,085,900,452.00	51,808,970,422,004.90	494,153,056,322,457.00	43,738,417,986,477.80	22,745.75	5,566.44	0.4%
43	0.482979488		121.734781		0.200164407		0.794343948		1281840.588		609.2134692		2611.347881		940.8125576	0	599.4481319		406.4282559		309,746,405,603,535.00	61,902,719,427,713.00	371,649,125,031,248.00	59,091,982,513,098.50	30,730.23	5,572.67	0.4%
44	0.62476467		137.0850491		0.148564435		0.878745362		1744913.593		576.9054599		2694.526234		945.2546732	0	567.6443993		395.4997986		289,005,633,952,188.00	141,854,308,639,414.00	430,859,942,591,602.00	56,248,898,413,554.10	29,251.71	5,579.89	0.4%
45	0.151637998		138.1605719		0.187505157		0.840153328		869230.9048		416.7147491		2669.861427		940.9648704	0	559.1830441		392.5410547		230,777,541,839,526.00	12,564,940,404,711.00	243,342,482,244,237.00	38,334,491,089,547.20	19,935.49	5,598.04	0.4%
46	0.231963498		126.7420786		0.167408975		0.726386423		649291.9761		582.5200496		2677.002659		928.8897161	0	661.310915		426.8850381		242,778,182,130,131.00	15,922,784,592,870.00	258,700,966,723,001.00	31,458,970,522,331.20	16,359.94	5,633.21	0.4%
47	0.159040546		137.6566427		0.1913025		0.836435705		667547.7451		387.7269066		2680.154971		936.9410247	0	761.2943013		458.0199315		198,472,548,245,270.00	9,295,098,951,862.49	207,767,647,197,133.00	33,245,366,967,154.40	17,288.94	5,646.81	0.5%
48	0.246107646		114.715681		0.176322159		0.746351499		1161371.065		843.7816301		2687.126959		923.8932082	0	717.3401615		444.6012313		651,417,217,678,293.00	32,333,291,593,386.20	683,750,509,271,679.00	89,980,409,781,382.80	46,793.47	5,653.96	0.5%
49	0.097024253		129.3977967		0.144159524		0.831544817		1006707.995		616.5035767		2695.076744		941.6118233	0	749.8843554		454.5746726		509,175,218,815,450.00	11,707,797,116,964.40	520,883,015,932,414.00	62,440,906,219,293.70	32,471.81	5,672.31	0.5%
50	0.351803249		117.0961198		0.143936284		0.776410713		870017.9776		485.15157		2620.937226		945.4264259	0	759.8449712		457.5837413		243,682,831,249,173.00	21,768,976,840,397.70	265,451,808,089,570.00	29,665,214,524,980.20	15,427.12	5,682.04	0.5%
51	0.372352563		120.1808858		0.165661455		0.748400115		1439321.715		488.4683495		2636.363425		960.428667	0	652.7991329		424.1289062		360,312,233,246,263.00	42,228,879,425,599.90	402,541,112,671,863.00	49,907,470,717,537.30	25,953.91	5,744.83	0.5%
52	0.113779789		117.2199217		0.171325084		0.754950212		1851600.533		380.671276		2649.669095		955.8712439	0	661.4566424		426.93207		516,794,225,527,199.00	11,926,517,874,948.90	528,720,743,402,148.00	68,385,749,954,566.20	35,563.37	5,752.05	0.5%
53	0.339726498		130.328279		0.104341479		0.875568895		1584958.234		881.2017424		2663.5756		938.1222121	0	648.6156945		422.7677149		757,747,451,848,191.00	93,641,933,704,696.90	851,389,385,552,888.00	77,781,362,190,141.70	40,449.47	5,762.38	0.5%
54	0.485123539		128.7489038		0.128483589		0.807935051		897960.1629		349.2559415		2693.309439		970.8070956	0	550.9004008		389.6230415		121,189,765,521,613.00	30,097,283,482,305.30	151,287,049,003,918.00	15,704,563,195,556.70	8,167.01	5,806.57	0.5%
55	0.351606022		109.5652086		0.201893455		0.759262568		1199296.652		442.001224		2669.485286		946.9874481	0	902.4423989		498.6752725		345,729,484,485,069.00	21,812,620,788,422.00	367,542,105,273,491.00	56,340,581,875,330.00	29,299.39	5,816.00	0.5%
56	0.429354068		127.8994324		0.158326482		0.763655355		557948.2467		406.9576853		2652.72444		942.424422	0	624.530518		414.8441027		103,582,693,386,839.00	18,395,514,339,093.10	121,978,207,725,933.00	14,748,002,830,104.60	7,669.56	5,823.36	0.5%
57	0.393894493		126.7968552		0.159248226		0.802819991		713949.115		522.0426667		2608.831281		946.1016048	0	733.5068958		449.5833184		196,029,915,157,463.00	27,169,640,887,421.20	223,199,556,044,884.00	28,535,540,786,982.20	14,839.64	5,865.77	0.6%
58	0.05215059		131.681735		0.174702523		0.871278002		1292149.226		673.1243567		2663.563481		930.7215839	0	538.1632563		385.0925433		602,954,410,238,480.00	9,120,115,776,443.83	612,074,526,014,924.00	93,166,596,739,708.50	48,450.41	5,871.81	0.6%
59	0.082129529		122.0905928		0.145580668		0.799213471		1465921.275		315.4312855		2658.709355		955.3344871	0	734.1519303		449.7809532		375,538,720,937,538.00	6,383,098,214,619.19	381,921,819,152,157.00	44,436,615,602,354.30	23,108.84	5,891.95	0.6%
60	0.036354112		111.3394971		0.188667367		0.756529826		1592977.367		717.274848		2643.841001		976.2560298	0	545.4847382		387.7032041		806,162,405,661,131.00	5,312,277,863,519.71	811,474,683,524,651.00	115,823,802,459,431.00	60,233.08	5,892.22	0.6%
61	0.171994929		124.7321207		0.208476237		0.784691083		678426.1639		354.9204328		2657.305112		946.9448278	0	592.0370855		403.9080827		154,444,449,651,177.00	7,332,797,282,195.46	161,777,246,933,372.00	26,465,049,862,270.10	13,762.90	5,917.14	0.6%
62	0.104200271		133.1755922		0.098795909		0.786917457		1365285.953		763.3253724		2632.366091		961.9943501	0	762.9424373		458.5154501		837,175,779,713,628.00	23,220,058,345,597.80	860,395,838,059,226.00	66,890,808,161,020.10	34,785.94	5,928.06	0.6%
63	0.094377643		109.5016095		0.199720493		0.768960662		753876.8319		554.6786653		2660.109784		958.2521365	0	895.0796025		496.6368243		377,736,295,027,027.00	4,663,508,517,780.04	382,399,803,544,807.00	58,727,891,967,291.20	30,540.89	5,934.83	0.6%
64	0.076292342		126.7918406		0.147029792		0.843742093		1214934.285		281.6792931		2615.179738		968.6954584	0	818.0639338		474.7901616		293,732,923,441,737.00	4,946,776,970,575.46	298,679,700,412,312.00	37,052,777,205,892.00	19,268.95	5,942.90	0.6%
65	0.099720123		119.2679088		0.176716297		0.810971116		1376529.002		708.6169596		2625.156445		960.6193659	0	632.6667547		417.5376042		700,316,428,481,997.00	15,337,165,529,665.50	715,653,594,011,662.00	102,561,613,877,855.00	53,336.20	5,946.49	0.6%

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(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
66	0.200808098		141.9293438		0.20386484		0.764631192		1125870.533		374.2743769		2676.682472		938.8776343	0	715.0610107		443.8943704		295,219,013,301,278.00	20,565,606,666,593.20	315,784,619,967,871.00	49,224,953,653,879.30	25,598.97	5,949.71	0.6%
67	0.3126838		115.3354097		0.136720524		0.752144336		1188559.11		839.7083257		2617.734813		980.2503695	0	746.8954261		453.667834		603,892,584,842,275.00	45,183,311,068,842.60	649,075,895,911,118.00	66,746,790,200,875.10	34,711.04	5,958.11	0.7%
68	0.327583298		134.7399573		0.154088748		0.861909919		1289538.455		702.9590242		2682.920351		947.044214	0	874.6212333		490.9283319		604,810,295,150,634.00	64,348,295,850,279.60	669,158,591,000,914.00	88,871,367,644,339.80	46,216.72	5,993.91	0.7%
69	0.149337248		134.3654569		0.184074374		0.814503182		1622401.399		537.2843766		2666.035531		942.4753256	0	609.3261896		409.7632546		586,719,664,273,201.00	27,880,463,063,212.60	614,600,127,336,414.00	92,146,482,663,562.20	47,919.91	5,999.29	0.7%
70	0.23466384		130.2138501		0.099251232		0.804575057		823337.5147		941.0379164		2660.012031		928.8685067	0	724.1937543		446.7200812		520,592,685,896,421.00	35,447,469,781,393.10	556,040,155,677,814.00	44,402,623,075,962.70	23,091.17	6,029.51	0.7%
71	0.176725694		125.6113634		0.224350904		0.827732896		928119.2384		760.5675064		2668.777834		938.4137332	0	634.8096875		418.2441362		472,140,560,464,494.00	22,319,524,077,285.00	494,460,084,541,779.00	91,822,534,726,980.80	47,751.45	6,041.42	0.7%
72	0.201976033		119.3810092		0.155352646		0.809115598		1294125.117		369.3814656		2679.482465		953.3060324	0	670.4813561		429.8346688		321,827,814,396,132.00	15,151,187,385,462.80	336,979,001,781,595.00	42,357,670,593,168.90	22,027.71	6,071.77	0.7%
73	0.147977765		130.1841068		0.184689		0.795868875		1441768.916		720.6227516		2629.657149		933.7156675	0	817.9820056		474.7663862		827,058,750,899,064.00	30,113,221,418,921.60	857,171,972,317,985.00	125,994,188,144,272.00	65,522.09	6,075.19	0.7%
74	0.182394506		131.7887339		0.190917587		0.913405844		1201801.504		768.7201799		2643.026972		978.9018535	0	865.6167718		488.3946741		733,785,288,828,244.00	35,707,833,697,305.60	769,493,122,525,550.00	134,188,242,275,537.00	69,783.33	6,083.86	0.7%
75	0.193860607		121.7477704		0.155997842		0.796619494		1166023.012		397.8857251		2684.238316		962.2247582	0	924.4964657		504.7318556		383,754,993,455,233.00	15,102,232,224,970.90	398,857,225,680,204.00	49,566,355,031,863.20	25,776.52	6,088.39	0.7%
76	0.079304136		114.4993464		0.109632315		0.832754985		971557.1082		928.2011262		2674.664271		952.2118259	0	777.5679335		462.889425		765,264,864,752,904.00	9,820,350,391,177.95	775,085,215,144,082.00	70,762,843,985,760.50	36,799.55	6,089.71	0.7%
77	0.049273083		129.6689323		0.171862705		0.738815705		1338423.411		326.3596551		2651.459794		955.2513044	0	697.6142476		438.4456432		355,219,371,534,777.00	4,268,531,288,524.02	359,487,902,823,301.00	45,645,928,227,604.10	23,737.74	6,115.88	0.8%
78	0.304267596		121.8111973		0.169553631		0.863382402		887644.4618		310.98664		2619.242829		951.2532327	0	941.1744726		509.264212		194,341,686,251,663.00	13,963,732,319,511.60	208,305,418,571,175.00	30,493,751,285,784.80	15,857.99	6,119.90	0.8%
79	0.148473431		127.0604361		0.227404712		0.751505962		1189594.708		919.173726		2674.908617		957.8384535	0	838.0746319		480.5620101		897,875,343,229,650.00	30,589,323,158,352.50	928,464,666,388,003.00	158,670,894,881,079.00	82,515.31	6,138.17	0.8%
80	0.383798883		122.6024394		0.10888518		0.825963559		1452133.723		775.8265746		2649.044757		959.5948101	0	588.0283574		402.5383139		533,834,774,181,801.00	73,887,948,592,177.30	607,722,722,773,978.00	54,655,659,135,380.50	28,423.16	6,139.77	0.8%
81	0.467257682		133.0003523		0.143009885		0.760753921		1229777.668		603.4105484		2661.139049		926.0375216	0	908.7686598		500.4201154		398,061,578,708,317.00	71,134,383,580,045.70	469,195,962,288,363.00	51,046,329,765,241.30	26,546.16	6,177.59	0.8%
82	0.300643191		108.904553		0.204139955		0.786753343		1191380.794		366.3936966		2623.327209		954.5433279	0	628.201971		416.0616963		242,220,772,030,448.00	15,135,199,358,139.00	257,355,971,388,587.00	41,333,374,396,021.80	21,495.03	6,226.74	0.8%
83	0.183485728		126.2942275		0.204407246		0.828628428		1009077.154		444.0418062		2603.881017		935.1245164	0	510.5124179		375.0690628		252,987,659,186,844.00	14,877,264,655,413.40	267,864,923,842,257.00	45,370,332,683,955.30	23,594.41	6,242.10	0.8%
84	0.177846197		135.8484029		0.143037554		0.758675342		900764.336		447.079658		2603.545072		946.6724025	0	646.7294169		422.1525295		265,446,209,207,962.00	15,828,050,703,011.90	281,274,259,910,974.00	30,523,619,696,879.60	15,873.52	6,264.50	0.8%
85	0.200107941		127.0519136		0.214223366		0.837222673		1669157.71		532.4829122		2677.38866		927.0425531	0	786.0952717		465.420684		660,272,760,166,872.00	32,428,033,542,496.90	692,700,793,709,369.00	124,237,729,295,050.00	64,608.66	6,271.23	0.8%
86	0.051210874		126.3449459		0.156639094		0.710287437		586259.9955		323.1038217		2656.897057		954.7247455	0	880.7519003		492.645911		177,335,970,918,943.00	1,794,119,566,822.72	179,130,090,485,766.00	19,929,795,461,252.10	10,364.30	6,307.71	0.8%
87	0.235746455		140.8398955		0.181516341		0.777662777		1483811.024		340.7166621		2661.968215		956.8013471	0	607.5639077		409.1702707		304,702,071,857,781.00	29,000,377,796,699.60	333,702,449,654,480.00	47,104,937,901,440.60	24,496.48	6,319.29	0.9%
88	0.2704187		127.8699442		0.138777026		0.871191661		654689.0602		626.3797977		2669.824889		925.0054545	0	875.1983563		491.0902759		295,535,061,016,285.00	20,525,466,777,395.60	316,060,527,793,680.00	38,212,156,303,404.80	19,871.87	6,346.79	0.9%
89	0.276244154		130.8184279		0.103979704		0.772442346		1600495.19		629.7740286		2685.098335		958.4108351	0	595.6125528		405.1259002		573,172,673,780,341.00	56,686,734,335,801.10	629,859,408,116,142.00	50,589,253,570,045.60	26,308.47	6,349.04	0.9%
90	0.266390714		120.9636125		0.190429489		0.870972209		805301.115		372.5560161		2636.767958		960.0428696	0	860.7882685		487.0306102		212,596,540,864,122.00	13,138,147,122,706.40	225,734,687,986,829.00	37,440,082,846,433.60	19,470.36	6,358.69	0.9%
91	0.188501253		105.9693195		0.182682827		0.878637008		1445166.884		757.7346368		2622.998353		927.0063556	0	1036.393303		534.4048452		953,249,255,966,081.00	20,771,551,973,322.40	974,020,807,939,404.00	156,341,922,863,666.00	81,304.15	6,362.60	0.9%
92	0.39741964		137.654959		0.146799863		0.80379189		816558.2163		711.648267		2623.568049		975.8857	0	585.4488543		401.6544364		265,945,049,158,844.00	54,314,248,988,558.40	320,259,298,147,403.00	37,789,488,922,545.50	19,652.07	6,374.36	0.9%
93	0.310894922		122.1830576		0.157119848		0.797584348		1254298.873		337.3205187		2667.456372		977.9006444	0	642.046038		420.6212147		238,418,948,992,640.00	22,681,224,167,949.40	261,100,173,160,589.00	32,720,115,910,553.60	17,015.79	6,376.57	0.9%
94	0.528844614		140.4983039		0.222908769		0.76908163		1312048.495		570.4869156		2698.26301		971.7093751	0	774.0176431		461.8314646		327,007,894,782,131.00	97,270,138,649,858.50	424,278,033,431,989.00	72,736,121,336,085.80	37,825.74	6,400.05	0.9%
95	0.229758877		123.6045113		0.206697344		0.815591682		1616662.762		436.2617812		2631.780234		951.8454231	0	568.1261829		395.6676016		406,177,110,678,627.00	28,113,378,155,764.90	434,290,488,834,392.00	73,212,966,194,115.00	38,073.71	6,401.42	0.9%
96	0.615715122		114.0606006		0.175936318		0.83032025		1164338.723		424.6987051		2625.181853		974.9323198	0	595.1890083		404.9818306		145,906,472,010,008.00	42,261,328,979,561.80	188,167,800,989,570.00	27,488,208,610,535.20	14,294.98	6,403.39	0.9%
97	0.187148743		115.7570214		0.171653121		0.726432766		664107.3209		925.3824511		2653.36297		925.8708284	0	773.4737599		461.6691773		455,299,183,041,024.00	15,916,019,327,345.50	471,215,202,368,370.00	58,757,921,119,257.10	30,556.50	6,434.37	1.0%
98	0.26760993		134.1859433		0.115735039		0.839838441		1139190.22		530.6611727		2668.784613		931.718936	0	988.5210838		521.9165353		469,950,692,844,258.00	34,140,008,653,981.70	504,090,701,498,239.00	48,996,978,438,233.40	25,480.42	6,437.94	1.0%
99	0.452529266		128.482603		0.145381447		0.843759512		1267177.588		646.8447508		2632.110099		938.3316529	0	818.4761046		474.909755		419,800,423,726,557.00	70,534,694,440,375.40	490,335,118,166,933.00	60,147,927,518,731.30	31,279.36	6,479.66	1.0%
100	0.17263765		127.4839976		0.125458139		0.871971085		1843745.414		317.3951632		2694.724053		933.7950914	0	658.0997092		425.8473387		406,104,926,192,007.00	18,724,572,751,480.30	424,829,498,943,488.00	46,474,592,297,313.60	24,168.67	6,482.35	1.0%
101	0.0399694		133.2548299		0.162724703		0.869992644		1659193.918		852.8389354		2642.080687		961.8377754	0	878.7616098		492.0889647		1,331,155,568,354,120.00	12,109,575,102,355.60	1,343,265,143,456,470.00	190,165,098,754,108.00	98,893.57	6,513.01	1.0%
102	0.375596397		120.2918528		0.185805146		0.867149138		822428.7363		506.765455		2654.386413		928.1090507	0	608.214384		409.3892471		204,779,629,182,477.00	24,469,169,215,997.50	229,248,798,398,475.00	36,936,743,427,088.00	19,208.61	6,547.07	1.0%
103	0.511788465		139.7641749		0.222547495		0.81514123		851587.164		409.0623356		2635.557197		935.1904905	0	873.0230636		490.4795973		165,589,642,074,344.00	41,651,091,382,678.20	207,240,733,457,022.00	37,595,052,147,959.20	19,550.95	6,548.12	1.0%
104	0.118618587		110.9818576		0.186371674		0.716087188		1072604.109		545.7598737		2693.996186		956.8654966	0	678.038606		432.2502958		440,652,053,401,783.00	8,604,555,370,876.21	449,256,608,772,659.00	59,957,053,969,065.90	31,180.10	6,548.98	1.0%
105	0.309507496		127.347373		0.170913518		0.877200908		1502649.076		555.1104062		2649.550786		947.6702316	0	627.4803313		415.8226546		461,233,298,438,122.00	48,421,419,618,771.80	509,654,718,056,894.00	76,410,235,155,681.30	39,736.42	6,551.69	1.0%
106	0.071064167		121.2580768		0.175216364		0.709603448		845314.3464		326.5825518		2665.419681		932.6828452	0	666.9596002		428.7043123		214,517,319,487,766.00	3,155,594,121,302.92	217,672,913,609,069.00	27,064,173,700,729.00	14,074.47	6,564.96	1.0%
107	0.388362947		127.5754973		0.120592537		0.827200814		710956.6629		551.2899727		2679.883674		945.4245802	0	571.3371292		396.784147		183,163,486,226,678.00	28,618,542,912,817.70	211,782,029,139,496.00	21,126,156,403,356.50	10,986.46	6,568.65	1.1%
108	0.473309662		116.611596		0.171061531		0.815334578		833300.8266		642.0637907		2683.235168		933.5670886	0	648.2413281		422.6456913		233,174,935,102,508.00	36,179,772,954,494.30	269,354,708,057,002.00	37,567,542,573,783.90	19,536.65	6,570.11	1.1%
109	0.134033788		118.5516673		0.193398654		0.865951366		827783.9336		361.69392		2687.516067		954.5585833	0	793.6600613		467.6547514		243,107,209,797,730.00	6,172,975,114,328.66	249,280,184,912,059.00	41,747,906,929,883.40	21,710.61	6,618.93	1.1%
110	0.081919402		134.6300151		0.228540089		0.812274775		1791531.197		592.3825763		2672.308806		948.893912	0	751.3465849		455.0176534		878,796,513,009,365.00	18,838,169,014,381.90	897,634,682,023,747.00	166,634,523,370,010.00	86,656.72	6,619.08	1.1%
111	0.637590533		118.8037747		0.159543953		0.827843886		934486.2005		698.6140323		2615.422079		931.8117567	0	630.1337561		416.7009213		187,516,000,275,012.00	62,911,566,518,374.50	250,427,566,793,386.00	33,075,843,365,000.10	17,200.78	6,631.78	1.1%
112	0.409204081		124.0997409		0.152633784		0.870423046		1710360.317		525.946582		2632.169104		969.3483419	0	816.7994238		474.4230699		496,575,560,438,400.00	65,775,081,635,076.60	562,350,642,073,476.00	74,711,636,366,201.80	38,853.08	6,644.11	1.1%
113	0.272483624		141.4205209		0.147896448		0.896442301		1017531.707		922.8863762		2623.152189		957.5344054	0	674.5029299		431.1218243		566,321,149,440,329.00	62,904,361,484,534.00	629,225,510,924,863.00	83,423,115,927,289.00	43,383.41	6,660.72	1.1%
114	0.28080243		133.6350485		0.129806635		0.765465007		1556634.707		675.3478673		2625.583672		954.0393618	0	908.9610529		500.4730839		751,223,259,912,415.00	63,140,258,532,846.50	814,363,518,445,262.00	80,917,143,435,143.90	42,080.20	6,663.66	1.1%
115	0.126493453		126.1990863		0.200414649		0.786061838		1139248.147		580.6523624		2649.052316		936.1698031	0	602.5278499		407.4709491		451,134,993,824,713.00	15,127,489,925,546.70	466,262,483,750,259.00	73,454,202,485,606.40	38,199.17	6,710.02	1.1%
116	0.151574357		134.2977374		0.113010284		0.761115461		1024843.761		829.4783497		2608.295785		932.2973317	0	736.6575403		450.5478352		627,364,777,252,027.00	27,264,711,533,147.20	654,629,488,785,174.00	56,307,218,865,091.50	29,282.04	6,711.35	1.1%
117	0.599092093		135.2769461		0.096129743		0.762140301		840787.6774		333.2705569		2635.473792		952.0646892	0	824.5629305		476.6723834		105,696,616,109,010.00	36,928,668,963,345.00	142,625,285,072,355.00	10,449,349,030,417.60	5,434.09	6,712.08	1.2%
118	0.091303483		138.0801172		0.129793506		0.893943633		862065.2646		451.2678615		2602.048376		948.4025986	0	711.3375284		442.7371335		300,291,685,251,507.00	8,178,212,644,567.00	308,469,897,896,074.00	35,791,169,459,576.00	18,612.86	6,727.45	1.2%
119	0.249566426		123.7198703		0.193983318		0.842332543		1306276.932		396.4089733		2661.603109		927.2312949	0	889.0163854		494.9518715		386,255,363,241,526.00	21,898,185,052,141.70	408,153,548,293,668.00	66,691,661,782,092.80	34,682.37	6,742.96	1.2%
120	0.207097208		101.9713552		0.156864747		0.8078007		1562607.987		651.6713915		2663.288258		964.4312997	0	879.6352895		492.3335255		798,009,338,733,503.00	18,679,160,944,113.40	816,688,499,677,617.00	103,487,052,928,012.00	53,817.47	6,751.17	1.2%
121	0.044892373		120.4934144		0.105931515		0.755512465		1064947.538		667.088624		2698.396918		942.7039584	0	825.0523498		476.8138269		653,881,725,341,889.00	5,088,857,838,396.69	658,970,583,180,286.00	52,739,115,719,092.60	27,426.48	6,754.44	1.2%
122	0.209592634		121.1989805		0.124781165		0.79362526		1339480.162		494.5660382		2605.664033		948.0649354	0	750.1651336		454.6597675		460,054,774,330,633.00	22,669,264,334,297.10	482,724,038,664,930.00	47,803,912,835,534.10	24,859.97	6,767.65	1.2%
123	0.162881921		128.1070516		0.131884279		0.775871107		793399.4408		708.1385876		2699.822971		938.3957057	0	898.637698		497.6229537		477,264,388,325,491.00	17,268,478,195,547.70	494,532,866,521,038.00	50,603,175,368,921.30	26,315.71	6,768.91	1.2%
124	0.10653036		126.4244401		0.177145505		0.794316263		1143363.269		725.0774314		2674.581342		949.3932854	0	732.9848089		449.4232904		658,674,750,546,858.00	16,270,883,386,199.70	674,945,633,933,057.00	94,971,300,383,441.00	49,388.93	6,797.06	1.2%
125	0.261707605		130.3331894		0.193503133		0.775369141		1493832.835		688.2141155		2620.910185		949.3160487	0	596.558481		405.4474751		582,679,215,071,150.00	53,738,244,494,563.00	636,417,459,565,713.00	95,485,758,071,449.90	49,656.47	6,799.70	1.2%
126	0.131831842		138.2684435		0.098201288		0.818819209		1185198.25		336.3502551		2676.152002		935.7063261	0	648.860111		422.8473627		285,785,845,821,854.00	11,977,118,548,701.90	297,762,964,370,556.00	23,942,852,361,585.20	12,451.26	6,803.49	1.2%
127	0.219811095		128.2638992		0.205776864		0.816298969		621430.3078		792.2858802		2697.390288		934.3702939	0	711.9623204		442.9315263		338,442,668,281,068.00	20,400,540,165,119.40	358,843,208,446,188.00	60,276,846,574,546.20	31,346.41	6,810.69	1.3%
128	0.147497209		113.9191311		0.118057099		0.778554152		1103673.351		356.0548955		2659.13795		934.3192942	0	806.0498189		471.2908742		313,715,823,183,062.00	7,678,168,500,754.89	321,393,991,683,817.00	29,540,557,502,160.10	15,362.29	6,825.62	1.3%
129	0.238754443		131.9751653		0.167567131		0.846617012		825061.1809		375.1332803		2637.888074		954.2396182	0	913.5495282		501.7346988		235,903,686,671,102.00	15,319,790,139,898.20	251,223,476,811,000.00	35,639,864,731,345.00	18,534.18	6,842.16	1.3%
130	0.288717058		133.227337		0.136556968		0.868064648		846979.3872		327.6226303		2670.58211		956.493009	0	684.1087312		434.1808402		168,020,640,601,708.00	17,049,513,745,253.70	185,070,154,346,962.00	21,938,267,236,948.70	11,408.79	6,845.15	1.3%

(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
131	0.166285288		131.5430083		0.105218727		0.791767132		1350895.746		526.4597178		2685.320524		940.6862606	0	863.1916744		487.7100551		584,244,333,297,796.00	23,967,992,132,392.10	608,212,325,430,188.00	50,669,396,036,883.80	26,350.14	6,848.38	1.3%
132	0.043189453		136.2049218		0.200683072		0.85750238		944400.8184		565.9236982		2600.034642		950.6549756	0	691.4749681		436.5121329		426,615,025,541,517.00	5,155,437,136,450.55	431,770,462,677,967.00	74,301,743,210,586.20	38,639.92	6,852.08	1.3%
133	0.235469381		136.8920752		0.189460254		0.787128785		919896.7961		427.9745294		2607.994272		943.3333738	0	1029.903094		532.7289147		319,844,795,350,784.00	20,796,235,546,906.30	340,641,030,897,691.00	50,799,667,413,612.50	26,417.89	6,884.48	1.3%
134	0.352022562		129.6951137		0.182263409		0.796368026		1432072.382		662.1551084		2675.323842		955.3947176	0	552.7396199		390.2728913		459,036,573,974,508.00	66,247,273,525,349.80	525,283,847,499,858.00	76,244,294,537,991.60	39,650.13	6,891.83	1.3%
135	0.44211327		119.9253463		0.141820883		0.850922836		1400468.282		691.0881125		2664.368119		969.8182128	0	810.4634702		472.579426		508,296,365,733,667.00	69,255,705,801,828.10	577,552,071,535,495.00	69,698,191,675,839.00	36,245.89	6,904.94	1.3%
136	0.140424063		134.3537358		0.16084779		0.846890067		1314931.551		875.8526923		2634.566307		942.5286078	0	535.3360015		384.0796644		713,768,675,554,778.00	34,631,872,393,711.60	748,400,547,948,490.00	101,947,418,940,020.00	53,016.80	6,927.50	1.3%
137	0.434091803		140.2117673		0.175023116		0.843888208		901651.333		669.5428837		2655.875824		958.8253908	0	614.6981543		411.565576		270,758,888,121,201.00	63,240,572,777,100.50	333,999,460,898,302.00	49,331,701,421,894.00	25,654.49	6,950.16	1.4%
138	0.153799938		122.2179627		0.124064427		0.841474856		876684.8246		466.8687073		2605.775437		930.2940071	0	777.587275		462.895182		311,007,387,006,270.00	10,334,469,566,983.50	321,341,856,573,253.00	33,547,156,490,988.90	17,445.88	6,958.34	1.4%
139	0.163916252		121.2023568		0.169830421		0.874255485		1540942.098		647.5621708		2697.81625		954.8784471	0	715.7525914		444.1089777		737,571,003,255,190.00	26,899,006,390,123.50	764,470,009,645,313.00	113,504,820,041,585.00	59,027.11	6,988.21	1.4%
140	0.548465013		122.2706993		0.127428819		0.743526214		901982.5741		318.5904403		2656.428586		936.5092233	0	711.4334383		442.7669796		112,535,798,910,488.00	26,080,000,136,556.60	138,615,799,047,045.00	13,133,385,004,292.80	6,829.89	6,999.21	1.4%
141	0.125657369		123.5628652		0.164400097		0.753238561		1366583.652		694.2355129		2659.114112		970.0056211	0	664.8924607		428.039445		690,927,776,892,198.00	21,057,071,824,750.20	711,984,848,716,949.00	88,166,858,310,303.30	45,850.34	7,008.31	1.4%
142	0.46411573		108.4919069		0.135218147		0.787657739		1439206.747		374.9598595		2665.807833		946.2232876	0	983.0310112		520.465201		305,606,034,287,376.00	28,224,462,673,524.10	333,830,496,960,900.00	35,554,823,921,296.20	18,489.95	7,009.27	1.4%
143	0.485366185		130.7801705		0.080811664		0.851148971		1009597.452		460.8584732		2668.05002		938.4175492	0	595.8317978		405.2004568		186,982,845,885,527.00	44,983,360,460,396.10	231,966,206,345,923.00	15,955,276,939,258.90	8,297.39	7,021.78	1.4%
144	0.367780349		134.5851158		0.170234658		0.759216704		819027.121		352.6588745		2661.286316		976.9011993	0	633.2581119		417.732696		147,716,261,695,988.00	23,677,878,113,932.50	171,394,139,809,920.00	22,151,834,863,511.70	11,519.85	7,034.08	1.4%
145	0.121321981		136.8097796		0.148624881		0.842812019		1150983.128		415.5812658		2668.069322		958.7331136	0	733.4783106		449.5745581		372,989,293,983,937.00	13,211,785,823,394.30	386,201,079,807,331.00	48,376,642,661,048.40	25,157.82	7,037.35	1.4%
146	0.517671975		121.2045562		0.207887021		0.83129165		1403542.331		808.287479		2639.351525		963.3946679	0	788.2837625		466.0680998		501,807,937,639,934.00	97,447,742,420,993.60	599,255,680,060,928.00	103,560,217,327,917.00	53,855.52	7,043.39	1.4%
147	0.282002439		119.173729		0.168582366		0.865142044		761306.5531		350.0930175		2622.349275		937.4450992	0	671.8481664		430.2725656		158,199,517,337,626.00	11,537,532,063,724.40	169,737,049,401,350.00	24,755,757,082,887.10	12,874.00	7,079.19	1.5%
148	0.154820886		115.787128		0.188820111		0.715035613		1635407.51		418.7049284		2667.590831		925.5715775	0	809.8518715		472.4010814		545,223,715,654,131.00	14,678,333,352,012.50	559,902,049,006,144.00	75,594,113,592,865.20	39,312.01	7,100.22	1.5%
149	0.354071963		108.1827339		0.130113463		0.747538515		1150523.437		427.6825964		2665.524048		938.9276931	0	727.8800217		447.855578		280,481,127,212,831.00	19,270,817,437,705.50	299,751,944,650,536.00	29,155,320,360,057.60	15,161.95	7,135.42	1.5%
150	0.303840005		137.8025735		0.136673928		0.813382314		903625.8164		431.6735752		2667.855881		946.1546403	0	788.1822528		466.0380903		251,702,883,315,544.00	27,094,093,706,265.60	278,796,977,021,810.00	30,993,345,908,339.70	16,117.80	7,137.44	1.5%
151	0.164412002		117.313404		0.127027485		0.802351036		692610.2076		485.5775887		2615.072252		933.4809198	0	611.6797346		410.5538548		218,629,188,704,727.00	8,050,588,667,990.59	226,679,777,372,718.00	23,103,346,717,819.90	12,014.68	7,143.88	1.5%
152	0.434510131		126.2986462		0.209210442		0.789530337		1049286.39		384.9929805		2620.985773		939.7451524	0	690.0223232		436.0533814		191,864,208,956,490.00	31,922,832,935,877.00	223,787,041,892,367.00	36,964,693,886,892.10	19,223.14	7,146.72	1.5%
153	0.204556409		130.1950898		0.116903262		0.849375659		1238180.257		813.6527697		2669.847444		931.7595058	0	775.4644127		462.2628836		736,077,352,880,306.00	40,288,159,111,342.40	776,365,511,991,648.00	77,089,046,879,058.80	40,089.43	7,150.84	1.5%
154	0.309059877		129.3909286		0.097262326		0.844552799		919230.1455		819.1470589		2627.906747		965.822346	0	665.4601259		428.2221296		428,484,753,963,355.00	46,403,366,083,906.00	474,888,120,047,261.00	39,008,815,303,459.90	20,286.17	7,151.27	1.5%
155	0.423761278		136.582419		0.182962741		0.85629115		879035.7251		435.0887544		2650.077732		962.6738091	0	713.3674128		443.3683844		191,000,754,378,943.00	36,901,379,561,374.40	227,902,133,940,317.00	35,705,285,118,335.10	18,568.20	7,166.17	1.5%
156	0.346510079		139.2343768		0.159242575		0.732900902		1269047.96		686.4543647		2650.91729		970.0939102	0	858.4505413		486.3688222		551,934,659,672,429.00	72,505,251,064,870.90	624,439,910,737,300.00	72,877,774,082,377.80	37,899.40	7,197.60	1.5%
157	0.210020586		137.8051528		0.163666396		0.765344661		1230762.64		532.67979		2655.293154		972.4271407	0	875.0715012		491.0546842		508,757,571,461,483.00	32,352,086,675,801.10	541,109,658,137,284.00	67,780,046,521,164.20	35,248.38	7,202.21	1.6%
158	0.16268214		126.4430815		0.156507167		0.841513457		1303014.584		379.7390027		2651.858258		933.0064108	0	657.9123859		425.7867272		341,921,155,668,003.00	14,579,958,787,723.00	356,501,114,455,726.00	46,952,225,945,273.30	24,417.06	7,205.02	1.6%
159	0.25103382		132.3070368		0.164049594		0.77044957		793083.344		582.2885841		2671.565327		949.3483737	0	805.4131295		471.1047038		325,252,511,996,449.00	24,063,087,461,680.50	349,315,599,458,130.00	44,150,675,960,064.50	22,960.14	7,207.87	1.6%
160	0.348451879		122.352532		0.108193317		0.878206117		1481642.719		482.296419		2618.279594		975.6470933	0	722.4376707		446.178131		401,749,143,065,711.00	43,007,951,361,597.50	444,757,094,427,309.00	42,259,054,529,668.50	21,976.42	7,207.98	1.6%
161	0.627788276		134.4672286		0.146971663		0.797715185		1072550.133		314.2922622		2636.114894		953.8133763	0	759.7306384		457.549314		112,388,498,392,640.00	45,955,707,760,152.90	158,344,206,152,793.00	18,564,516,521,923.30	9,654.30	7,239.31	1.6%
162	0.152876331		120.6892696		0.109394706		0.765230122		1052192.21		334.2398782		2656.612191		954.5799083	0	570.5091659		396.4965394		225,444,580,400,249.00	8,728,951,148,276.26	234,173,531,548,525.00	19,603,163,826,653.60	10,194.44	7,240.73	1.6%
163	0.053384563		124.4965305		0.190336365		0.918765987		833523.9737		396.551956		2616.424414		926.9669922	0	848.5316447		483.550804		297,331,343,527,846.00	3,042,289,849,169.55	300,373,633,377,016.00	52,527,712,435,192.10	27,316.54	7,257.72	1.6%
164	0.084977878		137.8552689		0.166588764		0.768409285		891201.9081		930.62598		2665.072587		934.793027	0	694.8407522		437.5732141		650,877,717,265,990.00	15,932,789,764,909.10	666,810,507,030,899.00	85,357,314,721,244.00	44,389.27	7,278.15	1.6%
165	0.14747758		132.6471701		0.156432659		0.797247704		1398456.825		429.7339403		2660.005311		938.3864903	0	954.4241185		512.8363385		530,888,423,179,302.00	18,302,388,991,195.00	549,190,812,170,497.00	68,492,649,501,831.40	35,618.96	7,293.43	1.6%
166	0.131353488		137.3688004		0.205210457		0.8050351		1733815.146		620.9663296		2652.850972		929.0547853	0	692.1636358		436.7294488		796,541,212,385,125.00	31,506,911,230,776.00	828,048,123,615,901.00	136,794,892,262,972.00	71,138.90	7,294.93	1.6%
167	0.209058769		137.1066754		0.079723073		0.747410548		1117351.107		540.5471127		2603.709965		930.0152513	0	642.1473121		420.654387		381,343,661,071,592.00	28,031,402,938,676.70	409,375,064,010,269.00	24,392,967,634,680.30	12,685.33	7,313.33	1.7%
168	0.299700193		126.4500363		0.169430594		0.885525783		867090.5669		341.8205579		2601.92344		948.3299502	0	584.34939		401.2771086		156,157,717,627,211.00	16,355,787,836,540.30	172,513,505,463,751.00	25,883,091,328,296.10	13,460.26	7,320.81	1.7%
169	0.063467726		131.3970721		0.206904948		0.814150484		1060324.841		424.8233216		2601.915386		976.0201589	0	573.1407822		397.409957		313,564,045,736,552.00	5,994,785,881,637.09	319,558,831,618,189.00	53,830,248,855,654.60	27,993.91	7,328.18	1.7%
170	0.412138023		131.2710072		0.153496278		0.757507996		774341.3283		337.6897829		2675.378181		966.2125793	0	583.6012449		401.0201479		118,818,950,401,155.00	22,315,871,992,433.30	141,134,822,393,589.00	16,410,403,149,379.50	8,534.08	7,333.25	1.7%
171	0.49500393		129.8061076		0.149966137		0.83177775		1505489.758		454.9271261		2695.766004		929.0324431	0	722.7700826		446.2807681		307,359,368,449,998.00	65,571,942,519,449.90	372,931,310,969,448.00	46,518,890,705,941.70	24,191.71	7,368.21	1.7%
172	0.326981489		136.7831032		0.159081597		0.770098844		1044690.936		529.4937438		2612.84324		932.9325043	0	574.2745707		397.8028415		278,220,616,771,522.00	40,051,377,357,261.80	318,271,994,128,783.00	38,991,041,832,104.20	20,276.92	7,372.75	1.7%
173	0.185959945		133.4840357		0.137013291		0.783568383		1292555.042		394.5199536		2648.111564		941.0899933	0	569.6403227		396.1945069		312,821,722,224,269.00	19,951,200,621,311.20	332,772,922,845,580.00	35,726,262,304,985.30	18,579.11	7,373.50	1.7%
174	0.17440397		141.2565003		0.169588691		0.82741417		1435818.703		395.1396656		2603.105979		973.0314695	0	742.5219671		452.337654		408,591,330,147,181.00	24,652,555,770,182.40	433,243,885,917,364.00	60,792,819,242,591.60	31,614.73	7,376.51	1.7%
175	0.052365087		140.0805617		0.206442473		0.812273511		950283.1578		858.7601915		2642.92585		971.275354	0	773.3434977		461.6303004		701,998,730,026,802.00	10,423,639,915,492.30	712,422,369,942,294.00	119,464,506,049,207.00	62,126.39	7,380.63	1.7%
176	0.196084925		110.4750578		0.112258258		0.896659444		1440650.957		396.495404		2612.147862		957.6932685	0	838.8628918		480.7879558		432,675,227,290,501.00	13,664,331,531,782.60	446,339,558,822,284.00	44,927,391,815,717.50	23,364.07	7,388.73	1.7%
177	0.259530308		116.1548238		0.180794503		0.785128986		959670.351		393.9319122		2676.672795		950.3869475	0	590.8380233		403.4988546		218,152,940,082,481.00	14,092,054,635,737.90	232,244,994,718,219.00	32,966,481,457,651.60	17,143.91	7,390.14	1.8%
178	0.066553272		112.3747013		0.166027381		0.873065568		1410657.232		836.669553		2691.393279		975.6090493	0	652.7424486		424.1104917		918,295,782,066,219.00	10,370,572,889,999.70	928,666,354,956,219.00	134,612,778,879,261.00	70,004.11	7,395.36	1.8%
179	0.106006667		133.4859449		0.149250359		0.825923404		1313567.95		290.4733895		2635.473073		948.2059754	0	602.7641627		407.5508467		265,016,549,513,130.00	8,574,537,777,430.70	273,591,087,290,561.00	33,725,399,572,827.40	17,538.58	7,396.97	1.8%
180	0.194473352		139.237164		0.153602313		0.751741619		587004.6231		800.4506114		2649.411536		949.696819	0	608.9971412		409.6525994		297,511,948,026,126.00	21,487,786,767,894.20	318,999,734,794,020.00	36,834,660,569,091.20	19,155.52	7,410.57	1.8%
181	0.422324427		135.5199612		0.084835464		0.858520825		981252.9903		817.6545076		2635.268511		943.0486563	0	748.436058		454.1354866		411,273,869,183,374.00	74,157,753,752,422.60	485,431,622,935,797.00	35,355,447,653,614.10	18,386.27	7,415.59	1.8%
182	0.119038987		137.8395509		0.18648615		0.781561286		1754094.425		575.792521		2660.008345		962.9153246	0	937.5961552		508.2951864		912,314,082,823,147.00	27,989,652,222,206.70	940,303,735,045,354.00	137,049,603,247,484.00	71,271.36	7,427.27	1.8%
183	0.232191193		126.5615629		0.165304393		0.802832673		947559.6646		269.1691906		2658.810646		932.2206224	0	619.7176714		413.2425456		156,162,000,957,715.00	10,744,846,002,770.40	166,906,846,960,485.00	22,150,502,755,162.00	11,519.16	7,430.78	1.8%
184	0.101731431		125.2640116		0.21972487		0.793822653		1555725.509		569.111932		2620.877791		932.5954639	0	685.1825722		434.521472		665,072,041,777,699.00	15,893,093,559,344.00	680,965,135,337,043.00	118,775,695,362,409.00	61,768.18	7,431.66	1.8%
185	0.393035764		140.8414238		0.197352238		0.73295054		1200965.947		660.0173557		2697.561873		961.3831159	0	776.2553968		462.4985807		446,779,155,874,059.00	76,171,105,894,814.60	522,950,261,768,874.00	75,644,456,975,839.00	39,338.19	7,453.35	1.8%
186	0.057929101		123.7790263		0.196417558		0.902279548		1405983.852		694.5627865		2662.932464		933.0656046	0	630.1702792		416.7129973		742,400,019,528,473.00	9,659,245,189,156.34	752,059,264,717,629.00	133,282,609,498,947.00	69,312.37	7,453.50	1.8%
187	0.071861067		140.7775293		0.20898394		0.833112886		772053.9036		569.3563886		2649.204849		974.7793487	0	1011.755139		528.0144374		435,807,672,581,540.00	7,822,600,063,667.25	443,630,272,645,207.00	77,239,230,697,558.20	40,167.53	7,460.07	1.9%
188	0.16057311		127.7827935		0.223418778		0.86710703		1113814.929		882.5947976		2670.132984		924.7554529	0	756.6866857		456.6317807		746,877,952,547,954.00	29,155,596,847,003.80	776,033,549,394,958.00	150,339,421,995,891.00	78,182.60	7,463.20	1.9%
189	0.253698168		110.792705		0.214054876		0.793346862		1364763.451		319.1717249		2697.819494		978.1641675	0	796.1499411		468.387743		306,561,219,733,031.00	13,913,455,354,447.70	320,474,675,087,478.00	54,422,933,751,910.20	28,302.13	7,478.48	1.9%
190	0.386385381		124.8789209		0.180289926		0.845964927		1060790.935		648.5913278		2666.281798		972.9993388	0	575.6644839		398.2839504		322,448,181,811,958.00	48,523,582,340,834.30	370,971,764,152,792.00	56,580,225,420,762.10	29,424.01	7,492.65	1.9%
191	0.104822346		112.8334395		0.215097191		0.751777034		1484275.737		417.4646091		2620.080364		957.5024008	0	719.4567364		445.2566656		477,747,866,530,263.00	8,535,336,776,061.87	486,283,203,306,325.00	78,634,487,680,026.70	40,893.13	7,494.14	1.9%
192	0.102113668		138.8366995		0.189625557		0.902552035		1066281.762		443.3755498		2679.70831		930.3511834	0	728.906717		448.1713232		376,916,433,108,776.00	11,045,848,809,079.50	387,962,281,917,855.00	66,398,554,455,869.90	34,529.94	7,497.67	1.9%
193	0.330708596		135.5341439		0.213144683		0.833585764		880232.2958		535.8024427		2651.861793		940.1195186	0	923.1364951		504.3604788		319,702,153,664,629.00	34,038,224,890,257.80	353,740,378,554,886.00	62,850,600,027,925.40	32,684.86	7,524.47	1.9%
194	0.407218384		117.8041404		0.214379696		0.780042795		785701.1236		818.4408562		2670.906436		935.7717085	0	638.5948359		419.4892049		311,076,035,035,149.00	38,721,984,933,538.20	349,798,019,968,687.00	58,495,091,931,321.30	30,419.82	7,536.52	1.9%
195	0.080254836		118.9021518		0.100855651		0.818778253		1363733.8		469.3192629		2608.860717		983.9665947	0	663.4439703		427.5729417		480,402,058,836,799.00	8,218,630,509,184.93	488,620,689,345,984.00	40,349,521,419,395.10	20,983.39	7,544.71	1.9%

(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
196	0.21695376		130.4332271		0.203644326		0.886436736		644489.5026		543.1749509		2666.453117		974.5200969	0	932.1121304		506.8064903		280,769,848,022,998.00	15,602,945,904,293.10	296,372,793,927,291.00	53,500,568,092,480.90	27,822.47	7,563.60	1.9%
197	0.182518362		137.4264411		0.127850957		0.805343642		1126476.042		879.057182		2673.615301		975.8599847	0	894.6232773		496.5102117		811,305,039,501,729.00	42,337,123,040,084.00	853,642,162,541,813.00	87,894,373,768,387.50	45,708.64	7,565.59	2.0%
198	0.293840325		142.5916125		0.104765874		0.775729912		565878.4256		413.1843476		2680.461076		975.6407337	0	848.8006405		483.6274439		160,769,112,167,179.00	17,537,219,577,882.80	178,306,331,745,062.00	14,490,959,497,835.00	7,535.89	7,569.26	2.0%
199	0.550851919		133.4494223		0.148501998		0.784572465		1254625.297		433.1337044		2626.719576		934.5703859	0	923.8256501		504.5487054		244,967,973,418,210.00	62,503,192,178,408.40	307,471,165,596,618.00	35,823,643,328,571.00	18,629.75	7,571.85	2.0%
200	0.19009238		122.6188727		0.172363989		0.759375141		1798338.043		484.4649457		2676.970202		957.6398662	0	705.5161469		440.9217951		613,575,952,470,063.00	28,253,929,353,823.10	641,829,881,823,886.00	84,008,425,568,398.30	43,687.79	7,592.86	2.0%
201	0.306718973		132.4385798		0.174274563		0.885767836		1400348.298		405.2766796		2663.721242		931.3720708	0	769.1299764		460.3709986		358,786,156,007,660.00	35,536,834,284,035.30	394,322,990,291,695.00	60,870,379,256,197.50	31,655.07	7,595.99	2.0%
202	0.053130836		135.6715359		0.204514901		0.819462307		1387548.771		628.3601878		2643.249215		965.0124446	0	634.554884		418.1601892		664,125,247,227,617.00	10,402,697,363,830.10	674,527,944,591,447.00	113,045,657,683,942.00	58,788.33	7,596.01	2.0%
203	0.490670056		139.933091		0.188403617		0.805155239		1416327.197		656.9057284		2638.158509		932.0260289	0	540.7235269		386.0074806		344,303,384,509,413.00	106,592,635,152,038.00	450,896,019,661,450.00	68,398,292,518,794.60	35,569.89	7,612.95	2.0%
204	0.218545295		128.9976666		0.195139617		0.78954205		1214142.582		526.820509		2606.224716		942.7000682	0	824.0542581		476.5253313		464,902,069,802,909.00	26,989,761,365,336.10	491,891,831,168,245.00	75,786,233,371,986.40	39,411.92	7,613.26	2.0%
205	0.296746207		126.7364683		0.154671926		0.879585413		908876.8686		612.3758296		2654.948381		978.0254768	0	675.221128		431.3512884		328,605,869,063,979.00	31,556,629,372,160.30	360,162,498,436,139.00	48,999,088,745,339.40	25,481.51	7,624.90	2.0%
206	0.114543255		133.4116852		0.183574805		0.878666943		782327.5185		370.8565099		2669.676985		963.0256084	0	829.5576881		478.1139159		245,736,942,155,171.00	7,145,200,701,762.60	252,882,142,856,933.00	40,790,171,074,703.20	21,212.54	7,631.72	2.0%
207	0.398837506		135.3213826		0.165796044		0.77404789		914072.3455		526.0689126		2631.78218		930.6145063	0	678.8662556		432.5140291		241,370,362,408,770.00	41,272,267,160,925.30	282,642,629,569,695.00	36,272,681,318,659.70	18,863.27	7,632.44	2.1%
208	0.162254965		120.0316675		0.187995724		0.826090263		1056585.458		432.9059531		2643.968323		928.5699226	0	717.0914163		444.5241396		332,380,165,705,384.00	11,531,631,548,860.80	343,911,797,254,245.00	53,409,996,284,193.10	27,775.37	7,648.32	2.1%
209	0.528348385		131.2251306		0.191427844		0.786711417		1229250.691		391.8998727		2643.213829		967.7929626	0	684.5436675		434.318838		191,516,395,755,027.00	52,744,573,358,962.30	244,260,969,113,989.00	36,785,328,391,751.40	19,129.86	7,669.00	2.1%
210	0.265822205		126.1510557		0.131233685		0.770178581		1080445.536		889.3338464		2678.584294		930.3885133	0	643.8459361		421.2103823		580,281,881,775,854.00	45,843,864,232,685.60	626,125,746,008,540.00	63,284,641,273,848.30	32,910.58	7,671.01	2.1%
211	0.225183142		132.3639372		0.145522136		0.792342581		1092876.459		600.5334975		2636.497926		939.5642409	0	936.1254706		507.8963818		516,316,408,668,032.00	30,393,396,702,592.30	546,709,805,370,625.00	63,037,491,044,694.20	32,782.05	7,682.24	2.1%
212	0.401997823		109.6658994		0.163413724		0.75740801		883229.4473		721.7295532		2638.780469		931.4350229	0	977.588638		519.0224707		397,450,743,968,818.00	29,597,708,929,849.30	427,048,452,898,667.00	52,856,155,901,620.90	27,487.35	7,684.60	2.1%
213	0.068725769		119.9464236		0.197907326		0.742343935		933889.3206		787.7105074		2612.144346		942.2929311	0	501.5071884		371.7463125		469,877,544,615,870.00	7,954,662,822,775.68	477,832,207,438,646.00	70,200,863,712,217.50	36,507.30	7,695.63	2.1%
214	0.138720841		129.5341636		0.196935312		0.743489659		1827005.79		644.13586		2658.583942		949.4223568	0	897.7018297		497.3637665		1,012,206,144,278,170.00	32,092,214,346,655.60	1,044,298,358,624,830.00	152,905,506,093,155.00	79,517.07	7,700.73	2.1%
215	0.17695902		124.8550561		0.146208911		0.824904191		1117497.027		568.7461808		2622.781867		968.4606169	0	651.3904237		423.6710341		424,359,511,889,132.00	20,422,421,020,247.40	444,781,932,909,379.00	53,644,412,271,364.70	27,897.27	7,701.65	2.1%
216	0.323082335		133.7779679		0.121436841		0.847509631		1280483.249		527.5060486		2611.224221		949.2163822	0	868.6052209		489.2370128		439,742,837,114,394.00	46,565,090,593,498.00	486,307,927,707,892.00	50,050,273,239,111.60	26,028.17	7,712.07	2.1%
217	0.114760615		119.0672771		0.18859811		0.823858267		992095.6838		707.9890393		2646.793746		940.0516124	0	683.3378027		433.93613		524,237,796,080,365.00	12,374,113,243,262.60	536,611,909,323,628.00	83,377,745,526,311.80	43,359.81	7,712.43	2.2%
218	0.087551723		120.2735994		0.183039437		0.848990739		1564779.81		417.9780827		2658.111127		932.5384397	0	573.5921244		397.5664043		453,382,959,729,187.00	8,989,487,094,130.01	462,372,446,823,317.00	71,852,117,436,913.00	37,366.02	7,713.20	2.2%
219	0.094935989		111.80484		0.133442872		0.748490172		876957.5504		847.5875062		2639.351808		944.669537	0	937.9919732		508.4024667		684,595,702,596,423.00	8,862,237,929,379.21	693,457,940,525,803.00	69,263,049,609,393.10	36,019.60	7,714.97	2.2%
220	0.372523338		136.9267591		0.169491961		0.876342518		790012.1733		370.1865198		2651.796915		935.6508605	0	930.1039038		506.2602411		186,685,057,364,564.00	24,255,734,585,468.40	210,940,791,950,033.00	31,331,671,121,547.90	16,293.74	7,721.85	2.2%
221	0.360427284		126.0532668		0.159578037		0.825516032		1176792.634		573.3787117		2644.123972		926.2549877	0	868.1554332		489.1103262		420,142,097,331,235.00	43,363,711,746,481.00	463,505,809,077,716.00	61,059,579,876,236.90	31,753.46	7,739.84	2.2%
222	0.471113887		129.9777234		0.121489492		0.84173292		1043331.207		781.84471		2670.05082		969.363104	0	740.1828095		451.6245952		385,275,462,004,764.00	77,822,977,323,040.50	463,098,439,327,804.00	47,357,236,112,739.50	24,627.68	7,741.49	2.2%
223	0.36585535		115.4296971		0.180566764		0.772838764		957243.9595		717.5771186		2643.168975		954.7529909	0	626.4024411		415.4653495		347,611,915,362,311.00	35,533,286,339,477.20	383,145,201,701,788.00	53,467,527,823,372.70	27,805.28	7,744.18	2.2%
224	0.121985008		130.8149064		0.103783005		0.834843349		1211298.819		407.234693		2634.630566		928.7556449	0	807.2606061		471.6447102		402,209,658,153,125.00	11,870,565,292,042.90	414,080,223,445,168.00	35,876,966,921,543.30	18,657.48	7,747.94	2.2%
225	0.105883341		120.5760901		0.173859237		0.866112944		1431992.47		660.8353178		2660.742824		952.367534	0	913.1051961		501.6126672		854,254,403,124,061.00	16,184,998,924,359.80	870,439,402,048,421.00	131,072,276,107,040.00	68,162.90	7,751.84	2.2%
226	0.095109243		133.3057949		0.091664329		0.868059455		1077131.521		355.0524435		2624.681147		931.2333632	0	892.1740572		495.8300951		339,932,252,364,371.00	7,547,327,563,039.76	347,479,579,927,411.00	27,648,980,580,402.50	14,378.59	7,757.83	2.2%
227	0.09456694		140.5352414		0.155794517		0.895154656		811253.9564		404.3334089		2629.447723		941.2727647	0	772.5658878		461.3981535		268,063,966,543,917.00	7,388,152,360,317.09	275,452,118,904,234.00	38,414,604,157,290.60	19,977.15	7,763.19	2.3%
228	0.467675393		107.6263259		0.207593269		0.859461623		1728613.384		679.0441613		2607.47966		927.5745153	0	902.9643986		498.819476		614,133,432,963,335.00	58,801,530,621,365.00	672,934,963,584,700.00	120,064,011,940,441.00	62,438.16	7,763.59	2.3%
229	0.361924129		103.2908024		0.179505829		0.742806403		1113361.198		462.4313883		2664.60845		941.172146	0	750.3160771		454.7055071		295,203,630,902,136.00	17,073,820,951,290.30	312,277,451,853,426.00	41,638,475,488,212.90	21,653.70	7,765.91	2.3%
230	0.056311851		141.0753498		0.165019446		0.735206693		943862.1675		652.6303629		2667.01498		946.6243572	0	668.2108041		429.1062446		487,113,242,732,619.00	8,382,924,960,349.47	495,496,167,692,968.00	60,115,280,296,621.90	31,262.39	7,769.00	2.3%
231	0.167234524		133.2025611		0.082068169		0.791074727		951950.9415		637.2526415		2618.027887		961.8061316	0	650.867413		423.5009142		408,877,863,975,203.00	21,699,439,394,607.20	430,577,303,369,810.00	27,953,963,004,185.60	14,537.20	7,772.41	2.3%
232	0.183990849		111.2713062		0.189906382		0.781547427		1014315.818		568.1643551		2655.538195		979.5508001	0	606.589586		408.8420555		369,593,757,272,589.00	13,576,651,568,188.70	383,170,408,840,777.00	56,870,475,581,597.10	29,574.96	7,783.33	2.3%
233	0.15846895		131.8087604		0.20887834		0.81117971		786688.336		679.9099696		2688.163919		962.576496	0	992.2416491		522.8977996		482,309,753,726,780.00	17,669,043,402,934.60	499,978,797,129,714.00	84,715,342,981,859.40	44,055.42	7,785.92	2.3%
234	0.63617668		131.4784815		0.183390309		0.738486419		731055.8628		611.02145		2604.698893		974.6948469	0	753.773938		455.7520668		143,152,509,676,351.00	59,601,260,627,888.00	202,753,770,304,239.00	27,459,197,078,985.90	14,279.90	7,806.01	2.3%
235	0.062865192		138.7771011		0.153179759		0.778453417		619324.1067		552.0622208		2679.130201		939.0176874	0	812.1038916		473.0574472		303,668,987,056,148.00	4,958,775,877,034.26	308,627,762,933,182.00	36,801,795,112,187.20	19,138.43	7,813.97	2.3%
236	0.15169649		113.2885008		0.192307058		0.845048382		724986.4871		673.9901747		2665.518488		930.6951236	0	889.3480708		495.0441944		412,717,888,598,692.00	9,599,242,596,946.12	422,317,131,195,639.00	68,630,236,645,094.70	35,690.51	7,821.14	2.3%
237	0.092786723		128.517201		0.146882087		0.792418772		772018.5646		350.6664679		2679.14595		950.9486743	0	829.1921447		478.0085641		235,701,681,085,204.00	4,844,365,640,000.41	240,546,046,725,204.00	27,997,665,042,369.10	14,559.92	7,821.39	2.4%
238	0.323477906		132.4658328		0.178014764		0.733014524		1593991.652		809.992993		2658.412734		967.5117952	0	682.5301611		433.6796182		739,135,803,635,114.00	88,617,817,276,386.10	827,753,620,911,500.00	108,011,424,022,768.00	56,170.32	7,822.21	2.4%
239	0.037121151		120.3677669		0.182930166		0.817345322		1160518.287		354.1713728		2642.235344		958.1207565	0	569.2011673		396.0417575		297,437,392,490,179.00	2,466,710,229,789.59	299,904,102,719,969.00	44,840,796,258,214.20	23,319.03	7,823.45	2.4%
240	0.2755787		124.9555522		0.078414369		0.755405517		919570.4626		668.5696948		2672.870007		934.6219126	0	662.7913549		427.3625929		372,157,097,321,780.00	29,755,888,665,978.80	401,912,985,987,759.00	23,807,173,806,412.80	12,380.70	7,827.81	2.4%
241	0.665407137		121.1631954		0.21311537		0.750238719		1436185.415		483.2066767		2601.631614		943.9583355	0	598.1531361		405.9890124		177,235,773,559,634.00	75,001,350,176,925.70	252,237,123,736,559.00	40,329,538,552,386.10	20,973.00	7,830.62	2.4%
242	0.121776603		130.1334091		0.151569369		0.764440383		1476365.504		627.6970141		2667.951373		936.3176743	0	673.3265916		430.7457203		685,427,863,593,148.00	22,142,902,429,891.20	707,570,766,023,040.00	81,983,214,910,988.60	42,634.60	7,843.78	2.4%
243	0.265411156		139.7713954		0.155471921		0.853269895		1356150.116		465.9157834		2692.843942		939.7282276	0	717.0667671		444.5164995		410,043,944,785,173.00	39,373,707,482,710.10	449,417,652,267,883.00	59,619,525,345,316.60	31,004.57	7,846.21	2.4%
244	0.340897441		120.8606014		0.192527122		0.758405184		1362884.387		328.6757188		2613.704014		933.6940901	0	917.9148987		502.9320327		293,730,557,539,693.00	24,352,077,891,441.00	318,082,635,431,134.00	46,444,380,415,319.60	24,152.96	7,855.74	2.4%
245	0.11483351		136.5130051		0.21109649		0.730710044		751195.6627		676.9745382		2661.25216		960.2473235	0	988.9705206		522.035168		476,579,909,134,258.00	13,246,521,045,590.30	489,826,430,179,848.00	75,555,886,231,764.30	39,292.13	7,877.74	2.4%
246	0.117618194		123.046683		0.162391802		0.876340459		1017099.284		562.6818286		2610.349215		949.5346675	0	1021.247515		530.4855938		534,447,206,710,017.00	11,500,786,547,920.20	545,947,993,257,938.00	77,694,135,223,474.90	40,404.10	7,883.02	2.4%
247	0.457515739		130.6966187		0.227534575		0.786403195		1259488.783		642.6524238		2692.572312		932.4745329	0	546.3057494		387.9948612		327,726,041,402,389.00	73,176,013,788,756.90	400,902,055,191,146.00	71,734,974,973,375.80	37,305.10	7,886.97	2.5%
248	0.27234308		130.4677639		0.171310062		0.80968561		734526.8105		563.6862233		2688.793383		946.0641253	0	622.8667767		414.2911645		243,723,033,703,514.00	22,504,653,745,652.00	266,227,687,449,166.00	36,927,721,535,670.30	19,203.91	7,900.02	2.5%
249	0.362550497		135.3402123		0.174949149		0.888945153		1110510.54		397.1418421		2650.535008		945.7483704	0	621.7802248		413.9296543		223,946,953,774,629.00	34,980,784,119,822.20	258,927,737,894,451.00	40,268,493,037,654.30	20,941.25	7,907.04	2.5%
250	0.252081457		130.1448653		0.191160844		0.86992436		1228548.318		328.0855469		2619.670807		955.7252559	0	877.0229322		491.6019113		292,550,102,044,717.00	20,354,294,516,283.20	312,904,396,561,000.00	52,034,585,196,356.20	27,060.10	7,910.04	2.5%
251	0.079537		137.5814922		0.148248939		0.833686835		1287277.236		747.8827954		2624.871788		948.7298886	0	764.3225528		458.9299757		793,270,920,163,379.00	17,485,442,155,370.30	810,756,362,318,749.00	100,203,964,082,753.00	52,110.13	7,918.86	2.5%
252	0.093855519		122.3612912		0.137770574		0.900083821		880656.3067		338.6044876		2611.739063		945.1168143	0	930.6907384		506.4199245		270,836,000,482,948.00	4,683,709,344,944.33	275,519,709,827,892.00	34,165,839,470,405.50	17,767.62	7,919.88	2.5%
253	0.594968052		121.1631112		0.215289359		0.772650213		817979.5264		332.4861842		2689.246303		965.0335157	0	729.23067		448.2709041		98,185,151,761,659.50	26,868,075,111,642.60	125,053,226,873,302.00	20,801,775,083,110.10	10,817.77	7,923.32	2.5%
254	0.098933963		135.5960286		0.179356163		0.794155042		910762.4182		313.0207438		2677.556681		952.7873762	0	684.0404774		434.1591804		219,237,341,773,366.00	6,245,103,961,685.32	225,482,445,735,051.00	32,116,953,239,668.20	16,702.12	7,931.21	2.5%
255	0.510036307		135.7155382		0.146089091		0.812706437		1486303.316		362.8872289		2677.058915		974.4457326	0	644.4761604		421.4164814		217,384,187,692,326.00	62,429,591,610,948.90	279,813,779,303,274.00	33,221,603,071,648.10	17,276.58	7,959.94	2.5%
256	0.406363236		125.3831378		0.177915475		0.787006038		1086321.37		510.7223694		2614.706217		929.8039825	0	715.7308131		444.1022212		282,197,218,977,455.00	39,766,724,151,078.40	321,963,943,128,533.00	45,081,569,455,978.90	23,444.25	7,960.79	2.5%
257	0.34559185		138.783147		0.125362514		0.845378495		747362.5329		404.2476092		2666.175141		953.9338382	0	549.6033374		389.1640986		146,672,171,395,513.00	24,473,137,089,199.10	171,145,308,484,712.00	18,137,769,936,159.40	9,432.38	7,999.04	2.6%
258	0.07384671		108.9446961		0.158019366		0.80845033		1291511.161		449.3028352		2608.829718		955.9652781	0	636.8800324		418.925604		427,673,969,269,609.00	4,956,280,429,100.46	432,630,249,698,710.00	55,268,864,108,479.40	28,742.05	7,999.96	2.6%
259	0.114827076		135.2539761		0.12980776		0.820852508		1485659.679		564.013338		2608.699712		934.559061	0	739.9665115		451.558603		647,039,439,341,504.00	20,768,234,862,018.80	667,807,674,203,522.00	71,156,928,030,192.50	37,004.49	8,000.84	2.6%
260	0.171507694		109.8186947		0.136690723		0.775049189		1384491.324		350.0417149		2632.918462		944.731135	0	872.2518899		490.2629201		390,337,887,324,118.00	9,787,387,587,134.32	400,125,274,911,252.00	42,390,085,502,509.10	22,044.57	8,013.51	2.6%

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(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
261	0.538698479		123.229373		0.172401347		0.836302276		793134.467		335.8422533		2669.950992		949.6427024	0	535.2267119		384.0404572		89,772,686,312,053.40	24,623,135,826,310.60	114,395,822,138,364.00	16,493,548,323,783.60	8,577.31	8,017.48	2.6%
262	0.16938546		124.2077986		0.131170497		0.916825411		1014120.251		427.7193814		2681.082546		935.9876088	0	794.5398239		467.9138744		337,237,547,562,269.00	12,707,782,803,865.70	349,945,330,366,135.00	42,084,580,996,511.20	21,885.69	8,018.63	2.6%
263	0.306405506		128.005036		0.181850592		0.865498578		1085451.279		894.8552556		2623.99721		956.5824675	0	738.0054619		450.9598486		590,203,184,916,333.00	57,127,496,281,360.30	647,330,681,197,693.00	101,884,300,716,604.00	52,983.97	8,022.10	2.6%
264	0.047273059		135.2912103		0.201685958		0.749343338		898620.0579		483.9976661		2646.443768		952.5184985	0	796.9063677		468.6101991		383,536,937,708,272.00	4,526,253,543,408.36	388,063,191,251,681.00	58,648,777,558,005.90	30,499.74	8,022.14	2.6%
265	0.477730064		108.3010457		0.167668512		0.776826684		847628.9122		318.1958426		2696.994712		929.5672885	0	1017.079007		529.4018239		153,657,132,670,025.00	14,169,105,433,938.10	167,826,238,103,963.00	21,859,262,507,328.20	11,367.70	8,038.62	2.6%
266	0.362834366		115.5384227		0.21590368		0.886825377		830667.1796		450.0463669		2656.503088		963.7897132	0	647.1128729		422.2776613		194,925,225,804,485.00	19,420,009,703,559.90	214,345,235,508,045.00	41,040,438,394,129.10	21,342.69	8,051.78	2.6%
267	0.372332882		134.1182816		0.16692186		0.880749854		1532604.367		683.3973377		2640.948814		947.6650669	0	603.2529514		407.7160572		512,074,244,636,226.00	83,600,694,525,004.40	595,674,939,161,230.00	87,573,987,542,273.50	45,542.03	8,062.87	2.7%
268	0.645682589		111.8511477		0.180417872		0.846930562		1448790.847		394.2379674		2600.794583		956.7603207	0	1075.152433		544.3059841		219,942,661,645,895.00	46,977,266,239,480.90	266,919,927,885,376.00	40,785,741,362,681.80	21,210.24	8,077.24	2.7%
269	0.208191654		111.9753534		0.177284453		0.863156233		1182138.303		478.2258131		2632.239387		938.0103151	0	957.1877633		513.5782901		459,787,118,476,853.00	14,755,837,641,545.90	474,542,956,118,399.00	72,616,547,110,606.50	37,763.55	8,079.26	2.7%
270	0.064823456		123.6946421		0.115497416		0.803705019		770452.5903		468.8222135		2612.190306		951.1221711	0	965.8538594		515.8979448		346,162,365,666,748.00	4,067,495,270,400.68	350,229,860,937,148.00	32,510,385,509,814.70	16,906.72	8,081.76	2.7%
271	0.293692297		136.0694857		0.096384742		0.780263414		649955.4533		356.4606639		2624.090613		937.6453355	0	875.4627098		491.1644371		158,900,779,575,691.00	14,953,030,209,074.50	173,853,809,784,766.00	13,074,760,530,329.50	6,799.41	8,082.30	2.7%
272	0.033230452		119.1837708		0.185480065		0.786764606		1443717.668		886.5267675		2647.049814		976.0106184	0	628.2109879		416.0646823		990,659,900,947,891.00	6,799,037,228,275.41	997,458,938,176,166.00	145,558,334,977,051.00	75,696.24	8,091.70	2.7%
273	0.298330905		120.4566441		0.200517492		0.848862407		690429.0528		560.9625422		2639.501001		939.9876899	0	741.8862582		452.1439785		240,248,456,374,134.00	18,367,052,535,875.00	258,615,508,910,009.00	44,019,401,146,229.20	22,891.88	8,104.05	2.7%
274	0.14026729		116.2228159		0.118235936		0.855970561		1136568.003		733.4186027		2667.199296		974.7510301	0	693.3067389		437.0899278		614,308,288,978,820.00	17,256,628,296,628.60	631,564,917,275,449.00	63,918,462,228,083.40	33,240.19	8,110.93	2.7%
275	0.235618543		112.9411864		0.194605363		0.814491386		765446.4499		520.6447917		2611.20372		948.8124297	0	635.4284192		418.4479122		242,293,402,576,862.00	12,267,658,898,826.80	254,561,061,475,689.00	40,349,046,193,179.50	20,983.14	8,114.99	2.7%
276	0.192165891		129.9497047		0.160824943		0.854028521		803084.2125		503.0547531		2668.020386		936.7357926	0	613.9578535		411.3176706		259,641,903,120,266.00	15,183,747,420,024.10	274,825,650,540,290.00	37,747,052,453,875.60	19,630.00	8,118.09	2.7%
277	0.036200209		123.7349733		0.12972124		0.863283318		1550923.887		613.9541166		2638.514234		957.1747765	0	525.4267418		380.508335		654,895,040,707,014.00	6,031,618,528,125.36	660,926,659,235,140.00	74,014,653,627,361.70	38,490.62	8,120.71	2.8%
278	0.579917057		133.74541		0.145016932		0.730379699		1248757.427		769.2621211		2627.417569		930.7734718	0	678.0511921		432.2543077		336,136,289,360,267.00	116,487,674,307,070.00	452,623,963,667,337.00	47,940,763,798,496.60	24,931.14	8,130.07	2.8%
279	0.220386154		111.2932169		0.187774771		0.752979629		1384474.627		378.0233556		2697.098006		951.7744035	0	645.5412295		421.7645566		338,492,800,878,636.00	14,359,802,008,035.10	352,852,602,886,671.00	49,890,033,254,861.10	25,944.84	8,134.33	2.8%
280	0.195708941		120.3536374		0.129319846		0.796919499		1169859.66		318.4406952		2625.494869		927.6054185	0	585.2390552		401.5824623		227,678,283,987,687.00	11,407,625,135,764.90	239,085,909,123,452.00	24,639,597,820,857.20	12,813.59	8,160.24	2.8%
281	0.487730864		134.113916		0.162106977		0.871716902		752390.0767		487.8523497		2670.51472		930.529467	0	761.2055806		457.9932421		170,824,898,548,389.00	37,681,403,894,191.50	208,506,302,442,580.00	29,464,315,787,988.10	15,322.64	8,165.99	2.8%
282	0.361532274		136.8955561		0.178306862		0.800192371		638774.0265		756.4287732		2650.429355		931.7081874	0	918.1370527		502.9928889		311,276,293,438,312.00	38,707,658,667,519.30	349,983,952,105,832.00	49,935,636,975,803.00	25,968.56	8,170.06	2.8%
283	0.087874653		118.1623628		0.207772798		0.785379536		1368734.859		566.0628897		2644.16457		938.0832695	0	682.1172304		433.5484102		594,591,116,285,445.00	10,188,272,780,991.60	604,779,389,066,437.00	98,688,205,474,866.60	51,321.87	8,184.93	2.8%
284	0.121816758		129.8500106		0.213885133		0.882847819		888673.3497		321.9582496		2665.256672		981.9191563	0	860.4545759		486.9362001		245,264,523,172,560.00	7,131,255,886,284.52	252,395,779,058,844.00	47,659,396,081,985.00	24,784.82	8,185.33	2.8%
285	0.275952876		113.9725293		0.232299983		0.774055851		1361842.356		275.5588982		2623.417141		935.6352842	0	732.5980014		449.3046909		236,920,584,399,444.00	13,759,002,739,648.70	250,679,587,139,093.00	45,075,488,967,973.20	23,441.08	8,187.91	2.8%
286	0.184232374		135.2215305		0.142697512		0.789469837		1000189.701		543.3574759		2649.642205		962.844372	0	646.8631151		422.1961629		361,775,680,201,811.00	22,252,294,072,203.90	384,027,974,274,015.00	43,262,817,986,042.90	22,498.42	8,195.12	2.8%
287	0.629398665		123.5006547		0.138968582		0.808761816		1727894.63		547.2636502		2692.927077		942.6531212	0	753.7543697		455.746151		319,140,910,550,230.00	102,014,912,316,202.00	421,155,822,866,432.00	47,334,748,624,172.10	24,615.99	8,199.90	2.9%
288	0.335249768		120.6169803		0.161687726		0.875412123		1599586.119		406.2423448		2685.216022		933.3474872	0	641.4396152		420.422526		355,378,658,534,131.00	34,521,414,270,704.90	389,900,072,804,836.00	55,187,780,227,158.70	28,699.89	8,205.72	2.9%
289	0.120638063		118.9703725		0.173592691		0.904676401		957223.6348		365.7178495		2682.537047		967.8361493	0	597.7041207		405.836602		242,167,210,812,587.00	6,658,196,456,815.53	248,825,407,269,403.00	39,076,838,486,305.00	20,321.54	8,206.36	2.9%
290	0.159371014		116.2921038		0.171493886		0.781400786		1136613.85		864.9064866		2630.676624		931.2201769	0	896.0463612		496.904956		815,705,689,999,617.00	22,132,589,958,632.30	837,838,279,958,250.00	112,274,901,716,638.00	58,387.51	8,206.64	2.9%
291	0.178923494		134.2159681		0.143088758		0.898163062		854736.2282		761.804863		2654.278305		965.4544607	0	728.1942284		447.9522313		469,937,265,866,467.00	25,490,509,484,808.10	495,427,775,351,275.00	63,670,909,904,153.20	33,111.46	8,209.27	2.9%
292	0.34471233		133.1623522		0.078103454		0.823004958		1387963.932		392.2727475		2639.232574		926.9007491	0	923.9655602		504.58691		359,819,824,265,295.00	38,657,773,648,862.30	398,477,597,914,157.00	25,613,952,828,870.90	13,320.30	8,218.76	2.9%
293	0.423650334		141.0740276		0.202303221		0.802813222		841351.1151		599.2738053		2606.898068		932.7564942	0	628.896517		416.2916336		229,282,673,949,399.00	50,864,086,173,555.70	280,146,760,122,955.00	45,499,111,839,982.90	23,661.38	8,224.07	2.9%
294	0.179902972		126.843482		0.114355233		0.833730746		1603124.115		476.1991068		2606.244027		935.7511283	0	699.5853796		439.0646276		527,291,987,120,557.00	25,164,011,334,112.40	552,455,998,454,670.00	52,671,969,145,365.90	27,391.56	8,237.68	2.9%
295	0.46302491		129.6387562		0.174200488		0.741752285		1411682.163		475.6254051		2637.921033		931.4450727	0	866.214517		488.5632736		349,719,408,981,686.00	60,084,264,481,397.40	409,803,673,463,083.00	52,952,211,961,627.30	27,537.30	8,239.15	2.9%
296	0.201870288		106.7036724		0.202455922		0.846023119		1635811.95		867.5731429		2602.563412		930.1730999	0	737.5262862		450.8134242		983,812,264,351,735.00	29,745,613,265,959.30	1,013,557,877,617,690.00	173,604,616,727,232.00	90,281.45	8,252.44	2.9%
297	0.462937903		120.1455594		0.122327429		0.736469965		828081.559		866.6876667		2675.061116		931.742789	0	677.4336281		432.0574158		326,700,612,043,718.00	51,947,937,047,297.90	378,648,549,091,016.00	34,112,628,570,903.80	17,739.95	8,255.72	3.0%
298	0.219586311		136.7602444		0.14157652		0.714683429		517121.036		432.4920812		2620.141819		959.2863736	0	765.9312385		459.4126817		156,161,651,867,738.00	11,177,493,918,917.70	167,339,145,786,656.00	16,931,775,210,725.30	8,805.21	8,269.36	3.0%
299	0.305068847		124.0958705		0.17867117		0.797430941		1380026.65		352.8735153		2652.448118		926.6460881	0	884.9502857		493.8186922		334,308,815,895,141.00	25,374,208,051,264.40	359,683,023,946,406.00	51,246,888,786,809.80	26,650.46	8,269.70	3.0%
300	0.223260331		138.6582502		0.177282853		0.815721141		916343.1837		421.1166861		2663.151423		941.5076926	0	1025.152755		531.4989118		324,362,894,548,363.00	19,888,472,360,227.00	344,251,366,908,590.00	49,783,350,719,703.60	25,889.36	8,281.58	3.0%
301	0.41143877		121.0523164		0.113022115		0.786594261		1460739.907		607.2581549		2669.824583		928.5538639	0	890.3253593		495.3161172		521,005,038,078,189.00	58,153,052,060,558.50	579,158,090,138,748.00	51,488,629,196,620.90	26,776.18	8,295.36	3.0%
302	0.379469203		136.8758683		0.171865457		0.857769668		1188528.81		726.2576968		2661.486966		957.5623199	0	703.3269018		440.2371646		462,188,537,870,485.00	74,567,291,122,014.30	536,755,828,992,499.00	79,129,068,355,641.20	41,150.33	8,304.94	3.0%
303	0.167513427		131.0820709		0.157841394		0.848144497		834509.8364		576.6841345		2670.862652		954.8418922	0	958.0926994		513.8210041		417,783,554,980,829.00	16,435,969,585,303.50	434,219,524,566,133.00	58,129,970,846,047.60	30,229.94	8,310.33	3.0%
304	0.34335929		123.0205213		0.13411828		0.790910163		1664279.741		629.2400079		2647.933069		930.883805	0	868.3992391		489.1790003		670,553,306,750,288.00	60,192,014,963,198.60	730,745,321,713,487.00	77,514,183,194,831.20	40,310.52	8,312.85	3.0%
305	0.448421801		137.8255756		0.139457371		0.778436819		1422227.488		454.7425484		2692.049474		936.1236427	0	748.5855033		454.1808244		323,406,560,818,014.00	65,622,207,805,948.20	389,028,768,623,962.00	42,232,477,836,870.40	21,962.60	8,329.31	3.0%
306	0.590113614		143.3112712		0.169541119		0.728231161		1476181.663		380.9457271		2695.96785		939.7955892	0	641.574875		420.4668507		190,413,816,781,462.00	82,533,310,444,544.00	272,947,127,226,005.00	33,699,451,355,250.50	17,525.08	8,338.55	3.0%
307	0.265654121		125.957163		0.140795193		0.885006474		947118.6159		635.2054107		2692.307461		975.6763533	0	952.1387161		512.2219681		462,693,314,243,006.00	29,955,073,642,275.30	492,648,387,885,281.00	61,386,283,561,790.90	31,923.36	8,338.62	3.1%
308	0.178646958		134.0444609		0.097821873		0.757133518		1597752.87		450.5755215		2686.07239		924.4205398	0	780.1077049		463.6447769		548,398,909,166,728.00	26,857,765,888,102.70	575,256,675,054,830.00	42,605,936,370,366.20	22,156.82	8,342.77	3.1%
309	0.311753668		135.0433681		0.207975983		0.779159641		985255.3721		563.7592865		2613.943573		951.7912506	0	700.4231329		439.3274388		323,158,456,790,234.00	37,920,764,323,061.80	361,079,221,113,296.00	58,511,621,279,072.00	30,428.42	8,353.28	3.1%
310	0.326087107		134.7837783		0.162282827		0.849400917		1108797.084		565.8776121		2689.974566		935.0089592	0	773.2733249		461.6093559		390,650,198,485,930.00	43,807,881,336,667.10	434,458,079,822,597.00	59,887,084,380,317.60	31,143.71	8,395.98	3.1%
311	0.467376039		126.3048584		0.219598082		0.762082285		856642.8997		621.0485196		2643.574932		940.5154397	0	563.5862155		394.0835159		211,750,931,166,807.00	45,264,795,877,416.80	257,015,727,044,224.00	43,012,046,570,670.00	22,368.01	8,399.63	3.1%
312	0.084717121		124.2897334		0.148800549		0.846814834		882161.8664		790.1720468		2644.055578		933.311271	0	704.3140558		440.5460035		547,392,769,446,036.00	10,203,448,758,228.50	557,596,218,204,265.00	70,260,754,518,347.10	36,538.44	8,402.27	3.1%
313	0.396378145		136.6314529		0.138587835		0.771025282		895165.3804		821.9084929		2694.763503		933.8231728	0	821.9582532		475.9189177		426,443,129,457,086.00	64,466,646,445,661.70	490,909,775,902,748.00	52,456,028,756,888.30	27,279.26	8,407.56	3.1%
314	0.563070148		122.850077		0.211177301		0.852884558		1386207.387		771.0019445		2690.272692		972.1737934	0	559.7620879		392.7442437		353,609,184,935,811.00	104,789,551,893,793.00	458,398,736,829,604.00	82,562,131,941,151.60	42,935.66	8,409.43	3.1%
315	0.202161398		128.5545074		0.174245795		0.73851365		988970.2061		518.9011817		2682.723897		930.7819471	0	989.8822771		522.2757512		437,214,472,246,081.00	19,598,366,934,126.50	456,812,839,180,207.00	58,783,999,919,677.40	30,570.07	8,410.05	3.1%
316	0.048216876		125.9369517		0.17837341		0.783769741		568182.4094		477.3899173		2654.334879		931.2544416	0	900.5443097		498.1505696		257,887,292,241,826.00	2,338,659,050,741.92	260,225,951,292,568.00	36,380,545,967,012.80	18,919.36	8,440.79	3.1%
317	0.291075649		129.8805703		0.194599196		0.920220495		1359839.118		348.0751159		2638.539018		969.4455914	0	855.2841177		485.4709996		323,092,017,925,060.00	27,848,224,636,208.30	350,940,242,561,268.00	62,844,332,095,366.20	32,681.60	8,445.33	3.2%
318	0.083487445		116.0880462		0.148301077		0.882314749		1695664.186		601.8679993		2698.976311		934.4235915	0	651.9527904		423.8538792		781,258,992,820,273.00	12,010,075,010,325.10	793,269,067,830,598.00	103,797,851,656,303.00	53,979.10	8,447.62	3.2%
319	0.051022656		143.0595727		0.176981427		0.838373041		1345014.973		403.6911984		2628.449845		930.7535924	0	807.1693349		471.6180467		477,350,239,285,935.00	6,796,753,043,153.76	484,146,992,329,089.00	71,836,015,584,610.30	37,357.64	8,449.30	3.2%
320	0.258222358		135.370651		0.112229507		0.866006248		1526700.653		445.8509435		2690.908856		930.426137	0	788.5167172		466.1369612		472,171,959,353,749.00	37,850,815,143,923.00	510,022,774,497,672.00	49,569,855,100,542.10	25,778.34	8,451.62	3.2%
321	0.042875015		109.3472247		0.150541386		0.878894573		1167182.855		689.7090719		2631.448846		928.1811179	0	675.7746365		431.528051		641,461,977,970,841.00	3,929,933,240,809.02	645,391,911,211,650.00	85,391,808,200,644.60	44,407.21	8,458.05	3.2%
322	0.080441957		141.430392		0.167677556		0.802868884		857779.549		434.7801532		2613.217934		956.705333	0	789.0742069		466.301714		311,579,819,102,231.00	7,369,971,173,605.55	318,949,790,275,836.00	42,938,007,005,346.50	22,329.51	8,463.47	3.2%
323	0.062081641		125.9061437		0.142008526		0.855033754		961812.1212		843.4282499		2634.362472		933.443234	0	597.5783457		405.7938996		587,711,805,495,922.00	9,020,624,030,607.36	596,732,429,526,529.00	72,456,494,565,315.30	37,680.32	8,495.38	3.2%
324	0.602196314		111.7217848		0.178370422		0.805459085		1116721.622		544.7255539		2621.182807		936.1357253	0	693.9270222		437.2854105		203,960,740,414,592.00	45,470,892,869,808.60	249,431,633,284,400.00	35,835,861,954,932.20	18,636.10	8,498.97	3.2%
325	0.420042582		126.5141889		0.133822264		0.7826381		1102364.927		416.0039139		2641.310346		950.6056304	0	665.0099745		428.0772694		220,067,807,645,253.00	35,602,315,067,829.80	255,670,122,713,083.00	26,777,457,590,472.70	13,925.36	8,504.85	3.2%

(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
9686	0.280802585		122.4344617		0.209684317		0.739691386		1245970.282		730.1895355		2619.71937		968.924225	0	664.0399816		427.7649557		536,505,900,917,169.00	43,906,536,819,798.00	580,412,437,736,967.00	90,022,946,041,811.90	46,815.59	58,256.42	96.9%
9687	0.258916324		139.7060211		0.167276781		0.824907014		949091.0009		670.2994245		2698.315504		979.7197163	0	603.7578121		407.8866297		375,407,457,039,798.00	40,274,707,446,855.40	415,682,164,486,653.00	57,359,063,124,178.40	29,829.04	58,321.02	96.9%
9688	0.044570838		128.2086559		0.119393219		0.806953155		1304674.395		712.9024597		2630.135624		948.1238192	0	594.2033701		404.6463649		682,907,594,741,170.00	7,920,441,995,965.12	690,828,036,737,135.00	66,557,644,113,715.00	34,612.68	58,352.24	96.9%
9689	0.53811239		140.6169555		0.210441271		0.820848647		1129956.631		438.3184877		2608.686911		947.8637869	0	682.5198685		433.6763482		189,958,338,731,255.00	64,008,977,395,222.20	253,967,316,126,477.00	43,870,423,939,113.30	22,814.40	58,497.20	96.9%
9690	0.151043259		120.404365		0.194572863		0.80326809		1454411.597		522.9649303		2699.433071		953.3794945	0	697.1010143		438.2843318		562,067,334,272,118.00	18,498,291,472,183.40	580,565,625,744,301.00	90,739,023,888,207.50	47,187.98	58,504.70	96.9%
9691	0.098597248		123.9909147		0.178679903		0.740529866		886161.7252		313.6218011		2641.552211		928.5224973	0	781.5749675		464.0805943		228,750,570,586,738.00	4,678,597,992,545.34	233,429,168,579,283.00	30,886,835,108,938.40	16,062.41	58,515.43	96.9%
9692	0.313710049		104.6261247		0.117637073		0.785588062		1339853.769		531.1471475		2661.16829		966.9400719	0	610.3037739		410.0918287		386,126,420,050,937.00	22,221,460,612,883.80	408,347,880,663,821.00	37,737,175,302,834.30	19,624.86	58,537.72	96.9%
9693	0.167250651		129.796547		0.099152908		0.85603065		1114379.047		668.8118466		2621.215392		952.3653943	0	792.002476		467.1661399		566,883,457,861,681.00	24,710,630,575,135.60	591,594,088,436,817.00	50,213,280,621,064.40	26,112.94	58,576.94	96.9%
9694	0.371279997		135.5294612		0.116683974		0.756017417		1533543.029		573.8023632		2660.456329		948.6485976	0	737.0896467		450.6799563		491,035,989,188,723.00	71,939,093,455,766.50	562,975,082,644,489.00	49,662,912,650,276.80	25,826.73	58,580.89	96.9%
9695	0.17244625		114.3562054		0.133892105		0.820393606		1342567.256		304.8201091		2661.224201		942.123901	0	721.9460767		446.0263007		296,901,329,278,399.00	9,548,230,937,419.15	306,449,560,215,818.00	33,661,715,015,818.10	17,505.46	58,594.66	96.9%
9696	0.423631195		126.145709		0.115853375		0.874875516		1004192.888		648.3042697		2632.833061		931.0932377	0	659.8113882		426.4007811		307,993,240,392,478.00	49,531,871,064,094.00	357,525,111,456,572.00	36,237,773,156,097.30	18,845.11	58,596.06	97.0%
9697	0.083414031		129.1566763		0.173989972		0.857245199		1226476.046		462.0674096		2665.555392		940.0205313	0	623.3081007		414.4379088		416,757,413,278,842.00	9,130,606,994,079.91	425,888,020,272,922.00	63,522,078,866,180.10	33,034.06	58,607.85	97.0%
9698	0.32959191		115.7788268		0.166275521		0.779330993		1128381.577		592.782578		2649.561638		936.8914057	0	791.9419227		467.1482808		413,984,933,759,944.00	30,890,119,937,235.00	444,875,053,697,179.00	57,648,540,730,713.00	29,979.58	58,618.23	97.0%
9699	0.208113863		135.0336882		0.178024551		0.769261962		1197311.655		330.206858		2617.216927		939.8003889	0	794.9046239		468.0212796		286,150,041,270,576.00	17,788,315,771,552.00	303,938,357,042,128.00	41,623,602,884,333.50	21,645.96	58,677.69	97.0%
9700	0.318891286		138.2122037		0.206956324		0.803738559		1398464.591		806.0986176		2642.304364		934.8996187	0	638.8582589		419.5757164		620,037,654,044,291.00	81,778,211,341,450.70	701,815,865,385,742.00	116,739,193,260,202.00	60,709.12	58,682.94	97.0%
9701	0.06047758		116.4280317		0.132931843		0.870444678		1320609.434		749.366549		2633.893288		958.1657229	0	1027.64365		532.1442326		996,537,226,700,658.00	8,732,040,040,720.98	1,005,269,266,741,380.00	116,319,521,323,102.00	60,490.87	58,690.65	97.0%
9702	0.234790705		136.0845892		0.154383248		0.781340779		581257.432		375.3253496		2672.263397		976.9032846	0	681.6445295		433.3981617		141,887,034,545,954.00	11,730,829,172,189.90	153,617,863,718,144.00	18,530,297,296,822.80	9,636.51	58,722.74	97.0%
9703	0.219634853		136.3904068		0.168462559		0.789486008		1567018.285		381.6699253		2672.823586		929.3268619	0	901.6461331		498.4552221		469,809,360,050,168.00	28,774,862,834,326.50	498,584,222,884,494.00	66,311,120,039,414.10	34,484.47	58,731.13	97.0%
9704	0.246161148		109.7873482		0.121257667		0.807362211		727247.7174		936.5419036		2640.268612		950.0492351	0	917.492784		502.8163796		515,858,418,668,237.00	19,832,767,777,993.60	535,691,186,446,231.00	52,443,555,360,698.60	27,272.78	58,733.68	97.0%
9705	0.282359069		120.8371251		0.197833657		0.880175936		1345425.243		530.5125787		2656.647353		978.2865803	0	787.057148		465.7053443		472,383,297,764,120.00	33,655,383,019,601.50	506,038,680,783,721.00	88,115,717,909,303.50	45,823.75	58,779.41	97.0%
9706	0.503981089		138.1692856		0.124495597		0.812951326		720014.3233		349.7094911		2690.356595		959.0416513	0	692.0523144		436.6943276		107,868,676,513,009.00	29,591,724,596,851.60	137,460,401,109,861.00	13,912,210,639,372.20	7,234.91	58,817.48	97.1%
9707	0.170163046		131.7356434		0.203431433		0.751639568		1252577.503		512.2550526		2621.436724		962.7489794	0	975.3277474		518.421946		550,754,181,480,386.00	22,731,877,713,701.30	573,486,059,194,087.00	87,690,098,332,543.00	45,602.41	58,843.25	97.1%
9708	0.096212529		143.5793753		0.168628344		0.833500393		1137821.221		316.8013003		2630.49433		933.5792229	0	560.7720541		393.0983938		241,483,810,661,349.00	8,604,711,854,864.02	250,088,522,516,213.00	35,150,389,818,127.50	18,279.63	58,853.76	97.1%
9709	0.157893752		127.343492		0.140458828		0.777536034		1725972.814		664.0816696		2625.379872		940.3782423	0	756.6624749		456.6244755		858,945,351,374,389.00	33,679,026,583,803.70	892,624,377,958,193.00	97,485,115,127,980.50	50,696.22	58,878.32	97.1%
9710	0.313344179		116.600855		0.197684891		0.815923907		876832.9507		337.476651		2667.822938		978.9795569	0	752.2299046		455.2850454		183,088,247,985,166.00	13,887,477,226,414.30	196,975,725,211,580.00	31,771,362,886,003.80	16,522.40	58,960.92	97.1%
9711	0.083437151		124.0074798		0.215650982		0.851729023		1588391.747		839.5994149		2625.33078		926.6086035	0	663.7603423		427.6748764		1,004,134,405,527,800.00	18,966,549,300,583.90	1,023,100,954,828,380.00	187,919,295,800,437.00	97,725.66	59,054.64	97.1%
9712	0.381204357		125.1800378		0.133041145		0.873299171		674720.659		430.9220337		2606.253176		951.2420779	0	661.89305		427.0728847		146,470,361,043,426.00	19,911,064,963,946.20	166,381,426,007,372.00	19,330,979,599,662.10	10,052.89	59,070.78	97.1%
9713	0.07246524		111.9663271		0.175196494		0.825971036		1281285.289		399.3759768		2654.139585		977.5463	0	898.3387324		497.5401703		473,393,733,408,586.00	4,843,550,929,518.99	478,237,284,338,105.00	69,204,392,736,056.20	35,989.09	59,200.77	97.1%
9714	0.526543549		123.0456637		0.201531035		0.752783049		910973.4246		372.0074472		2621.443638		932.451561	0	774.7037725		462.036115		144,618,826,693,877.00	29,938,056,833,569.50	174,556,883,527,447.00	26,481,875,903,158.20	13,771.65	59,212.39	97.1%
9715	0.048783075		130.5504174		0.151697844		0.878538682		704973.3193		332.2498326		2648.07941		969.6958954	0	645.7694667		421.8391094		181,514,901,037,098.00	2,341,225,281,064.78	183,856,126,318,163.00	24,502,951,595,179.60	12,742.53	59,227.01	97.1%
9716	0.128043358		116.843459		0.121426766		0.872312516		968311.7703		366.5406552		2621.718415		928.4259862	0	638.4224688		419.4325875		247,864,506,720,152.00	6,497,980,200,005.43	254,362,486,920,157.00	26,942,605,743,858.00	14,011.25	59,269.96	97.2%
9717	0.40916896		131.5543395		0.15597937		0.766215601		965246.7963		681.0140143		2655.65197		959.7808287	0	697.0022857		438.2532942		332,553,545,240,225.00	55,630,207,338,999.70	388,183,752,579,225.00	46,393,325,819,745.90	24,126.41	59,272.66	97.2%
9718	0.198582405		129.3821276		0.110190843		0.766562908		1075160.319		392.0566891		2619.092053		930.7201089	0	912.7718226		501.5210897		335,655,330,746,357.00	16,081,554,898,297.90	351,736,885,644,655.00	29,710,586,109,297.70	15,450.71	59,386.98	97.2%
9719	0.391805496		135.4812742		0.206579738		0.797181348		867712.2034		351.8946571		2685.723725		930.8351925	0	733.4917686		449.5786825		165,898,182,309,766.00	25,825,836,925,192.00	191,724,019,234,958.00	31,573,401,734,250.80	16,419.45	59,417.95	97.2%
9720	0.40007564		122.1907944		0.168157292		0.867899672		1293811.004		271.8446777		2651.082324		935.0039716	0	629.0409442		416.3394319		169,329,131,859,923.00	23,202,844,192,935.80	192,531,976,052,859.00	28,098,820,996,110.00	14,612.53	59,438.35	97.2%
9721	0.253068352		131.9325804		0.123946915		0.756122652		1431885.044		396.5774169		2661.379104		941.0864635	0	626.4281513		415.4738757		340,819,905,525,091.00	29,357,541,296,422.30	370,177,446,821,513.00	34,692,686,077,729.90	18,041.60	59,471.61	97.2%
9722	0.167974023		137.8112114		0.14127042		0.803526289		1748412.715		940.1137431		2654.788528		928.2679386	0	705.6313708		440.9577991		1,179,478,734,548,590.00	61,933,864,990,115.70	1,241,412,599,538,700.00	140,918,326,076,507.00	73,283.25	59,552.15	97.2%
9723	0.564936938		124.4011387		0.161989475		0.787620662		780745.7928		309.9052348		2693.023486		932.9456325	0	877.9168004		491.8523696		105,078,773,805,042.00	23,668,201,732,467.10	128,746,975,537,509.00	16,426,344,756,412.90	8,542.37	59,569.84	97.2%
9724	0.390784046		131.08576		0.13023325		0.83671966		829350.1276		525.3308412		2661.707835		957.5241306	0	685.3671659		434.5799998		225,454,656,469,443.00	34,812,363,323,216.20	260,267,019,792,659.00	28,360,964,270,080.20	14,748.85	59,590.46	97.2%
9725	0.205583846		124.8326777		0.117162616		0.858779134		1379000.119		303.7671797		2644.443816		937.2015408	0	537.8240635		384.9711664		241,539,884,267,269.00	15,125,094,419,521.90	256,664,978,686,791.00	25,824,811,470,381.20	13,429.95	59,682.38	97.2%
9726	0.320236323		138.7499134		0.125773689		0.768779167		1145014.116		470.6680246		2648.622482		953.3822343	0	616.2815168		412.0952982		290,007,204,614,094.00	40,406,077,654,831.90	330,413,282,268,926.00	31,948,384,466,022.90	16,614.46	59,717.05	97.3%
9727	0.469504037		112.3798607		0.151727025		0.774800999		1100490.179		317.1411157		2603.755715		933.5189108	0	1015.294151		528.9371006		194,782,101,443,093.00	20,703,912,797,377.30	215,486,014,240,471.00	25,332,158,779,523.30	13,173.75	59,753.18	97.3%
9728	0.33310399		132.9464047		0.152429843		0.833419084		1473566.711		383.1949119		2600.213912		934.0027279	0	756.2554134		456.5016339		331,792,150,340,850.00	38,880,359,464,558.10	370,672,509,805,408.00	47,089,472,009,722.10	24,488.44	59,764.31	97.3%
9729	0.485822008		110.3864681		0.144076283		0.800693682		968601.0328		633.9846484		2626.703125		982.3937177	0	887.9727855		494.6612788		309,516,735,841,111.00	37,225,705,424,755.30	346,742,441,265,867.00	40,000,544,291,505.70	20,801.91	59,789.69	97.3%
9730	0.104493398		122.976869		0.131866333		0.850633245		802578.0728		576.9167233		2619.859704		950.8729771	0	766.7079271		459.6455552		371,165,904,067,043.00	8,264,618,867,178.39	379,430,522,934,221.00	42,560,678,821,280.00	22,133.28	59,878.17	97.3%
9731	0.224519408		113.9201748		0.190880373		0.715870672		1237544.08		794.0405961		2658.819893		939.3254722	0	810.7704501		472.6689171		716,031,734,034,495.00	29,383,784,907,100.10	745,415,518,941,595.00	101,857,796,008,452.00	52,970.19	59,935.10	97.3%
9732	0.041290515		135.9583019		0.180163305		0.732837598		1755725.192		535.5738017		2610.155241		939.9388587	0	852.6849263		484.73277		857,116,994,450,241.00	8,536,239,340,092.39	865,653,233,790,334.00	114,292,580,308,309.00	59,436.78	59,979.20	97.3%
9733	0.042931043		113.3228722		0.177665551		0.796743328		1333911.02		306.7363988		2620.81083		962.1291085	0	791.4298644		466.9972306		357,455,057,448,260.00	2,354,049,999,689.12	359,809,107,447,949.00	50,932,361,624,750.40	26,486.90	59,982.22	97.3%
9734	0.22758728		122.34095		0.170230454		0.758899465		1380262.184		331.0666683		2641.440549		975.7015008	0	846.6212273		483.0061546		338,159,422,542,535.00	17,958,865,022,446.20	356,118,287,564,982.00	46,006,138,367,465.50	23,925.06	60,029.04	97.3%
9735	0.082540756		132.4743574		0.161639944		0.795719121		1150750.906		393.7770852		2604.867476		956.6368148	0	598.8626258		406.2297197		317,958,333,312,340.00	7,848,211,722,439.95	325,806,545,034,780.00	41,905,236,035,799.10	21,792.42	60,066.51	97.3%
9736	0.471543039		113.9282244		0.140548605		0.774091766		656720.4158		347.5789953		2604.774622		941.9179532	0	709.9201921		442.2958378		102,451,818,190,738.00	14,378,244,600,582.50	116,830,062,791,321.00	12,710,820,805,177.10	6,610.14	60,087.20	97.4%
9737	0.214113991		138.0844463		0.118289721		0.809263463		940483.8887		355.5465901		2690.102197		939.7834848	0	766.1206621		459.4694872		241,432,418,085,774.00	16,336,419,178,573.70	257,768,837,264,348.00	24,675,579,119,511.70	12,832.30	60,107.86	97.4%
9738	0.115366998		124.1110893		0.202363927		0.757822505		923309.86		637.2501182		2629.605119		947.0183199	0	546.638469		388.1129945		379,545,280,765,714.00	11,852,813,095,503.80	391,398,093,861,218.00	60,023,221,806,259.30	31,214.51	60,141.49	97.4%
9739	0.396863075		131.2529987		0.104370191		0.724810838		811946.7879		404.750255		2681.468912		938.3489036	0	1078.475393		545.1464752		222,502,874,972,242.00	26,218,950,534,268.20	248,721,825,506,510.00	18,815,469,256,823.60	9,784.81	60,208.71	97.4%
9740	0.326123134		105.6131846		0.167052229		0.794970632		906145.4314		597.9802211		2660.456747		931.6006017	0	792.8288407		467.4097938		338,715,117,121,506.00	17,625,277,088,693.50	356,340,394,210,199.00	47,322,580,308,963.50	24,609.66	60,337.00	97.4%
9741	0.397730996		123.9929817		0.167661899		0.807989025		915021.4347		458.4644985		2612.169709		938.9450533	0	792.7038855		467.3729589		230,091,561,324,386.00	28,808,873,399,263.50	258,900,434,723,650.00	35,072,976,251,485.40	18,239.37	60,388.12	97.4%
9742	0.17497856		133.3207332		0.153348879		0.748397263		1233159.679		783.1224652		2616.746688		923.2341511	0	716.5505282		444.35646		683,667,444,955,758.00	34,771,072,871,557.40	718,438,517,827,315.00	82,452,229,868,928.50	42,878.51	60,434.16	97.4%
9743	0.588139424		135.3597549		0.197582158		0.769820986		1061636.378		338.1389154		2693.777541		943.0809271	0	622.8269082		414.2779053		119,821,038,341,180.00	46,075,561,945,362.20	165,896,600,286,542.00	25,233,352,649,095.30	13,122.37	60,491.70	97.4%
9744	0.137832945		132.0347037		0.11136067		0.769472421		1198778.307		551.5409775		2629.725854		949.5356353	0	586.6550766		402.0679954		434,518,867,901,463.00	18,821,330,936,616.30	453,340,198,838,080.00	38,846,252,041,393.10	20,201.63	60,497.19	97.4%
9745	0.411008399		134.2825307		0.190623332		0.78892475		1321780.382		434.758549		2600.673387		942.7547196	0	894.5231189		496.4824173		329,944,982,479,033.00	50,523,474,914,154.40	380,468,457,393,188.00	57,217,686,525,267.60	29,755.52	60,553.91	97.4%
9746	0.253725403		131.912489		0.198999682		0.846531733		1030078.529		437.5187661		2625.253433		940.9833583	0	887.4180237		494.5067346		329,390,458,666,346.00	23,348,610,888,608.80	352,739,069,554,955.00	59,422,263,369,100.40	30,901.99	60,610.45	97.5%
9747	0.530058755		109.0146229		0.156579857		0.806907025		1106980.745		443.2883912		2610.764209		927.5445222	0	775.3749176		462.2362083		207,115,199,893,382.00	29,260,275,751,377.00	236,375,475,644,759.00	29,864,950,775,184.30	15,530.99	60,639.08	97.5%
9748	0.312648385		120.0369449		0.205909861		0.734650295		1949534.06		438.6481084		2669.607395		925.8079483	0	683.1935179		433.8903154		499,786,625,175,694.00	41,424,892,882,160.50	541,211,518,057,855.00	81,870,008,186,295.70	42,575.73	60,856.54	97.5%
9749	0.043780963		129.9165076		0.210610599		0.840870926		1903457.231		306.3489927		2612.349364		944.5052377	0	632.7253982		417.5569551		442,524,981,150,472.00	5,031,178,655,575.07	447,556,159,806,047.00	79,260,553,171,386.90	41,218.70	60,913.12	97.5%
9750	0.296223971		134.1813804		0.170196492		0.883419591		722963.739		675.5927497		2687.267822		984.648174	0	651.7916973		423.8015103		285,823,022,533,827.00	32,264,810,742,493.40	318,087,833,276,320.00	47,826,069,332,171.20	24,871.50	60,914.18	97.5%

(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
9751	0.164072579		131.436045		0.205839436		0.81517988		810330.0318		522.410677		2662.807461		939.5889156	0	653.0014596		424.1946277		291,896,517,077,482.00	14,031,099,926,376.60	305,927,617,003,858.00	51,333,481,356,997.90	26,695.49	60,972.30	97.5%
9752	0.113028907		129.3979149		0.19381651		0.81475516		971955.1401		643.0479901		2657.61661		936.5758904	0	636.1944286		418.7000558		449,106,333,003,383.00	13,661,771,173,600.90	462,768,104,176,984.00	73,077,100,182,563.80	38,003.06	61,010.97	97.5%
9753	0.090517765		109.3226112		0.141366134		0.809328384		1154728.177		544.727724		2688.436651		949.5086055	0	715.7847376		444.1189506		504,009,894,220,761.00	6,626,296,975,548.23	510,636,191,196,309.00	58,422,716,208,945.10	30,382.18	61,063.49	97.5%
9754	0.114361588		137.3596657		0.141523578		0.723211787		1346980.717		322.5127344		2621.045299		971.5765586	0	674.8962929		431.2475188		318,782,881,501,222.00	11,573,063,700,595.90	330,355,945,201,818.00	33,812,433,131,442.90	17,583.84	61,093.79	97.5%
9755	0.385779533		133.4514008		0.150796952		0.833434623		1006878.186		601.0869244		2657.921416		931.95883	0	756.5730764		456.5974999		334,888,762,812,801.00	48,616,702,252,585.20	383,505,465,065,386.00	48,198,737,067,034.20	25,065.30	61,125.68	97.5%
9756	0.162980741		134.9646393		0.158501806		0.708410912		646602.2361		392.406011		2627.777532		937.5094214	0	951.246145		511.9818236		216,972,594,490,256.00	8,907,266,510,365.02	225,879,861,000,621.00	25,362,786,741,795.80	13,189.68	61,150.57	97.6%
9757	0.27167876		131.574088		0.185636491		0.818281986		1466260.301		328.5821589		2659.177996		964.0179579	0	924.5766277		504.7537375		356,701,682,240,831.00	27,202,179,590,586.70	383,903,861,831,418.00	58,316,146,877,055.90	30,326.76	61,171.08	97.6%
9758	0.122165285		105.6637541		0.212142767		0.807037229		1096320.795		619.8252934		2605.66635		944.973923	0	693.765368		437.2344735		499,728,794,323,872.00	8,415,328,034,037.67	508,144,122,357,910.00	86,997,887,026,336.80	45,242.43	61,225.94	97.6%
9759	0.201011447		129.1657497		0.187769393		0.722673792		793791.8963		570.6851807		2693.548626		931.5714002	0	752.3161961		455.3111584		329,308,256,453,743.00	17,433,281,452,887.00	346,741,537,906,630.00	47,051,446,376,244.60	24,468.66	61,268.21	97.6%
9760	0.187931296		135.1608235		0.122591074		0.857340868		836789.364		655.5625207		2644.318759		941.7458075	0	594.1962624		404.6439448		344,180,819,357,093.00	22,385,669,850,367.50	366,566,489,207,460.00	38,526,994,904,387.40	20,035.60	61,273.87	97.6%
9761	0.36516774		102.5495439		0.196676237		0.86798064		1452476.336		587.1099263		2603.466439		939.8592576	0	1015.81079		529.0716598		569,636,248,508,236.00	27,586,573,422,534.00	597,222,821,930,770.00	101,952,604,466,026.00	53,019.49	61,284.39	97.6%
9762	0.20419376		134.9625705		0.192961183		0.729578284		1630379.837		417.9794432		2686.377088		942.7372209	0	680.3485531		432.9859666		462,826,250,516,176.00	30,138,397,468,157.30	492,964,647,984,334.00	69,399,705,497,935.80	36,090.66	61,305.09	97.6%
9763	0.215526706		132.1026804		0.179346159		0.835012725		1545873.133		388.0443169		2639.405564		942.8409307	0	641.9974398		420.6052954		380,744,267,281,393.00	26,547,953,187,994.00	407,292,220,469,387.00	60,994,586,043,355.20	31,719.66	61,331.32	97.6%
9764	0.354507539		110.6595076		0.195378		0.7419823		813611.9169		678.9056749		2622.335579		933.1958897	0	881.5367248		492.8653568		347,421,854,407,733.00	23,418,899,914,017.60	370,840,754,321,750.00	53,759,678,361,095.40	27,957.21	61,378.59	97.6%
9765	0.55194151		136.5095862		0.205645594		0.783282668		1697707.407		526.8372431		2686.756231		962.5840879	0	699.638677		439.0813522		347,966,671,589,675.00	112,245,633,830,982.00	460,212,305,420,658.00	74,130,367,455,056.70	38,550.80	61,392.49	97.6%
9766	0.254866139		116.9161168		0.165121749		0.757774341		1046357.092		770.3177043		2635.319015		978.0212684	0	815.3017194		473.9879131		561,232,360,966,321.00	31,002,915,313,835.70	592,235,276,280,157.00	74,103,453,633,535.10	38,536.80	61,482.05	97.7%
9767	0.183200802		132.3785635		0.234849103		0.863507453		1829830.72		489.6911916		2610.093213		926.7671322	0	716.5519762		444.356909		626,432,159,546,634.00	33,308,959,343,738.60	659,741,118,890,373.00	133,791,507,717,926.00	69,577.01	61,519.29	97.7%
9768	0.067430278		139.9158685		0.125842426		0.893107933		1133764.556		597.5033234		2635.041812		963.3863598	0	781.6514187		464.1032912		575,469,830,945,168.00	11,021,400,509,808.30	586,491,231,454,976.00	65,916,258,991,415.90	34,279.13	61,530.61	97.7%
9769	0.35567559		130.7562834		0.180213508		0.720442304		678718.0461		314.7405561		2643.313762		937.2690548	0	575.2017125		398.1238299		104,167,950,184,876.00	15,108,680,518,468.50	119,276,630,703,345.00	15,486,094,671,996.70	8,053.40	61,560.14	97.7%
9770	0.358416256		133.038859		0.195560162		0.797625143		633381.5438		876.3161666		2641.714258		965.7525557	0	736.0033128		450.3477244		313,557,800,957,792.00	42,594,178,528,155.60	356,151,979,485,948.00	55,553,904,202,369.40	28,890.29	61,575.95	97.7%
9771	0.190366997		122.735561		0.156164047		0.813619598		1311235.691		813.9279567		2627.285589		934.2969047	0	836.9996956		480.2537206		817,786,809,252,911.00	33,908,532,048,841.10	851,695,341,301,752.00	108,214,816,513,998.00	56,276.10	61,613.02	97.7%
9772	0.479248455		132.7295603		0.191664273		0.774304892		1735005.288		351.5015638		2623.530455		950.8524445	0	923.7003189		504.5144794		318,331,604,782,685.00	61,253,702,400,501.90	379,585,307,183,186.00	56,332,958,994,583.50	29,295.43	61,645.94	97.7%
9773	0.083896005		113.1600723		0.202470888		0.855985729		839678.766		790.6395961		2654.88951		935.4803345	0	682.4110409		433.641772		513,912,317,605,740.00	7,222,032,317,420.15	521,134,349,923,160.00	90,318,935,940,414.90	46,969.51	61,780.94	97.7%
9774	0.42588631		130.2571398		0.160615183		0.838486526		778932.2473		412.9780843		2603.666448		959.9016503	0	1071.086678		543.2758462		200,489,718,351,419.00	27,626,200,401,741.10	228,115,918,753,160.00	30,721,207,251,753.10	15,976.27	61,809.58	97.7%
9775	0.168791991		131.1104443		0.165455779		0.77497503		1757518.967		370.6920882		2603.28863		964.3929846	0	573.2593882		397.451075		402,777,024,580,223.00	22,657,143,483,157.00	425,434,168,063,380.00	54,550,912,200,873.40	28,368.69	61,811.27	97.7%
9776	0.126978606		128.6213067		0.204059963		0.792146689		794658.4802		348.0125305		2666.703154		937.3375835	0	683.3024534		433.924906		205,082,498,551,792.00	6,689,673,105,840.78	211,772,171,657,633.00	34,232,002,463,495.90	17,802.03	61,870.48	97.8%
9777	0.155007518		118.547575		0.164378573		0.9226519		1564435.903		572.2919333		2601.39918		981.9332248	0	527.3762164		381.2135756		533,521,952,358,114.00	21,957,528,689,006.00	555,479,481,047,120.00	84,246,352,391,774.00	43,811.52	62,077.97	97.8%
9778	0.154502929		129.0304155		0.099925501		0.783313082		982116.912		971.0882322		2633.202189		948.618008	0	572.4252127		397.1617953		606,096,216,114,899.00	28,647,835,780,837.30	634,744,051,895,737.00	49,683,290,842,045.80	25,837.33	62,104.34	97.8%
9779	0.324341106		136.666811		0.143142175		0.909067239		518781.7842		490.2760357		2649.081109		979.7599216	0	813.3293015		473.4142186		161,190,966,342,462.00	19,144,855,944,772.00	180,335,822,287,234.00	23,466,354,307,390.70	12,203.46	62,112.92	97.8%
9780	0.099983009		114.5988689		0.17863408		0.725304682		1285316.079		363.9730879		2623.378056		945.2918163	0	788.710863		466.194343		383,918,659,772,949.00	6,394,542,794,161.33	390,313,202,567,111.00	50,570,592,407,575.70	26,298.76	62,219.42	97.8%
9781	0.132099643		137.2230921		0.183825292		0.756321243		1744658.681		446.7517497		2625.274013		941.5472337	0	747.770553		453.9335343		597,665,473,836,997.00	23,188,256,643,534.30	620,853,730,480,531.00	86,317,898,558,641.30	44,888.81	62,245.40	97.8%
9782	0.455059911		125.8342158		0.155965991		0.781671416		1602827.975		371.0842395		2664.249845		928.1507272	0	658.4058837		425.9463878		268,865,105,185,034.00	48,129,638,193,448.30	316,994,743,378,482.00	38,646,146,862,533.20	20,097.56	62,262.56	97.8%
9783	0.230931339		128.5659165		0.174227536		0.771654413		1618125.23		387.0731952		2602.678119		924.4006128	0	657.1606689		425.5434101		389,884,461,200,001.00	27,142,896,876,819.70	417,027,358,076,821.00	56,066,595,630,751.40	29,156.91	62,379.37	97.8%
9784	0.072011307		135.350554		0.203192979		0.774683655		583831.1772		419.6917243		2610.661826		931.0691328	0	894.7025143		496.5321992		222,536,923,956,401.00	3,801,006,102,012.65	226,337,930,058,414.00	35,627,916,845,994.70	18,527.96	62,422.67	97.8%
9785	0.188648103		117.1039936		0.14695226		0.861064246		1020775.808		686.6715731		2623.221538		943.2271343	0	869.6690871		489.5365294		549,868,471,008,345.00	19,343,947,491,061.50	569,212,418,499,407.00	72,025,485,005,574.00	37,456.18	62,448.97	97.8%
9786	0.457888551		131.4781639		0.161441922		0.814843115		1623739.255		441.0813909		2631.037042		923.6431281	0	716.6581746		444.3898363		335,011,204,244,291.00	65,177,596,800,916.30	400,188,801,045,207.00	52,644,772,290,115.60	27,377.42	62,457.87	97.9%
9787	0.08021622		132.7644099		0.191481997		0.827447401		697030.7467		287.0605697		2671.090591		952.5144037	0	642.9047332		420.9023976		150,824,678,248,890.00	3,371,914,772,412.99	154,196,593,021,303.00	24,431,105,673,391.60	12,705.17	62,474.38	97.9%
9788	0.496364586		120.8344477		0.212731626		0.781002441		1068651.83		353.8218104		2622.563203		933.4044915	0	879.6575648		492.3397593		185,336,424,738,290.00	29,901,603,341,211.00	215,238,028,079,501.00	35,760,489,501,307.00	18,596.91	62,478.98	97.9%
9789	0.346703834		141.2402959		0.15385295		0.774267141		891048.5477		285.8231442		2602.177027		959.420929	0	752.6575223		455.4144342		146,284,793,521,053.00	21,686,034,961,921.70	167,970,828,482,975.00	20,009,236,688,210.60	10,405.62	62,536.43	97.9%
9790	0.04568198		129.5633144		0.09818966		0.775884034		876807.4564		481.4054644		2654.528429		947.7704843	0	926.8421778		505.3717746		409,361,442,093,293.00	3,786,168,778,748.81	413,147,610,872,042.00	31,475,150,636,701.00	16,368.36	62,618.97	97.9%
9791	0.093792448		135.6155036		0.16927114		0.844829154		1036420.871		935.1303385		2609.711639		961.1068603	0	855.4471656		485.5172715		836,527,768,517,368.00	20,310,471,412,569.50	856,838,239,929,938.00	122,532,318,834,586.00	63,721.78	62,799.73	97.9%
9792	0.355138229		134.7054225		0.16689264		0.811097709		720705.4061		757.9670717		2676.333047		932.7829816	0	852.3407079		484.6349198		343,337,132,547,151.00	41,380,221,960,904.20	384,717,354,508,055.00	52,077,740,988,531.60	27,082.54	62,835.52	97.9%
9793	0.149150397		132.0022189		0.090901455		0.75265352		1305475.484		543.2658226		2629.318407		927.4129552	0	630.1648341		416.711197		480,814,055,626,803.00	21,324,400,649,123.70	502,138,456,275,927.00	34,354,957,441,568.70	17,865.97	62,881.42	97.9%
9794	0.46081767		139.5790762		0.200250991		0.740129579		1130388.203		486.228357		2651.565494		956.4856958	0	900.4473489		498.1237511		295,701,316,143,367.00	60,331,698,215,477.30	356,033,014,358,844.00	52,768,251,654,862.30	27,441.63	62,956.72	97.9%
9795	0.260885021		141.8932102		0.170502331		0.835493119		825524.4968		653.8365485		2656.873464		966.1295158	0	935.915349		507.8393777		408,136,369,255,808.00	35,196,780,809,935.40	443,333,150,065,743.00	63,154,369,527,220.60	32,842.84	63,033.07	97.9%
9796	0.035848466		114.7346085		0.200332115		0.848937463		1378182.281		399.1726524		2655.463274		972.0548126	0	552.3218038		390.1253597		393,126,960,222,836.00	2,783,347,688,442.09	395,910,307,911,278.00	67,332,243,219,810.40	35,015.50	63,059.50	98.0%
9797	0.19940901		131.0642022		0.135981045		0.796617522		1582235.743		614.5342362		2670.975297		955.1404919	0	714.0750466		443.5882323		680,377,857,867,498.00	39,529,574,616,395.90	719,907,432,483,894.00	77,983,888,687,401.50	40,554.79	63,063.85	98.0%
9798	0.049062098		131.946358		0.17788229		0.778367585		1455151.796		458.1224079		2617.88195		930.0334431	0	600.031451		406.6259542		487,848,811,853,200.00	6,604,894,775,260.18	494,453,706,628,460.00	68,460,976,552,676.50	35,602.49	63,185.90	98.0%
9799	0.397162028		129.2353896		0.179101121		0.818950641		1464062.165		763.7525785		2666.955241		936.7394686	0	1013.383131		528.4390747		725,561,937,015,020.00	85,615,501,784,514.60	811,177,438,799,535.00	118,979,432,723,548.00	61,874.13	63,304.06	98.0%
9800	0.341085117		119.3033732		0.123549953		0.767037373		828466.5732		418.5026032		2685.542155		925.1804273	0	825.17995		476.8506968		219,131,141,848,541.00	17,974,982,128,432.70	237,106,123,976,973.00	22,469,938,331,098.90	11,685.28	63,311.96	98.0%
9801	0.206442249		117.9683944		0.194721038		0.827894124		1212893.232		755.4720429		2623.079788		942.1431393	0	1030.093795		532.7782335		777,247,008,105,099.00	28,284,920,109,934.20	805,531,928,215,033.00	129,858,515,672,625.00	67,531.70	63,334.31	98.0%
9802	0.055761337		128.3731351		0.154593826		0.732505492		1635415.873		691.5815864		2668.105015		936.8324961	0	635.5539419		418.4892403		868,047,930,799,786.00	11,946,681,023,550.10	879,994,611,823,336.00	99,651,316,947,055.70	51,822.73	63,361.37	98.0%
9803	0.645642312		133.0370632		0.142341811		0.75555908		1001012.258		369.0547751		2665.125467		936.1997946	0	672.4896681		430.4779355		110,050,731,887,749.00	49,504,707,592,799.80	159,555,439,480,549.00	17,159,812,159,601.80	8,923.80	63,363.98	98.0%
9804	0.250975646		118.0534108		0.196415745		0.801680687		1324648.335		440.2742045		2612.271113		951.8870193	0	883.397861		493.3853611		424,556,631,264,055.00	22,162,088,998,399.70	446,718,720,262,455.00	70,341,540,007,121.20	36,580.46	63,419.38	98.0%
9805	0.219951756		125.1791001		0.158637527		0.827977956		1181707.14		484.5910318		2608.810139		940.2614987	0	664.7814311		428.0037046		364,985,445,162,299.00	22,365,323,138,297.50	387,350,768,300,597.00	50,877,894,194,102.70	26,458.57	63,427.17	98.0%
9806	0.176452758		138.726872		0.139512548		0.856592815		1213765.479		351.87168		2624.192312		935.4683503	0	822.3563813		476.0341631		328,986,769,401,872.00	17,305,724,948,664.50	346,292,494,350,537.00	41,383,839,151,938.70	21,521.28	63,537.65	98.1%
9807	0.518826692		135.2180955		0.217362299		0.92599773		1029146.399		466.3658135		2614.908915		966.0087624	0	933.7513824		507.2519403		232,214,060,667,788.00	55,521,980,364,501.50	287,736,041,032,290.00	57,914,645,725,603.30	30,117.97	63,679.77	98.1%
9808	0.042946217		137.8420723		0.109288577		0.735721767		1594821.778		663.2659179		2628.892741		970.5217809	0	840.8263022		481.3502839		961,335,840,979,005.00	10,659,827,337,264.00	971,995,668,316,269.00	78,154,268,886,426.50	40,643.39	63,688.22	98.1%
9809	0.342240915		135.8667729		0.17027317		0.896180834		1314097.335		713.3357142		2609.862744		949.8658028	0	577.2632223		398.8366251		461,760,456,691,367.00	71,161,574,877,568.30	532,922,031,568,935.00	81,321,531,220,896.30	42,290.50	63,767.67	98.1%
9810	0.403261259		140.3327197		0.20837038		0.803738665		1213514.095		368.0026093		2610.589241		957.795752	0	768.0354349		460.0433071		237,954,596,750,132.00	43,499,505,064,661.80	281,454,101,814,794.00	47,136,618,887,235.60	24,512.96	63,920.79	98.1%
9811	0.532394086		126.7193913		0.141491398		0.853307253		831485.1732		452.9423291		2688.93366		947.8341729	0	921.8340921		504.0045659		180,705,155,992,827.00	37,113,888,705,020.30	217,819,044,697,847.00	26,298,520,995,561.80	13,676.30	63,942.22	98.1%
9812	0.078850824		134.9710087		0.195913102		0.824622106		911398.3383		555.8044782		2662.65537		946.1910499	0	577.5545715		398.9372604		356,634,185,074,925.00	8,684,110,313,133.33	365,318,295,388,059.00	59,018,732,235,401.20	30,692.14	64,026.31	98.1%
9813	0.030043913		130.4609706		0.18930365		0.784398086		639405.0488		459.462059		2687.029725		935.48875	0	841.4822912		481.5380153		276,706,548,113,000.00	1,741,617,051,164.63	278,448,165,164,164.00	41,346,606,851,572.10	21,501.91	64,231.33	98.1%
9814	0.09234277		123.755742		0.175785522		0.720667262		1082989.07		460.2642533		2640.914277		936.3166778	0	701.4440275		439.6474909		386,747,076,740,100.00	7,882,578,632,872.25	394,629,655,372,972.00	49,992,817,622,361.50	25,998.29	64,251.69	98.1%
9815	0.088124349		123.9741004		0.222530417		0.78764094		971201.8886		547.4502641		2648.695332		956.4118758	0	646.0153089		421.9193981		395,173,727,090,850.00	8,236,985,769,434.95	403,410,712,860,285.00	70,707,436,143,299.60	36,770.74	64,252.83	98.1%

(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
9816	0.144470545		130.7368952		0.169029131		0.79126118		1522723.812		314.788235		2654.626256		936.9848629	0	794.4060853		467.8744926		380,024,602,635,441.00	13,761,053,619,728.80	393,785,656,255,170.00	52,667,331,027,641.70	27,389.15	64,292.40	98.2%
9817	0.073374511		122.7415423		0.1519972		0.89802345		983823.6824		577.0470632		2699.709008		960.6104379	0	741.5183972		452.0318678		475,523,909,139,328.00	7,149,036,225,702.49	482,672,945,365,031.00	65,883,433,202,826.50	34,262.06	64,392.69	98.2%
9818	0.107966991		119.6879079		0.186518766		0.880356326		1368814.786		374.0055719		2662.091282		939.8180016	0	643.5993919		421.1297287		373,240,452,535,730.00	8,617,712,570,243.53	381,858,165,105,973.00	62,702,246,808,008.80	32,607.71	64,404.74	98.2%
9819	0.248526644		136.7910588		0.143661044		0.816800862		1901593.187		550.6775272		2661.05666		954.8879733	0	687.0266487		435.1058071		669,241,645,991,636.00	58,992,471,699,687.40	728,234,117,691,324.00	85,452,786,311,457.90	44,438.92	64,440.50	98.2%
9820	0.575518021		140.2315512		0.120488303		0.784860062		1183727.986		629.0167928		2611.81658		951.1012841	0	840.5466244		481.2702233		298,123,032,307,041.00	102,612,479,229,510.00	400,735,511,536,550.00	37,896,137,426,177.30	19,707.53	64,481.84	98.2%
9821	0.07063391		124.6955604		0.121891316		0.785970598		870353.6168		966.2240138		2683.064722		952.2176622	0	575.9501046		398.3827441		600,874,214,853,757.00	10,567,292,118,036.00	611,441,506,971,793.00	58,577,924,884,411.80	30,462.90	64,505.42	98.2%
9822	0.090704008		130.0051841		0.101537557		0.885577987		1319627.449		372.3014871		2613.511663		952.4732897	0	929.973992		506.2248841		447,875,330,606,363.00	8,871,901,405,070.84	456,747,232,011,434.00	41,070,448,536,058.50	21,358.30	64,659.99	98.2%
9823	0.241452815		109.064166		0.16530044		0.89052917		590727.829		650.2584679		2679.498399		948.8255775	0	707.8871395		441.6620656		254,129,462,518,272.00	10,691,194,987,268.10	264,820,657,505,540.00	38,982,888,869,365.20	20,272.68	64,705.64	98.2%
9824	0.511778221		120.6256254		0.138162122		0.802173171		1657613.601		338.2022569		2689.226071		928.3230625	0	604.7287443		408.2144691		217,422,505,769,666.00	45,229,010,289,010.00	262,651,516,058,676.00	29,109,653,740,736.10	15,138.20	64,719.86	98.2%
9825	0.587115761		110.1528202		0.109894057		0.827719635		1430041.706		488.5165503		2635.762672		934.4675327	0	651.2783774		423.6345945		235,126,717,602,965.00	48,308,122,749,546.30	283,434,840,352,511.00	25,781,649,488,731.20	13,407.50	64,794.02	98.2%
9826	0.124251728		135.7559077		0.179842667		0.908028324		837347.6594		880.2226343		2640.085116		935.8106974	0	948.1325406		511.1432313		661,240,799,054,821.00	19,973,582,042,079.40	681,214,381,096,900.00	111,243,831,520,141.00	57,851.31	64,981.16	98.3%
9827	0.325812629		135.2292386		0.190476749		0.842297249		972706.0957		380.3657318		2607.310876		925.0530034	0	783.2170059		464.5678402		225,098,148,351,999.00	25,743,221,281,087.00	250,841,369,633,086.00	40,244,498,166,928.70	20,928.77	65,008.67	98.3%
9828	0.225158025		116.9773317		0.18928925		0.81888365		714252.7257		649.9082859		2649.32835		928.6722805	0	708.2546104		441.7766862		310,267,290,054,752.00	15,002,572,835,567.00	325,269,862,890,319.00	50,418,738,648,157.00	26,219.79	65,038.48	98.3%
9829	0.058462469		126.8992152		0.085319093		0.810147846		1787928.811		479.0054478		2613.646593		941.4399823	0	700.4152994		439.3249821		681,561,574,634,475.00	9,240,645,737,265.52	690,802,220,371,741.00	47,748,995,149,377.70	24,831.42	65,084.81	98.3%
9830	0.21511712		118.4267433		0.153366132		0.860384273		1378595.457		572.7494969		2638.08588		932.6784691	0	682.0464428		433.5259136		520,186,536,629,299.00	25,445,931,104,345.60	545,632,467,733,645.00	71,998,281,772,645.00	37,442.03	65,096.69	98.3%
9831	0.150316928		112.821682		0.152722858		0.856450029		766051.6775		555.85122		2669.528399		936.1558622	0	937.9736467		508.3975001		372,389,630,979,338.00	8,220,718,911,905.86	380,610,349,891,243.00	49,783,642,130,128.90	25,889.51	65,146.10	98.3%
9832	0.089099997		117.2475246		0.179359516		0.853473491		1227560.695		528.5552564		2648.175672		958.9049126	0	813.6556237		473.5091801		554,304,294,710,138.00	8,630,983,763,194.33	562,935,278,473,332.00	86,173,340,168,231.80	44,813.63	65,233.03	98.3%
9833	0.50682182		112.4575759		0.142294494		0.788878894		949867.6794		587.2008964		2608.913951		946.6401995	0	717.2522214		444.5739782		235,473,265,161,932.00	36,306,336,693,736.00	271,779,601,855,668.00	30,508,109,106,282.20	15,865.46	65,321.74	98.3%
9834	0.10376619		132.8574376		0.190528128		0.802835959		1393872.639		400.8277547		2647.388782		961.2989158	0	857.76285		486.1739719		484,590,087,461,432.00	12,313,388,685,095.60	496,903,476,146,528.00	76,007,763,192,504.20	39,527.12	65,344.89	98.3%
9835	0.11930284		127.2609666		0.165354567		0.761371423		757456.063		466.8162916		2656.686748		972.7296857	0	640.422857		420.0891839		253,224,501,648,649.00	8,106,348,764,634.36	261,330,850,413,283.00	32,900,572,037,672.70	17,109.63	65,470.45	98.3%
9836	0.510548865		134.3388737		0.166754828		0.841377662		1411491.121		765.5415502		2630.441665		942.0851532	0	564.0199148		394.2351173		393,443,305,207,568.00	118,048,726,697,786.00	511,492,031,905,354.00	71,764,269,092,786.30	37,320.33	65,477.51	98.4%
9837	0.292839201		125.2685808		0.148231025		0.870549971		1520006.913		469.3242045		2613.77875		945.6787641	0	881.1170492		492.7480229		489,816,067,823,456.00	37,382,171,587,218.40	527,198,239,410,675.00	68,030,986,288,181.40	35,378.87	65,477.70	98.4%
9838	0.256707861		128.7060752		0.216106467		0.824638495		967395.3469		353.9324184		2666.031285		964.852346	0	767.7083881		459.9453483		232,013,235,140,792.00	17,265,683,694,670.70	249,278,918,835,462.00	44,423,924,301,378.50	23,102.24	65,572.05	98.4%
9839	0.086930518		107.1517006		0.154914206		0.893825399		717979.859		353.8066339		2694.592528		934.4269874	0	639.942511		419.9316115		191,209,393,597,468.00	2,341,904,552,585.03	193,551,298,150,053.00	26,800,322,749,123.30	13,937.26	65,609.87	98.4%
9840	0.436381695		129.7951749		0.204292526		0.803425267		1064797.512		534.0535599		2615.704545		974.481942	0	866.7323025		488.7092727		308,377,454,220,633.00	50,333,334,967,800.30	358,710,789,188,433.00	58,876,556,684,356.50	30,618.20	65,763.71	98.4%
9841	0.418253787		109.0579662		0.16177887		0.805824134		1642968.141		338.1153626		2671.437656		962.5367639	0	904.0683733		499.1243141		325,655,201,680,777.00	27,163,939,147,991.20	352,819,140,828,768.00	45,995,379,452,123.30	23,919.46	65,823.79	98.4%
9842	0.562803069		126.1890137		0.163295183		0.819635804		721267.3797		556.184574		2693.31417		933.6163798	0	834.9681071		479.670524		169,911,972,165,063.00	40,696,318,200,043.10	210,608,290,365,107.00	28,188,356,625,987.80	14,659.09	65,914.35	98.4%
9843	0.274186264		138.8419174		0.165896607		0.744518771		1093313.214		293.9807046		2629.06847		967.7523405	0	668.5083113		429.2017594		192,756,679,452,655.00	20,976,665,134,892.10	213,733,344,587,547.00	26,398,876,059,943.50	13,728.49	66,010.89	98.4%
9844	0.576557056		130.9233018		0.169096471		0.777585246		1569726.089		276.4595052		2659.981652		976.0128655	0	735.553771		450.2101699		162,862,012,962,931.00	51,981,172,754,546.20	214,843,185,717,478.00	28,249,069,019,688.10	14,690.66	66,165.07	98.4%
9845	0.291142301		102.2796955		0.161059796		0.819607919		1234968.284		273.1923016		2650.858322		948.2404925	0	900.0237986		498.0065842		238,503,892,605,993.00	8,674,283,279,394.86	247,178,175,885,387.00	32,628,973,647,278.70	16,968.39	66,178.66	98.4%
9846	0.631716262		120.9843314		0.147704426		0.760754652		1532647.82		611.0073317		2666.159029		929.9534788	0	725.6240649		447.1610083		303,848,047,217,515.00	94,246,712,410,971.90	398,094,759,628,487.00	44,732,645,977,300.20	23,262.79	66,285.98	98.5%
9847	0.363361063		106.0671064		0.214234619		0.798972757		1467338.49		346.9031003		2683.819508		931.2520808	0	716.1260614		444.2248276		285,099,889,564,340.00	18,767,794,544,908.50	303,867,684,109,249.00	52,012,309,561,357.70	27,048.51	66,363.05	98.5%
9848	0.052428251		122.776559		0.160916719		0.795755729		1585464.094		471.8574502		2614.522111		953.8516946	0	591.042871		403.5687965		539,735,263,810,992.00	6,689,529,582,327.83	546,424,793,393,320.00	69,969,913,843,988.20	36,387.20	66,440.85	98.5%
9849	0.097828384		129.5474392		0.094503863		0.72970663		1263779.438		384.7193983		2611.994829		939.8239384	0	765.4626225		459.27212		391,084,199,719,093.00	9,258,150,782,161.21	400,342,350,501,254.00	27,607,646,780,725.70	14,357.10	66,611.55	98.5%
9850	0.352694087		113.1575887		0.133458199		0.797353797		1459353.176		387.1910909		2679.900401		953.250508	0	679.2436171		432.6342233		311,086,352,881,428.00	26,329,960,624,325.70	337,416,313,505,754.00	35,905,617,774,357.90	18,672.38	66,724.98	98.5%
9851	0.290683638		133.8086758		0.163083608		0.862090916		1179266.909		665.2390137		2688.499733		939.2013974	0	627.0410392		415.6770727		451,964,149,378,168.00	48,172,338,175,719.80	500,136,487,553,888.00	70,315,637,573,714.30	36,566.99	66,823.38	98.5%
9852	0.258677363		113.9263463		0.187824934		0.760858836		1118499.96		330.1554049		2694.734491		930.3619018	0	566.799234		395.2052592		209,273,188,717,484.00	12,603,120,822,812.60	221,876,309,540,297.00	31,707,957,480,813.50	16,489.42	66,889.09	98.5%
9853	0.342748774		125.5998843		0.101893109		0.728044916		1228020.906		407.1516224		2608.115953		973.6008794	0	684.6115294		434.3403654		273,327,525,093,025.00	31,802,321,209,741.30	305,129,846,302,766.00	22,635,374,038,173.40	11,771.31	66,912.44	98.5%
9854	0.082980047		138.7883696		0.105682854		0.843052201		1245711.75		772.5116304		2606.676332		945.6739163	0	840.3817146		481.2230099		830,647,614,648,810.00	18,556,897,702,077.80	849,204,512,350,888.00	75,660,863,474,485.20	39,346.72	67,145.27	98.5%
9855	0.35777625		121.4145554		0.179177435		0.822248382		901028.9281		440.4313944		2646.941721		923.9410063	0	779.8498025		463.5681305		232,880,309,311,245.00	22,709,210,639,494.90	255,589,519,950,740.00	37,655,583,833,035.00	19,582.43	67,147.41	98.5%
9856	0.225720009		132.1676128		0.170395024		0.80837677		727785.8781		712.4170095		2620.462468		941.3132827	0	945.4538992		510.4206858		407,520,564,408,940.00	24,022,566,023,790.80	431,543,130,432,731.00	59,442,209,058,093.10	30,912.36	67,202.03	98.6%
9857	0.343007225		115.8296762		0.178625523		0.815004288		655609.1894		450.8528898		2690.725691		947.9107591	0	694.9875671		437.6194397		168,179,685,784,625.00	14,393,611,485,999.90	182,573,297,270,625.00	26,579,124,169,528.50	13,822.22	67,313.39	98.6%
9858	0.494641067		121.0526742		0.213602616		0.821646743		714540.5715		344.4385215		2680.958228		950.7726455	0	933.8972307		507.2915541		128,231,706,440,476.00	19,862,009,822,276.20	148,093,716,262,753.00	25,991,320,013,548.20	13,516.54	67,326.02	98.6%
9859	0.06224634		132.7177509		0.210506729		0.714494066		1483769.872		596.3514428		2691.451527		937.5798076	0	822.9044184		476.1927567		796,330,214,760,240.00	11,379,522,584,171.30	807,709,737,344,412.00	121,484,236,218,163.00	63,176.73	67,538.96	98.6%
9860	0.229550662		131.4007002		0.163010964		0.85501721		756820.302		769.6337307		2652.761224		947.4049176	0	599.3630426		406.3994095		349,712,364,798,322.00	27,216,756,503,967.00	376,929,121,302,289.00	52,535,317,995,977.70	27,320.50	67,669.90	98.6%
9861	0.299258782		123.0202552		0.109661203		0.818150893		1327531.737		325.0478247		2667.659747		941.1437355	0	815.3235116		473.9942477		286,030,711,421,621.00	21,854,672,393,922.40	307,885,383,815,543.00	27,623,295,455,680.10	14,365.23	67,731.87	98.6%
9862	0.22331187		138.2217019		0.185267734		0.907283127		1399375.208		694.6436606		2655.204128		965.1767329	0	601.8810708		407.252192		590,426,590,325,207.00	50,988,951,667,125.40	641,415,541,992,332.00	107,815,723,835,309.00	56,068.55	67,790.88	98.6%
9863	0.47036904		137.3766671		0.126771159		0.818247406		1490414.904		786.4901414		2654.227626		926.2556408	0	974.032657		518.077638		649,689,115,988,972.00	122,484,648,887,509.00	772,173,764,876,481.00	80,097,717,645,281.30	41,654.06	67,811.05	98.6%
9864	0.532575674		131.769933		0.183417944		0.719506478		1119630.484		671.9748458		2609.363282		937.6485634	0	734.2499947		449.810992		305,418,902,839,220.00	81,302,337,767,480.00	386,721,240,606,700.00	51,035,756,262,297.80	26,540.66	67,844.12	98.6%
9865	0.110359105		132.6665755		0.176129826		0.772580263		800901.58		680.8428972		2698.295283		951.6577208	0	709.0476995		442.0239632		426,491,227,060,676.00	12,607,424,239,735.10	439,098,651,300,411.00	59,750,097,473,808.40	31,072.48	67,900.75	98.6%
9866	0.13950158		116.1236484		0.136305656		0.912553616		1342617.297		507.3981006		2670.881691		928.1189918	0	917.3753236		502.7841924		595,754,119,279,973.00	13,318,390,600,785.90	609,072,509,880,759.00	75,760,226,609,381.40	39,398.39	67,924.71	98.7%
9867	0.060850895		114.8703637		0.159638697		0.879076076		1554503.915		742.1581122		2649.461891		926.4639163	0	964.3646243		515.5000639		1,125,152,054,264,260.00	9,480,178,133,168.66	1,134,632,232,397,430.00	159,228,114,428,373.00	82,805.08	68,227.68	98.7%
9868	0.087185999		140.4086496		0.196615734		0.819310083		707001.8082		443.7591364		2686.988637		930.4091122	0	582.9545418		400.7978961		222,172,332,980,479.00	6,426,343,655,390.20	228,598,676,635,869.00	36,824,790,104,135.40	19,150.39	68,333.89	98.7%
9869	0.494783723		137.19557		0.168598115		0.844525731		617124.7917		539.7642283		2648.837737		938.9309315	0	888.9070702		494.9214405		166,463,173,083,856.00	36,996,855,843,266.80	203,460,028,927,123.00	28,969,747,009,243.90	15,065.44	68,442.41	98.7%
9870	0.257164399		133.4412767		0.11676363		0.89063078		751791.6915		723.9558377		2671.282276		945.208864	0	553.240852		390.4498037		301,756,050,649,131.00	29,552,983,749,700.50	331,309,034,398,831.00	34,453,914,063,806.70	17,917.43	68,616.05	98.7%
9871	0.076004492		108.5318167		0.167541732		0.78564807		1099004.235		475.1862456		2610.113264		941.6701242	0	667.3484389		428.8292618		395,410,191,828,081.00	4,457,660,500,907.98	399,867,852,328,989.00	52,634,140,997,247.60	27,371.89	68,721.70	98.7%
9872	0.488008999		137.2722518		0.185172649		0.852742294		1071498.723		325.6433658		2609.478311		960.9838245	0	606.6683387		408.8685943		137,979,581,407,488.00	39,174,038,105,809.80	177,153,619,513,298.00	27,973,362,408,548.50	14,547.28	68,800.55	98.7%
9873	0.500630911		117.3761172		0.18478873		0.856394889		1352379.541		702.2956486		2663.767507		945.8306547	0	743.3532615		452.5907917		423,653,861,602,602.00	70,261,930,903,075.60	493,915,792,505,677.00	78,163,223,364,203.00	40,648.05	68,910.25	98.7%
9874	0.112645373		137.7094974		0.182086691		0.762057987		728276.4612		487.7060624		2673.029736		938.2296993	0	628.0818029		416.0219004		254,780,114,689,227.00	9,055,251,844,938.18	263,835,366,534,165.00	36,609,958,293,548.50	19,038.66	69,049.51	98.7%
9875	0.15699984		129.8797864		0.081155374		0.84984696		1652096.477		691.0193599		2641.02019		948.6476494	0	676.0187087		431.6059723		804,310,523,810,964.00	35,451,174,863,362.40	839,761,698,674,327.00	57,918,068,959,772.00	30,119.75	69,153.68	98.7%
9876	0.394001802		121.9911257		0.179760271		0.76056782		679594.6612		511.0552341		2605.593099		929.6643459	0	844.8988173		482.5145781		198,664,308,948,200.00	22,329,344,874,964.60	220,993,653,823,164.00	30,214,225,214,688.80	15,712.62	69,205.55	98.8%
9877	0.378288219		134.0288775		0.137958807		0.846338853		1071133.765		390.5885732		2634.151582		958.1072417	0	729.709411		448.4180252		227,183,341,224,332.00	34,245,413,065,422.40	261,428,754,289,755.00	30,524,394,812,919.60	15,873.92	69,300.04	98.8%
9878	0.349329634		132.5276261		0.219275651		0.91279281		1640975.247		426.6583021		2637.858817		947.9609076	0	923.3062776		504.4068575		459,007,422,142,975.00	50,906,371,640,356.00	509,913,793,783,331.00	102,060,896,626,352.00	53,075.81	69,318.47	98.8%
9879	0.436618511		126.1855974		0.203785262		0.754572214		1070353.048		597.2524963		2678.968088		934.0654288	0	703.9675721		440.437628		312,988,059,559,629.00	50,332,362,266,750.40	363,320,421,826,379.00	55,868,034,320,680.10	29,053.65	69,389.54	98.8%
9880	0.176789519		125.4921143		0.121836713		0.784459054		530371.7103		389.0236046		2614.377588		939.6816743	0	797.8927561		468.9001257		155,423,291,060,120.00	6,517,874,268,023.14	161,941,165,328,143.00	15,477,674,642,544.30	8,049.02	69,409.99	98.8%

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(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
9881	0.044307887		121.9372142		0.123068998		0.783958554		1207856.438		741.1723453		2686.504951		945.7681401	0	877.9374177		491.858145		851,981,845,857,607.00	6,576,216,448,998.28	858,558,062,306,605.00	82,834,535,226,480.20	43,077.32	69,569.40	98.8%
9882	0.05970127		124.2828935		0.154547259		0.747345725		1475230.439		412.7119366		2696.711956		955.6400889	0	760.217067		457.6957668		524,797,710,638,008.00	6,429,794,513,527.85	531,227,505,151,536.00	61,356,900,720,794.70	31,908.08	69,576.71	98.8%
9883	0.182835645		142.4598157		0.199219881		0.862775215		1631246.937		677.6523291		2678.796207		952.1206571	0	551.681302		389.899089		674,898,624,657,081.00	50,240,792,525,206.60	725,139,417,182,288.00	124,638,395,646,319.00	64,817.02	69,629.81	98.8%
9884	0.142574446		134.2836534		0.198887104		0.812791152		1469410.704		516.1977359		2625.550438		956.3064425	0	612.9251078		410.9715838		508,638,582,519,667.00	23,466,235,237,296.10	532,104,817,756,963.00	86,016,701,017,081.10	44,732.18	69,921.00	98.8%
9885	0.146821042		130.0082547		0.214919895		0.74965282		1125382.997		667.0190237		2621.072816		936.991079	0	600.452084		406.7684554		493,674,195,086,507.00	21,586,404,286,582.60	515,260,599,373,089.00	83,016,368,962,935.80	43,171.88	70,005.85	98.8%
9886	0.090580882		127.5329302		0.157601196		0.804579483		1572903.054		460.5585881		2609.888929		959.6606996	0	581.6556451		400.3511328		495,726,024,875,028.00	12,511,574,466,436.50	508,237,599,341,464.00	64,445,894,054,773.90	33,514.48	70,029.74	98.9%
9887	0.47840799		120.8497699		0.193477362		0.779908855		787937.55		472.9979085		2630.762845		930.3017142	0	572.9625965		397.3481762		146,063,654,965,769.00	28,322,993,969,821.10	174,386,648,935,590.00	26,314,022,501,689.10	13,684.36	70,124.46	98.9%
9888	0.516376828		109.0500352		0.188354416		0.809334263		1124653.917		488.8919024		2673.762884		929.8423806	0	509.9959005		374.8792744		188,689,830,393,721.00	32,057,582,631,938.10	220,747,413,025,659.00	33,651,107,035,281.80	17,499.94	70,125.62	98.9%
9889	0.557914041		121.2008868		0.180384729		0.827505043		680187.149		478.2000992		2681.165158		960.3965204	0	802.6817318		470.3051967		135,430,105,160,080.00	30,015,031,217,576.30	165,445,136,377,657.00	24,695,875,252,063.70	12,842.86	70,231.33	98.9%
9890	0.044156762		135.0741638		0.130786562		0.824123292		901794.6085		643.1807845		2663.990709		967.3102163	0	785.3013915		465.1856097		512,003,154,548,462.00	5,703,321,857,452.51	517,706,476,405,915.00	55,800,605,391,370.20	29,018.58	70,252.33	98.9%
9891	0.350114224		133.8278894		0.214778556		0.912440746		1144501.818		613.3552898		2664.275349		940.4519994	0	662.1365422		427.1514317		379,757,369,077,636.00	52,006,619,414,410.10	431,763,988,492,046.00	84,613,957,318,144.30	44,002.69	70,296.75	98.9%
9892	0.101863038		132.4744904		0.139495521		0.834638759		848194.2851		350.2873613		2637.296841		941.4984162	0	850.088426		483.9941804		255,881,573,553,375.00	6,250,007,504,354.68	262,131,581,057,730.00	30,519,552,425,518.90	15,871.41	70,372.82	98.9%
9893	0.373611684		123.5680062		0.145012233		0.830636891		1050818.109		836.7705452		2601.198799		945.6194036	0	615.9990992		412.0008638		428,087,797,778,099.00	56,573,718,540,928.90	484,661,516,319,028.00	58,378,696,183,304.00	30,359.29	70,497.45	98.9%
9894	0.103558558		124.6828691		0.199467689		0.88271583		825920.6243		660.643122		2643.901359		928.8266373	0	861.7257829		487.295759		474,050,708,347,280.00	9,802,643,753,882.81	483,853,352,101,163.00	85,193,649,955,669.70	44,304.16	70,664.36	98.9%
9895	0.540329433		134.4135714		0.211989056		0.786969696		824078.7564		691.2804377		2600.00604		936.9604236	0	794.9462979		468.0335478		237,769,324,155,057.00	65,597,361,544,412.50	303,366,685,699,469.00	50,610,349,616,836.90	26,319.44	70,664.36	98.9%
9896	0.226374973		136.7021016		0.137397691		0.858461883		929074.0954		515.7093926		2661.677096		928.6601192	0	702.7491817		440.0563197		319,708,525,823,478.00	23,873,496,909,875.80	343,582,022,733,353.00	40,525,733,377,382.80	21,075.03	70,684.99	99.0%
9897	0.536003688		114.8156552		0.166719305		0.795487032		1243559.756		268.0032168		2657.619316		960.1699797	0	678.2357743		432.3131388		130,312,271,506,591.00	24,961,657,541,398.20	155,273,929,047,990.00	20,592,901,314,708.20	10,709.14	70,760.04	99.0%
9898	0.043080056		109.5927799		0.125071894		0.789585971		1202470.949		872.0910771		2639.413045		946.8833341	0	995.3118025		523.7061393		1,057,687,441,974,080.00	5,291,407,573,456.31	1,062,978,849,547,530.00	104,974,489,646,893.00	54,591.00	70,845.08	99.0%
9899	0.068297463		127.9862517		0.184669465		0.827609781		1685276.71		639.9037357		2667.299895		931.9964662	0	846.2532685		482.9011811		971,798,088,085,804.00	13,768,854,547,035.00	985,566,942,632,839.00	150,628,390,210,288.00	78,332.88	70,968.80	99.0%
9900	0.060976144		126.9349853		0.179379293		0.79980577		868958.0532		284.2953383		2695.82328		964.9229691	0	813.036156		473.3288953		221,378,253,972,850.00	2,851,636,211,554.94	224,229,890,184,405.00	32,169,946,881,208.00	16,729.68	71,016.07	99.0%
9901	0.358952745		134.9540738		0.136371825		0.913915598		1077415.54		852.2589766		2601.06653		939.3663323	0	802.9858704		470.3942883		537,950,467,648,480.00	71,121,885,948,759.80	609,072,353,597,240.00	75,910,111,530,398.20	39,476.34	71,186.71	99.0%
9902	0.110847942		135.2704201		0.116150473		0.871786416		789166.5115		616.0985006		2665.863826		935.1195481	0	1013.217465		528.3958787		465,089,913,127,809.00	11,643,475,061,112.30	476,733,388,188,921.00	48,273,262,364,553.90	25,104.06	71,233.99	99.0%
9903	0.443035518		118.7775641		0.095815752		0.790920669		733854.2268		477.1090168		2674.078279		952.4223699	0	881.3771495		492.8207456		193,746,142,655,034.00	23,947,068,840,790.70	217,693,211,495,825.00	16,497,370,283,807.50	8,579.30	71,284.26	99.0%
9904	0.216650452		120.6588245		0.152355679		0.81407785		1066243.581		719.4402474		2648.158306		931.8365459	0	806.842465		471.5225442		560,725,082,419,048.00	26,319,740,248,966.20	587,044,822,668,014.00	72,810,807,492,764.50	37,864.58	71,317.31	99.0%
9905	0.181107066		125.4890005		0.098286004		0.740570617		1109390.047		493.1334123		2622.057445		929.9519049	0	652.4398607		424.0121791		363,692,502,246,890.00	17,519,723,698,426.40	381,212,225,945,317.00	27,747,571,287,951.30	14,429.86	71,597.81	99.0%
9906	0.208996932		114.5948703		0.147971744		0.898598245		1367359.134		773.8358375		2678.899132		929.0357814	0	939.9190829		508.9244566		865,544,265,236,809.00	29,709,255,931,227.40	895,253,521,168,036.00	119,039,308,639,141.00	61,905.27	71,601.83	99.1%
9907	0.176854683		139.2211196		0.200068388		0.877382834		1359827.442		449.2602822		2623.217254		945.1128604	0	822.5171033		476.0806791		470,239,131,076,261.00	25,277,548,912,588.90	495,516,679,988,849.00	86,981,298,111,756.70	45,233.81	71,624.19	99.1%
9908	0.219330816		123.8914377		0.13682337		0.801271178		1688710.955		637.4995238		2688.428053		958.854217	0	680.8505842		433.1456879		718,120,058,541,125.00	41,537,801,911,314.30	759,657,860,452,439.00	83,283,283,874,522.20	43,310.69	71,786.77	99.1%
9909	0.219909328		136.977197		0.121457799		0.851016556		1850281.94		384.2482215		2633.357203		930.4881024	0	668.9300457		429.3371209		459,189,427,149,548.00	34,648,274,724,959.00	493,837,701,874,507.00	51,044,347,864,394.00	26,545.13	71,848.59	99.1%
9910	0.33576079		133.5015147		0.151734195		0.794263398		1495518.366		396.9494136		2671.337366		957.5948235	0	867.1928893		488.839107		387,592,266,367,413.00	42,685,565,845,033.00	430,277,832,212,446.00	51,855,757,778,217.20	26,967.10	72,056.89	99.1%
9911	0.184026246		128.1442595		0.145972571		0.841632377		1145066.513		550.0462186		2632.811052		950.8995647	0	723.7755393		446.5910743		446,426,715,018,267.00	22,180,181,988,741.40	468,606,897,007,008.00	57,570,813,564,165.70	29,939.16	72,071.99	99.1%
9912	0.103015459		132.1967629		0.109015553		0.798035391		1642717.423		765.6614866		2603.560493		938.7623552	0	854.9726321		485.3825898		1,071,667,103,009,150.00	26,538,574,063,075.90	1,098,205,677,072,230.00	95,541,993,733,117.70	49,685.71	72,142.93	99.1%
9913	0.207932133		135.2827658		0.092445047		0.897394929		1063406.309		341.5808727		2661.601675		939.9687006	0	591.5796506		403.7520136		223,127,561,881,897.00	16,405,664,365,101.60	239,533,226,246,999.00	19,871,608,608,840.90	10,334.04	72,284.48	99.1%
9914	0.421652095		134.1231432		0.108674419		0.770276615		551849.0639		397.4088403		2630.190854		933.3038347	0	632.9911747		417.6446433		101,376,346,947,502.00	19,525,152,691,649.90	120,901,499,639,151.00	10,120,587,601,641.80	5,263.12	72,297.38	99.1%
9915	0.294756667		138.5548479		0.15611519		0.759745463		1144027.224		385.602811		2621.26071		970.6476221	0	733.6712714		449.6336904		271,293,766,747,649.00	30,891,636,887,635.70	302,185,403,635,285.00	35,841,548,189,861.90	18,639.06	72,360.29	99.1%
9916	0.215507735		112.154905		0.183956981		0.791762359		1000107.199		515.3553441		2686.939282		956.7780683	0	767.3315414		459.8324472		371,393,609,551,565.00	14,284,035,650,655.20	385,677,645,202,220.00	56,174,031,336,420.50	29,212.78	72,764.68	99.2%
9917	0.565918352		121.5050793		0.186112949		0.796015519		1275437.352		753.9600895		2687.238209		927.1359956	0	700.9183178		439.4827092		362,915,565,251,020.00	87,535,101,420,764.10	450,450,666,671,784.00	66,733,723,834,632.50	34,704.25	73,049.38	99.2%
9918	0.322261118		137.319166		0.161235957		0.81768045		1542533.538		791.4331087		2686.13888		953.4624296	0	664.5695004		427.9354759		695,954,611,075,686.00	89,874,496,107,040.10	785,829,107,182,726.00	103,603,308,832,714.00	53,877.93	73,287.96	99.2%
9919	0.082998765		135.8904386		0.155659695		0.872610172		832321.4528		635.2636422		2652.647549		960.7140295	0	708.8772653		441.9708353		418,996,744,941,795.00	9,849,737,332,595.35	428,846,482,274,390.00	58,250,317,734,119.50	30,292.53	73,385.15	99.2%
9920	0.547930111		132.7076465		0.114893329		0.741851087		1033923.694		326.6441361		2607.767712		938.6464774	0	611.9724361		410.6520723		118,481,787,445,972.00	38,268,415,617,460.60	156,750,203,063,433.00	13,360,406,162,870.80	6,947.95	73,394.55	99.2%
9921	0.393983623		116.8412413		0.192613659		0.813650765		1301667.07		333.4313917		2631.207428		945.8564372	0	792.7561295		467.38836		241,287,557,228,126.00	24,906,937,630,718.80	266,194,494,858,845.00	41,718,068,008,959.10	21,695.09	73,436.68	99.2%
9922	0.584344752		121.4004612		0.117019059		0.759109448		1258902.192		410.722027		2627.910359		937.6152135	0	647.5322293		422.414466		174,051,757,693,803.00	49,024,733,205,026.70	223,076,490,898,830.00	19,815,945,683,931.50	10,305.10	73,758.82	99.2%
9923	0.07955817		125.031047		0.209634312		0.749249594		1338682.496		595.1785066		2658.634075		960.4585255	0	808.9902164		472.1497051		688,135,780,580,083.00	11,459,787,154,128.10	699,595,567,734,211.00	109,884,372,768,451.00	57,144.33	73,858.75	99.2%
9924	0.195160276		123.1307027		0.182045979		0.779687026		1603036.525		717.4509061		2624.637256		966.3625755	0	726.7555129		447.5094961		803,573,070,372,918.00	39,104,789,048,602.60	842,677,859,421,521.00	119,608,758,115,487.00	62,201.41	74,039.73	99.2%
9925	0.080185611		141.1943055		0.124005478		0.730642781		923613.8225		318.3689925		2694.235322		938.1042794	0	610.3643845		410.1121917		216,501,537,507,593.00	5,657,910,080,167.62	222,159,447,587,761.00	20,128,469,613,450.40	10,467.62	74,041.43	99.2%
9926	0.232433126		129.0530026		0.222328585		0.768809858		1142365.491		493.3800081		2674.35355		938.8930747	0	1006.66965		526.685759		465,121,358,756,838.00	25,219,859,356,320.20	490,341,218,113,158.00	83,813,243,842,003.50	43,586.29	74,090.33	99.3%
9927	0.185167344		112.2660872		0.173591469		0.74604657		605701.6848		360.5610803		2676.285001		928.9223841	0	713.518486		443.415329		155,770,123,939,529.00	5,066,453,228,497.90	160,836,577,168,027.00	20,829,514,117,448.90	10,832.19	74,108.35	99.3%
9928	0.434517442		123.3872722		0.164248644		0.810242664		931169.8288		497.05551		2689.759391		933.6827453	0	635.7536042		418.5549703		214,505,354,788,320.00	34,054,849,358,701.00	248,560,204,147,021.00	33,078,704,960,669.00	17,202.27	74,350.77	99.3%
9929	0.203874148		136.5433484		0.095764706		0.75256476		1031409.144		648.8715449		2672.25879		957.3092487	0	813.8464946		473.5647158		504,322,812,149,662.00	30,871,798,077,635.60	535,194,610,227,297.00	38,571,016,703,568.60	20,058.49	74,674.74	99.3%
9930	0.448006227		116.6114625		0.19292145		0.779996654		1303562.002		880.953495		2684.245592		924.9978203	0	595.480111		405.0808554		497,823,054,914,096.00	72,828,739,728,883.60	570,651,794,642,980.00	85,870,589,321,131.40	44,656.19	74,699.18	99.3%
9931	0.198062677		135.7464506		0.155537285		0.812215356		874390.8443		280.2749711		2652.141339		936.261851	0	740.3503481		451.6757044		174,354,713,130,935.00	10,589,693,583,180.60	184,944,406,714,115.00	23,363,984,574,728.90	12,150.22	75,101.58	99.3%
9932	0.581055265		132.1189236		0.137775317		0.806670366		1291272.373		699.22267		2678.745577		941.8133557	0	859.7356936		486.7327477		370,913,989,836,310.00	107,643,389,489,414.00	478,557,379,325,724.00	53,186,515,500,573.90	27,659.15	75,285.13	99.3%
9933	0.248759248		135.4039711		0.153850983		0.834976455		1051706.022		757.3908333		2676.516322		957.2842601	0	680.3909022		432.9994423		508,838,506,135,383.00	43,929,042,234,446.40	552,767,548,369,829.00	71,009,596,175,532.00	36,927.87	75,424.47	99.3%
9934	0.276864747		142.329687		0.163331387		0.748689003		636032.1318		302.8550186		2681.945076		927.755935	0	721.132783		445.774999		122,981,496,011,056.00	12,890,995,631,959.10	135,872,491,643,015.00	16,615,087,977,226.90	8,640.52	75,562.46	99.3%
9935	0.140108419		119.0633508		0.178652439		0.787248067		1217998.37		478.227456		2676.705328		976.0157741	0	769.8706564		460.5926162		459,227,980,267,661.00	13,006,129,043,772.80	472,234,109,311,434.00	66,416,793,794,461.60	34,539.43	75,656.79	99.3%
9936	0.057424492		117.0413092		0.177931132		0.804642764		1025215.274		693.3979593		2649.349311		935.1117564	0	636.629723		418.843272		541,370,238,407,901.00	5,910,455,011,710.07	547,280,693,419,611.00	78,354,723,000,008.70	40,747.64	75,871.87	99.4%
9937	0.234967635		128.3885476		0.142720085		0.783344488		1026752.815		604.1487865		2675.068397		933.5214003	0	699.8235749		439.1393677		410,326,940,675,870.00	27,520,796,659,139.20	437,847,737,335,009.00	48,950,935,711,238.70	25,456.47	75,923.32	99.4%
9938	0.065014295		127.9087574		0.184631911		0.786263692		884358.0715		871.439166		2627.907085		934.9995488	0	752.3201537		455.312356		639,610,474,773,846.00	9,381,594,704,789.81	648,992,069,478,636.00	94,213,768,365,723.40	48,994.98	76,127.70	99.4%
9939	0.087318638		136.6488603		0.087543204		0.774795665		817211.4065		472.9993007		2673.843997		939.5932918	0	652.7862499		424.1247211		292,151,787,044,913.00	7,509,469,192,167.20	299,661,256,237,080.00	20,325,452,241,612.80	10,570.06	76,224.21	99.4%
9940	0.502592878		130.8920293		0.188662553		0.827744294		1381958.785		338.7133201		2646.012561		944.467137	0	727.8481388		447.8457694		203,957,435,576,663.00	47,266,843,185,880.70	251,224,278,762,543.00	39,232,276,568,259.10	20,402.38	76,381.35	99.4%
9941	0.122022485		134.9666932		0.158275616		0.83515349		1086447.343		559.5759594		2696.562374		948.801913	0	802.3488413		470.2076634		505,475,253,093,262.00	16,171,825,189,065.90	521,647,078,282,328.00	68,953,623,117,459.80	35,858.68	76,700.34	99.4%
9942	0.328550927		136.6695796		0.146725022		0.748781483		621565.028		591.1090165		2612.426899		957.9375208	0	894.8111522		496.5623436		241,620,566,230,915.00	27,391,783,398,767.40	269,012,349,629,682.00	29,555,036,386,663.00	15,369.82	76,715.63	99.4%
9943	0.11078271		134.2764414		0.138974036		0.807773934		1245238.927		423.667601		2678.730346		943.6716319	0	666.6515601		428.6053008		394,267,822,867,630.00	12,512,914,403,055.10	406,780,737,270,685.00	45,665,044,510,450.90	23,747.68	76,735.17	99.4%
9944	0.064109506		124.0306637		0.192211928		0.873529543		578816.9919		281.2403978		2653.689051		946.7164964	0	592.9286393		404.2120927		117,968,419,990,397.00	1,818,414,421,340.19	119,786,834,411,737.00	20,112,544,643,437.50	10,459.34	77,124.76	99.4%
9945	0.051843453		129.0434479		0.098256473		0.805268732		677940.6267		425.4963486		2680.838119		940.6659113	0	705.8874403		441.0378023		238,250,226,638,459.00	2,883,859,532,408.35	241,134,086,170,867.00	19,079,219,872,603.90	9,921.97	77,266.34	99.4%

(cont. on next page)

Table 49. (continued)

gözeneklilik		sıcaklık		üretim faktörü		dönüşüm		yüzey alanı		kalınlık		kayaç d		su d (yoğ)		derinlik		kayaç sıcaklık			terketme sıcaklığı		kayaç özg ısı		su özg ısı		yük faktörü
üçgen		üçgen		üçgen		üçgen		üçgen		üçgen		uniform		üçgen		üçgen					sabit		sabit		sabit		sabit
min	0.0275	min	100	min	0.07	min	0.7	min	500000	min	250	min	2600	min	921.7	min	500	-			80		0.9		4.18		0.41
max	0.7	max	145	max	0.24	max	0.93	max	2000000	max	1000	max	2700	max	986.7	max	1100	-									
mode	0.05	mode	135	mode	0.18	mode	0.8	mode	900000	mode	350	expect	2650	mode	930.6	mode	650	-	166		Hk	Hs	Htoplam	Htop*Üret*Dönüşüm	saha rezerv	13835.17	
																									29410.07	26196.98	
9946	0.087674815		114.6151498		0.168764739		0.783165004		1552507.311		294.1865795		2626.125799		947.4462019	0	755.7894272		456.3609696		370,654,083,416,509.00	5,489,444,812,863.35	376,143,528,229,372.00	49,715,129,855,127.80	25,853.89	77,296.20	99.5%
9947	0.118455897		126.5878956		0.175813335		0.749526736		1017800.594		650.3579313		2690.077771		945.7909875	0	662.1405484		427.1527239		490,441,382,695,289.00	14,441,635,304,654.70	504,883,017,999,944.00	66,531,865,896,406.60	34,599.27	77,393.30	99.5%
9948	0.182671106		124.5369037		0.153800861		0.840776368		938600.2777		703.4292374		2648.412669		977.3644094	0	962.3463211		514.9603404		559,468,671,466,087.00	21,944,403,170,753.70	581,413,074,636,841.00	75,183,762,649,556.20	39,098.61	77,507.55	99.5%
9949	0.131235391		108.8560173		0.21558036		0.883793807		1675364.703		327.3138551		2642.173591		937.5439431	0	670.6940122		429.9028285		396,394,099,706,740.00	8,138,212,445,836.85	404,532,312,152,576.00	77,074,969,926,693.80	40,082.11	77,593.72	99.5%
9950	0.258386993		140.2008481		0.166697741		0.770250285		1064595.466		534.9065773		2648.073974		937.3105635	0	636.3632146		418.7555939		340,956,509,258,355.00	34,705,283,855,879.60	375,661,793,114,235.00	48,234,591,998,734.70	25,083.95	77,749.48	99.5%
9951	0.124998569		118.6378102		0.185157049		0.794862087		721928.8496		319.8488544		2623.774094		967.4119509	0	771.6211456		461.1159538		181,833,558,685,880.00	4,509,666,980,794.15	186,343,225,666,674.00	27,424,937,213,403.70	14,262.08	77,770.13	99.5%
9952	0.127042118		140.9218866		0.20560214		0.840495442		1198728.167		315.7098575		2631.369985		952.577475	0	969.9145139		516.9812796		341,892,363,911,612.00	11,662,898,895,943.40	353,555,262,807,555.00	61,097,058,268,441.90	31,772.95	77,794.00	99.5%
9953	0.264035953		133.3548779		0.197324784		0.814465337		718762.8459		306.9613165		2645.339904		930.1082958	0	789.7544192		466.5026557		149,417,801,458,618.00	12,084,154,420,059.90	161,501,955,878,677.00	25,955,657,037,342.00	13,498.00	78,415.16	99.5%
9954	0.088530899		135.188208		0.185134007		0.799630396		961862.2347		335.8068243		2639.43475		967.7533557	0	1026.34909		531.8089461		315,974,916,048,894.00	6,383,877,254,863.75	322,358,793,303,758.00	47,721,602,186,528.20	24,817.17	79,105.42	99.5%
9955	0.088334675		118.8044269		0.152620598		0.780936465		1335157.979		444.7711751		2649.456841		939.6120386	0	884.5894346		493.7180011		534,082,690,070,172.00	7,994,782,094,561.62	542,077,472,164,733.00	64,608,582,500,391.80	33,599.09	79,106.93	99.5%
9956	0.200230244		135.773736		0.142750182		0.840638402		743124.1629		653.1147379		2667.269543		937.371465	0	709.7046771		442.2286974		337,526,684,349,044.00	21,237,250,514,964.90	358,763,934,864,009.00	43,052,133,110,527.50	22,388.86	79,122.95	99.6%
9957	0.201385669		120.8787609		0.187429839		0.788488717		1431619.465		335.7381514		2605.700913		954.8847418	0	758.72296		457.2457751		339,591,528,828,586.00	15,793,624,545,014.30	355,385,153,373,600.00	52,521,061,510,452.00	27,313.08	79,489.53	99.6%
9958	0.636294973		127.30729		0.101139644		0.810021401		1164323.718		445.0772162		2643.12348		942.4407941	0	727.4771839		447.7316303		164,872,931,906,069.00	61,450,585,937,711.90	226,323,517,843,781.00	18,541,616,775,591.10	9,642.39	79,734.62	99.6%
9959	0.285600999		134.4197823		0.172377262		0.736128479		1374045.487		695.2116192		2626.011589		934.3074889	0	553.4743714		390.5321981		500,846,630,021,454.00	57,983,011,230,082.90	558,829,641,251,537.00	70,910,905,428,166.90	36,876.55	80,012.75	99.6%
9960	0.313031607		124.0992452		0.154253914		0.812538752		1627099.026		660.5508741		2697.765526		950.9444462	0	1040.548905		535.4751688		816,523,010,808,848.00	58,975,418,517,042.80	875,498,429,325,891.00	109,732,594,115,873.00	57,065.40	80,463.54	99.6%
9961	0.046651709		126.3631628		0.169449717		0.800414218		916488.5609		817.5071657		2669.440183		932.4942865	0	907.3479568		500.0288021		720,795,363,128,864.00	6,316,575,435,818.88	727,111,938,564,683.00	98,618,164,836,372.90	51,285.45	80,468.32	99.6%
9962	0.108529922		127.8918647		0.200467917		0.815484692		1180979.555		504.6274863		2697.41661		937.1585385	0	658.0404424		425.8281629		446,037,062,088,028.00	12,134,276,009,850.30	458,171,338,097,879.00	74,901,171,195,068.80	38,951.65	80,475.41	99.6%
9963	0.127466462		120.1828546		0.147618357		0.837343962		1443775.924		543.7064739		2606.897073		934.8768505	0	676.7865147		431.8510067		565,420,591,599,398.00	15,712,008,489,416.80	581,132,600,088,815.00	71,832,254,683,516.20	37,355.69	80,721.27	99.6%
9964	0.303505584		131.8599214		0.18920189		0.745100343		893683.7516		395.4454851		2617.982272		946.6684362	0	757.0289595		456.7350436		218,490,899,815,417.00	22,011,173,743,878.30	240,502,073,559,295.00	33,904,633,843,159.90	17,631.79	81,123.89	99.6%
9965	0.146628896		136.5132295		0.181240652		0.762863932		1144617.877		421.6000058		2640.62827		938.8878819	0	628.1896998		416.0576326		328,899,041,404,554.00	15,693,537,071,938.30	344,592,578,476,492.00	47,644,044,134,196.70	24,776.84	81,279.00	99.6%
9966	0.131677679		115.6029041		0.180794406		0.763659754		811177.0794		285.491882		2642.865344		928.6168732	0	664.3922977		427.8784191		166,393,145,822,986.00	4,214,245,914,006.56	170,607,391,736,992.00	23,554,979,731,633.10	12,249.55	81,869.90	99.7%
9967	0.288055774		139.0771703		0.127637438		0.712708792		1459134.841		344.4686786		2657.050277		942.8797899	0	734.8192126		449.9853133		316,605,099,123,426.00	33,711,187,060,221.30	350,316,286,183,647.00	31,867,685,503,841.40	16,572.49	81,921.78	99.7%
9968	0.172845368		131.2672979		0.165116134		0.764569778		912908.1831		355.044745		2624.986614		949.8514462	0	755.9911601		456.4218707		238,419,265,939,117.00	11,403,556,865,216.50	249,822,822,804,334.00	31,538,334,041,131.60	16,401.21	82,533.95	99.7%
9969	0.415517539		113.1092998		0.222345434		0.869500245		650483.649		574.8618012		2683.620995		936.3071989	0	835.0239468		479.6865631		210,986,446,285,966.00	20,134,174,894,093.20	231,120,621,180,060.00	44,682,413,199,008.20	23,236.67	82,940.86	99.7%
9970	0.430213667		113.9796716		0.102796965		0.824308351		935509.6606		748.9305478		2605.535682		962.8876703	0	962.7331977		515.0638407		407,281,209,304,684.00	41,223,523,479,019.10	448,504,732,783,703.00	38,004,674,965,431.20	19,763.97	83,037.94	99.7%
9971	0.358793229		123.417749		0.094104066		0.777758706		1426605.159		829.6788605		2653.301386		932.1285052	0	972.2068852		517.5918559		793,067,656,741,701.00	71,841,836,967,861.20	864,909,493,709,562.00	63,302,947,428,256.20	32,920.10	83,112.30	99.7%
9972	0.396528698		118.4020407		0.090744393		0.797771564		1032128.851		714.0914623		2688.418908		939.7241003	0	742.5391197		452.3428786		400,706,957,863,210.00	44,085,252,569,781.90	444,792,210,432,992.00	32,199,974,122,902.80	16,745.29	83,300.00	99.7%
9973	0.34723684		141.9314715		0.15791036		0.781814924		875267.3248		440.7404772		2683.160036		936.9859286	0	591.6257241		403.7677359		196,880,155,611,821.00	32,491,532,645,203.00	229,371,688,257,023.00	28,317,466,204,227.20	14,726.23	83,671.52	99.7%
9974	0.193210494		132.4330576		0.110804877		0.794693862		1489066.202		281.9451932		2661.366483		967.5993558	0	679.3157215		432.6571856		286,113,843,802,214.00	17,202,297,230,365.60	303,316,141,032,579.00	26,708,792,764,592.40	13,889.66	83,808.29	99.7%
9975	0.078264033		125.2002461		0.167300908		0.806970178		1061124.611		355.0132705		2683.97246		962.7771002	0	879.3222857		492.2459233		345,775,679,324,771.00	5,363,101,716,529.21	351,138,781,041,301.00	47,406,138,597,709.90	24,653.12	83,855.01	99.7%
9976	0.20227668		126.7568703		0.201939767		0.880391251		1325827.028		396.3274045		2646.482447		960.6280011	0	686.5306929		434.94873		354,380,986,951,186.00	19,955,551,991,556.90	374,336,538,942,743.00	66,551,797,342,966.60	34,609.64	84,373.14	99.8%
9977	0.364170869		135.0758339		0.127668139		0.882726724		1127288.568		572.5620687		2619.452336		951.4580926	0	708.1695411		441.7501542		349,993,382,209,352.00	51,486,089,369,740.50	401,479,471,579,093.00	45,245,161,888,835.40	23,529.32	84,601.51	99.8%
9978	0.1980711		133.4169839		0.198547002		0.809449025		1730066.105		579.0812432		2680.118371		929.4876375	0	673.7069488		430.8673657		679,950,852,000,407.00	41,183,435,329,776.10	721,134,287,330,183.00	115,896,143,150,254.00	60,270.70	85,181.54	99.8%
9979	0.327984496		115.0452211		0.177506543		0.781401754		1707591.267		401.9127974		2634.233326		962.0320939	0	1020.071462		530.1800561		492,241,304,470,671.00	31,722,230,799,618.00	523,963,535,270,289.00	72,675,798,500,245.10	37,794.37	86,100.37	99.8%
9980	0.176994626		131.4463266		0.200759744		0.89132249		780050.3331		463.9852561		2680.981563		945.2361521	0	894.4600798		496.4649228		299,325,863,032,027.00	13,021,405,477,517.90	312,347,268,509,545.00	55,891,943,279,869.00	29,066.08	86,246.66	99.8%
9981	0.398642481		139.9917231		0.171884998		0.792788495		1137108.871		688.1109644		2621.16474		933.6733407	0	787.5516095		465.8516089		428,302,306,233,705.00	73,030,904,491,812.20	501,333,210,725,517.00	68,315,898,941,743.00	35,527.04	86,353.73	99.8%
9982	0.094782362		114.0387895		0.18391096		0.868917347		1114764.083		664.3456013		2615.22816		947.8641003	0	877.8164953		491.8242709		649,821,491,569,769.00	9,466,752,462,173.17	659,288,244,031,943.00	105,356,518,617,750.00	54,789.67	87,613.82	99.8%
9983	0.377767728		121.5229829		0.122636478		0.75538743		1415127.377		496.8327528		2656.096827		930.0418578	0	822.9928278		476.2183361		414,361,374,834,583.00	42,874,387,302,592.80	457,235,762,137,176.00	42,357,431,129,993.20	22,027.58	88,237.47	99.8%
9984	0.065078911		133.2260444		0.106599217		0.761038251		821792.7912		812.6597974		2666.253097		939.4277604	0	682.3816274		433.6324264		529,836,682,144,206.00	9,083,960,602,177.28	538,920,642,746,383.00	43,720,520,229,010.60	22,736.45	88,271.53	99.8%
9985	0.15294847		118.1587094		0.136792689		0.728094315		1057333.306		311.8082419		2679.827305		981.96385	0	596.1960678		405.3243003		219,116,537,278,445.00	7,897,872,133,145.10	227,014,409,411,590.00	22,610,176,414,020.30	11,758.21	89,108.70	99.8%
9986	0.123377442		127.4310689		0.131868527		0.757707841		1238551.045		635.4313787		2612.570166		961.1942652	0	747.2004871		453.7604723		606,316,032,330,180.00	18,504,130,987,990.10	624,820,163,318,170.00	62,430,666,504,503.40	32,466.48	91,398.66	99.9%
9987	0.080642562		139.0060791		0.193798202		0.845623986		1518762.464		383.4375019		2698.849495		947.2844422	0	1055.006102		539.1822339		597,138,520,665,003.00	10,972,414,364,191.90	608,110,935,029,195.00	99,657,468,059,954.80	51,825.93	91,746.03	99.9%
9988	0.517703059		132.4367956		0.15310824		0.874415086		1329322.378		412.0316875		2658.182258		936.1223986	0	810.528843		472.598485		248,114,030,617,225.00	58,181,742,841,257.00	306,295,773,458,482.00	41,006,925,510,905.60	21,325.27	91,813.32	99.9%
9989	0.267688332		134.3707438		0.197215938		0.730361176		817672.9854		567.117113		2689.414564		980.6274335	0	761.3620392		458.0403078		310,732,533,440,608.00	27,664,793,826,045.60	338,397,327,266,654.00	48,742,366,642,692.20	25,348.01	92,780.77	99.9%
9990	0.049479691		136.2572159		0.174230386		0.835962047		941609.6895		477.4048045		2605.185098		937.963552	0	643.8528817		421.2126542		341,841,927,600,796.00	4,905,973,064,032.38	346,747,900,664,828.00	50,503,828,354,669.60	26,264.04	94,762.52	99.9%
9991	0.302405962		130.2963629		0.099990575		0.814573783		1258154.774		534.1172981		2636.048706		947.3474767	0	852.8614642		484.7829464		450,185,622,114,609.00	40,474,661,745,259.20	490,660,283,859,868.00	39,964,133,318,541.20	20,782.97	94,943.50	99.9%
9992	0.287368146		136.6914077		0.187287489		0.84508334		636627.1974		608.8543839		2657.056052		926.1312919	0	757.0479404		456.7407694		248,856,909,098,498.00	24,445,748,098,319.60	273,302,657,196,817.00	43,256,578,078,613.60	22,495.18	96,230.11	99.9%
9993	0.166809102		124.4549438		0.078853701		0.841972314		907786.1573		789.4674594		2680.823722		938.9049763	0	881.2951611		492.7978233		594,717,163,697,859.00	20,857,176,777,904.00	615,574,340,475,763.00	40,869,601,530,115.10	21,253.85	97,516.89	99.9%
9994	0.27803948		132.0304879		0.181460336		0.882007238		1044577.442		402.4316895		2667.692253		968.6288183	0	970.3622592		517.1005938		318,497,404,364,667.00	24,622,426,398,360.30	343,119,830,763,027.00	54,916,098,995,371.60	28,558.60	98,315.37	99.9%
9995	0.259485887		124.3307074		0.141276976		0.830529261		1014944.957		491.8566372		2630.620701		936.1654525	0	936.6218617		508.0310229		374,619,478,915,417.00	22,471,306,430,244.60	397,090,785,345,661.00	46,592,513,419,537.00	24,230.00	99,662.01	99.9%
9996	0.319766343		119.6368139		0.106299992		0.886478689		652511.8747		310.0902652		2629.068698		937.5283439	0	690.8594446		436.3178068		116,042,382,986,151.00	10,050,061,709,426.50	126,092,444,695,577.00	11,882,028,715,351.50	6,179.14	100,141.82	100.0%
9997	0.157351092		126.8791404		0.166594404		0.769022748		875748.5884		567.4077276		2619.716982		922.838018	0	982.3808		520.2930456		434,670,398,275,414.00	14,139,233,043,441.80	448,809,631,318,856.00	57,499,194,795,255.80	29,901.92	102,322.69	100.0%
9998	0.438934807		138.7799465		0.167774411		0.851642899		734693.3172		750.0976018		2602.369011		973.7139314	0	673.6053525		430.8348766		254,068,803,393,928.00	57,870,966,985,185.50	311,939,770,379,113.00	44,571,166,451,588.20	23,178.82	104,776.54	100.0%
9999	0.177829432		123.9045394		0.184856224		0.776432311		1550812.211		570.9589437		2682.02231		952.2445336	0	989.3259167		522.1289588		776,926,393,258,230.00	27,517,053,511,853.10	804,443,446,770,083.00	115,460,436,515,763.00	60,044.11	104,797.91	100.0%
10000	0.226376899		105.7793838		0.161954727		0.766375568		1301864.897		556.0516867		2688.111031		927.0099684	0	647.4610719		422.3912558		463,898,412,888,653.00	16,369,914,195,415.80	480,268,327,084,069.00	59,610,014,230,071.10	30,999.63	105,614.13	100.0%