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When disasters hit sustainability

Seda KUNDAK
Istanbul Technical University Faculty of Architecture, Istanbul, TURKEY

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Abstract
"Sustainable development is development that meets the needs of present without compromising the ability of future generations to meet their own needs" (UN, 1987). In the last 20 years following this statement, world population suffered by numerous natural and man-made disasters so that they strived to protect their own existence prior to the future. However, most of the disasters were caused by un-sustainable attitudes of politicians, decision makers and communities. In this paper, the concept of sustainability will be discussed related to economic effects of probable earthquake in Istanbul. The study focuses on the economic losses by two different earthquake scenarios where replacement costs of damaged housing units and business interruption have been discussed. The results show that even in the worst case, there are always prevention measures to be taken to reduce impacts of an extreme event. In the case of Istanbul, the risks are not expanded homogenously in the city wide. Therefore, pioneered by the previous comprehensive strategic plans, the probable economic losses which reflect the current situation can be diminished in short or medium term period.

Keywords: *Economic sustainability, economic loss estimation, Istanbul, earthquake*

1. Introduction

The idea of sustainability often emerges in catastrophic events and scarcity of resources. Once Hans Carl von Carlowitz first mentioned about "sustainability" in 1712, his main focus was to prevent un-controlled consumption of forests to obtain necessary timber for mining industry. Likewise, Rachel Carson (1962) argued that the usage of pesticides gave great damages on both flora and fauna of a given region which would cause exponential impacts for human being as well. The main reason of high consumption of non-renewable resources might be described as the rate of population growth. In 1968, Paul R. Ehrlich underlined that in the 1970s and 1980s hundreds of millions of people will starve to death because of the over population growth. Unfortunately, his predictions came true and in Ethiopia close to 8 million people were affected and over one million people died because of famine in 1984-1985. In one hand, while human being creates circumstances to increase vulnerability in their living places, on the other hand, nature produces hazards which are able to affect large territories. In relation to the population growth rate in the entire world, Tucker et al. (1994) revealed that *"… in 1950, about 1 in 4 of the people living in the world's fifty largest cities was "earthquake-threatened" while in the year 2000, about 1 in every 2 will be. Further, of those people living in earthquake-threatened cities in 1950, about 2 in 3 were located in developing countries, while in the year 2000, about 9 in every 10 will be*". This statement especially targets crowded cities in developing countries where natural facts are underestimated, standards in quality of life are not achieved and regulations are mismanaged. This vicious circle affects human activities at every level and mainly economic life.

Economic losses by severe earthquakes can cause long-term reductions in the growth of a nation's economy and trigger inflation. Therefore, evaluation of the economic losses can be considered regarding to their share in country's gross national product (GNP). Coburn and Spence (1992) argued that "*the poorer nations with lower GNP, tend to be more vulnerable to the economic impact of a costly earthquake, even though in absolute terms, the cost of the damage may not be as high as elsewhere*". As seen in Table 1, earthquakes in Nicaragua (1972) and El Salvador (1986) caused $2.0 and $1.5 billions damage respectively. These costs are quite low comparing with those in Italy (1980) and USSR (1988). However, while $45 billions loss is representing 6.8% of the GNP in Italy, in Nicaragua, $2.0 billions loss is equivalent to 40% of the GNP (Table 1).

Table 1. *Economic losses by major earthquakes (Coburn and Spence, 1992)*

Country	Year	Billions $ damage	Loss (%GNP)
Nicaragua	1972	2.0	40.0
Guatemala	1976	1.1	18.0
China	1976	6.0	1.5
Romania	1977	0.8	3.0
Yugoslavia	1979	2.2	10.0
Italy	1980	45.0	6.8
Mexico	1985	5.0	3.0
Greece	1986	0.8	2.0
El Salvador	1986	1.5	31.0
USSR	1988	17.0	3.0
USA	1989	8.0	0.2
Iran	1990	7.2	7.2
Philippines	1990	1.5	2.7

The aim of this paper is to emphasize the threats on economic sustainability on a given case of probable earthquake in Istanbul. In the second section of the paper, the scope of loss estimation techniques will be introduced. Section 3 evaluates Istanbul as an earthquake-prone metropolis and gives information on past earthquakes occurred in this region. In the section 4, probable losses due to a severe earthquake which would affect Istanbul will be discussed in terms of impacts on housing units and business activities. In the last section, results of the study will be evaluated.

2. Scope and benefits of loss estimation models

Natural disasters, especially earthquakes, can be devastating to human activities, to social organizations at every level and to economic life. After the first shock, the damage is counted by deaths and injuries. In a while, the destroying effects of disaster appear on economic asset of the region. The most obvious consequence of an earthquake is the physical destruction of the built environment. Beside the damages in houses, work places, schools, hospitals, centers of administration and historical buildings, the physical destruction may also extend beyond buildings to infrastructure (lifelines). Transportation systems, power, gas, water and communication lines may be destroyed. As a consequence of this physical damage, economy of the region is disrupted as well. In order to estimate probable future losses in earthquake-prone regions, loss estimation techniques have been developed. Loss estimation techniques have been studied with every aspects and consequences by engineers, economist, architects, urban planners, sociologists and so on. The sum of all these studies shows that losses caused by disasters are multi-faced. Numerous loss estimation techniques and their empirical application have been examined in various research fields. Different types of loss estimation studies are used depending on the nature of the problem and the purpose of the study. As the main aim of these techniques is to calculate probable losses regarding to any event, loss estimation models used in earthquake hazard have been developed as well to estimate impacts of any earthquake at any intensity in any place.

Bendimerad (2001) has defined loss estimation models as a powerful tool for risk assessment which provides urban planners and emergency managers with key information on potential damages and losses. His study emphasizes the difficulty in gathering inventory data required in loss estimation techniques, and proposes “tiered classification” which provides different layers of resolution in data (i.e. first tier of data for building occupancy: residential, commercial, etc; second tier of data represents the type of occupancy such as single family houses, retail trade etc.). Sharma (2001) argued that loss estimation is of great importance following a disaster. He emphasized the importance of developing a comprehensive database of economic, social, and demographic information to estimate the extent of losses caused by earthquake. This information will be invaluable for several purposes, including planning of relief and rehabilitation measures after a disaster and will also assist the government in monitoring the effectiveness of rehabilitation measures over time. Champell et al. (2002) developed a seismic hazard model for Taiwan that integrates all available seismic hazard information in the region to provide risk managers and engineers with a model they can use to estimate earthquake losses and manage seismic risk.

Kunreuther (2000) has investigated risk management strategies for reducing losses from natural disasters and providing financial resources to victims of these devastating events in both developing countries and emerging economies. Chen et al. (1997) have proposed a “quick and approximate estimation” of earthquake loss using with detailed local GDP and population data. Their study argues that gross domestic product (GDP) of a country or a region is considered the better exposure indicator than gross national product (GNP) which includes GDP plus the net factor income from abroad and property income. The same research group has applied their model in various case studies (Chan et al. 1998, Chen at al. 2002). Moat et al. (2000) presented a comparative study on the performance of industrial facilities in three earthquakes (Kocaeli, Athens and Chichi) occurred during 1999 and they extracted key lessons which will be able to reduce the risk. Spence et al. (2003) practiced loss estimation models to explore discrepancies between the model predictions and field observations from the 1999 Kocaeli earthquake. Rose and Lim (2002) investigated business interruption losses from electricity lifeline disruptions following the Northridge Earthquake. They compared the model results with a questionnaire survey as an attempt at model validation. Kunnumkal (2002) evaluated the direct and indirect economic losses from a large earthquake at national scale with special consideration for the effects of damage to the road transportation network.

In many studies, loss estimation techniques have been practiced using built environment. However, Olshansky and Wu (2001), beside the calculations of losses in current land uses, investigated how planned future land-use growth would affect the earthquake risk. They found that planned growth of 14.2% would result in a 15.8% increase over the risk to current land uses. The results of this study are important for both local governments and planners "*to be sure that they are not disproportionately planning future growth for hazardous locations*". It is obvious that earthquakes have impacts not only on the local production but also on foreign tourism and other international exchanges. Mazzocchi and Montini (2001) showed the effects of the earthquake, occurred in Central Italy in 1997, on tourism business and they found out that the monetary loss related to the average tourist's expenditure exceeded $71 million between the period October 1997-June 1998.

Studies on economic impacts of earthquakes have been usually examined in two categories: a) loss caused by destruction of built environment (direct loss), and b) loss caused by interruption of economic activities (indirect loss). The loss estimation of built environment can be made by calculating the cost of reinstatement of all that was destroyed or rendered unusable by the earthquake. Likewise, the loss of production to the region's economy can eventually be estimated; however, this estimation can not be so precise because of the complexity of fiscal asset of the settlements (Rose, 2004).

3. Earthquake-prone metropolis: Istanbul

1300 km-long North Anatolian Fault system, extending from east side through the west side of Turkey has been studied by numerous researchers in order to explore its characteristics (Ambraseys 1970, Barka 1992, Papazachos et al 2002, Stein et al. 1997). The common point of these studies is that North Anatolian Fault (NAF) can produce major earthquakes with high frequency of occurrence. For instance, while the San Andreas Fault in California, as a close analogue of NAF, produced just two severe earthquakes (M>6.7) in 20th century, NAF suffered ten such shocks. During the 20th Century, in Turkey, 130 devastating earthquakes occurred, and as the consequences of these earthquakes 80.633 people were killed, 54.380 people were injured and 441.611 housing buildings were destroyed (Bagci et al, 1994). The earthquake occurred in Erzincan in 1939 with the Mw=7,9, was the most destructive earthquake experienced ever with 32.962 deaths and 116.720 destroyed buildings. A similar earthquake occurred in Kocaeli in 1999 with the Mw=7,4. The Kocaeli earthquake was felt in the whole North Anatolia Region, and its effects expanded on about 8 provinces surrounding the earthquake epicenter. Aftermath of this earthquake, another earthquake occurred at Duzce – Kaynasli, nearby of the affected region with the Mw=7,2 which caused severe losses. Stein and his colleagues described the progressive failure of the North Anatolian Fault as "failing dominoes" due to its earthquake characteristic with faulting from eastward through westward (Stein et al. 1997) (Figure 1). According to their argument, 1999 earthquakes were expected as the next failures on the NAF. Referring scientific researches and earthquake experiences, it is well known that the gaps between ruptured zones are likely to produce earthquakes according to their seismic features. Aftermath of the Kocaeli earthquake occurred in 1999, the probability of occurrence of a severe earthquake, which would affect large territory including Istanbul, has been calculated regarding to earthquake catalogues and tension accumulated on the NAF due to most recent seismic events. In the following 30 years from 1999, it has been estimated about 62% of probability of occurrence of a big earthquake affecting southern Istanbul, whereas about 32% of probability for the following 10 years (Barka 2000, Parsons et al. 2000).

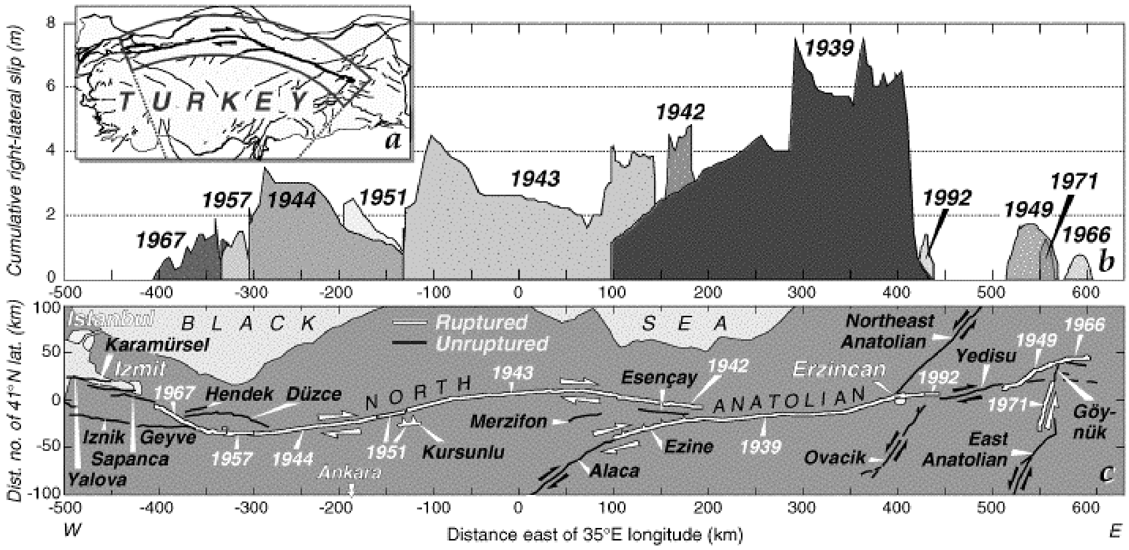

Figure 1. *The North Anatolian Fault System with major earthquakes (Stein et al. 1997)*

Istanbul, due to its strategic location and historical background as the capital of three empires, has been the heart of national and international economic activities in Turkey. In the beginning of 1950's, the development of Turkish economy reinforced the dominant economic role of Istanbul in all over the country. In this period, the rapid population growth due to migration from rural part of the country caused rising density and expending urban area. However, the planning processes remained insufficient against this "rapid development" and Istanbul gained a complex and uncontrolled urban pattern. Today, within its 12 million inhabitants, Istanbul is the most populated city in Turkey. Moreover, Istanbul undertakes several leading roles in cultural, financial, commercial, tourism and service functions. This feature of the city certainly reflects on nation's economy. Istanbul's contribution to tax revenues reaches 42% (IMM), its contribution to the budget is 34% (IMM) and its share in GDP exceeds 20% (SIS).

Expansion of urban land in Istanbul showed linear development in the southern part of the city, from the eastern side to western side, parallel to NAF. Both population and building density increased in the fringes of the city. Newly developed sub-centers and industrial areas enabled to change mono-centric structure of Istanbul to poly-centric structure. Despite, this development process tends to arrange inner-city flows and protects forest land in the northern part of the city, earthquake vulnerability increased in Istanbul. When 1999 Kocaeli earthquake hit the Marmara Region, in Istanbul, Avcilar (in south-west) and Tuzla (in south-east) were the most affected districts with collapsed buildings.

After the Kocaeli and Düzce earthquakes (1999), which occurred in the most industrialized region in Turkey, total economic losses reached about $22 billion which represents 12% of GDP in 1999 (SED 1999). The probability of seismic hazard for Istanbul has not been over within these earthquakes. Several researches indicate that according to the historical seismicity of the region, a major earthquake is expected in Marmara Sea which will severely affect Istanbul. Researches carried by local government, institutions and universities accelerated in this period. A research team from the Bogazici University worked on the "Earthquake Risk Assessment of Istanbul Metropolitan Area" within the funds provided by American Red Cross in the year 2002. A comprehensive project named "A Disaster Prevention/Mitigation Basic Plan for Istanbul" was carried by Istanbul Metropolitan Municipality (IMM) in cooperation with Japan International Cooperation Agency (JICA). In this research, probable earthquake intensities and their impacts on built environment were examined. The study started right after the earthquake and final report has been released in the end of 2002. In 2002, the Metropolitan Municipality of Istanbul signed a memorandum of agreement with the Bogazici, Istanbul Technical, Middle East Technical and Yildiz Technical Universities to develop a comprehensive earthquake risk mitigation master plan. The Earthquake Master Plan for Istanbul was established to make an overall assessment of the current situation; seismic assessment and rehabilitation of existing buildings; address urban planning legal and financial issues; ensure that social and educational issues and risk and disaster management issues (IEMP, 2002). Following negotiations between the Earthquakes and Megacities Initiative and Istanbul Metropolitan Municipality in 2004, the Municipality decided to have the Earthquake Master Plan for Istanbul (IEMP) evaluated by an International Team of Experts. The experts emphasized the importance of IEMP for the reduction of risk in Istanbul and considered the Zeytinburnu Pilot Project as the laboratory of this plan. The Zeytinburnu Pilot Project Framework is in response to the IMM and JICA report and the IEMP. The project is the first phase of the implementation of the IEMP (Turkoglu and Kundak, 2006).

4. Probable economic losses for Istanbul

Despite the magnitude of historical earthquakes affected Istanbul are not too precise, researchers could estimate the range of earthquake scales according to their impacts narrated in essays or diaries by eye witnesses of the period. Another constrain in loss estimation is that Istanbul has no experience with a major earthquake (except 1999 earthquakes) and the city has never been as big as it is today. Therefore, each estimation model, made to assess risks, is established on other estimations such as magnitude, site response, vulnerability curves etc. The reliability of the numbers is always a discussion but not in this paper. The main challenge in economic loss estimation is that big metropolises have complex economic system where interconnections among businesses cannot be clarified enough. Consequently, the economic losses referred in this part are for losses on destruction of houses and interruption of business activities caused by probable "major earthquake".

Kundak (2004) demonstrated the spatial distribution of economic losses in Istanbul. Two earthquake models developed in IMM & JICA Project and their three-leveled damage ratios (heavily-moderate-partly damaged) were used in order to express losses in built environment. Therefore, economic losses were calculated in three different damage levels of two different earthquake magnitudes (Model A: most probable-case scenario- Mw=7.5 and Model C: worst-case scenario-Mw=7.7) for both in case of housing and business units. Housing that has collapsed or is too heavily damaged to be inhabitable will need to be demolished and rebuilt at an estimated cost of US$20.000/unit. Furthermore, contents cost of housing unit which refers all the equipment of a house is also added. According to insurance compensations of an average house, it is about US$20.000/unit. Housing with moderate damage is estimated to cost US$ 8.000/unit for repairs and light damage reparable at US$3.000/unit (World Bank Report, 1999). The data set representing losses caused by business interruption includes number of business units and the share in GDP (2001) of each neighborhood. This data enable to calculate indirect losses caused by earthquake (Kundak, 2004).

In the maps which were produced by Kundak (2004) to indicate neighborhoods where the losses would be high are concentrated mostly on the south-western side of the city. The Asian Side, on the other hand, seems relatively safer comparing to the European Side due to planned settlements and soil conditions. Moreover, both population and business activities are taken place in the European Side of Istanbul.

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When the most probable-case scenario (M7.5) occurs on the NAF, the expected economic loss in Istanbul can be $26.04 billions. In this case total damage cost of housing units can reach $17.46 billions and $8.57 billions of losses from interruption of business activities. If the worst-case scenario (M7.7) occurs on NAF, the expected economic loss in Istanbul can be $29.87 billions with losses of $20.07 billions in housing units and $9.79 billions from interruption of business activities. In comparison with the most probable-case scenario, in the worst-case, total cost increases just $3.03 billions. However, if damage ratios of these two scenarios are compared, the second one can create mega-disaster with its damages on urban facilities, infrastructure, and industrial areas. Furthermore, comparing with the GDP of Istanbul in 2001 which was around $31 billions, these estimated values are rather high if one considers damages on lifelines, probable secondary hazards damages (fire, flood) etc. are excluded (Kundak, 2004).

Table 2 is designed to realize some crucial points about probable economic losses which Istanbul might be faced with. At the both earthquake scenarios, some neighborhoods give red alert in terms of economic and physical losses. For instance, the neighborhoods, where expected losses in housing are higher (more than $100 millions in each neighborhood), are represented about 4.2% (Mw=7.5) and 5.2% (Mw=7.7) of the neighborhoods respectively. In these zones, estimated losses, however, are nearly one fifth and one quarter of the total. The losses might be caused by interruption of business activities point out very remarkable facts. Neighborhoods which would face with great damage on business activities are few in number, but their contribution to GDP is nearly half of the total losses due to interruption of business activities. A similar indication is for total losses as well.

Table 2. *Distribution of probable economic losses on housing and business activities according to earthquake models*

	MODEL A							MODEL C							
		Total Loss		Number of Neigborhood		Number of Housing Units			Total Loss		Number of Neigborhood		Number of Housing Units		
		#	%	#	%	#	%		#	%	#	%	#	%
HOUSING	<20	2.684,5	15,4	334	54,0	930.049	29,3	<20	2.562,9	12,8	310	50,2	817.553	25,7
	20-40	4.291,9	24,6	147	23,8	900.446	28,3	20-40	3.993,1	19,9	138	22,3	788.324	24,8
	40-60	3.053,7	17,5	63	10,2	539.712	17,0	40-60	3.768,7	18,8	78	12,6	570.609	18,0
	60-80	2.116,6	12,1	31	5,0	275.499	8,7	60-80	2.501,9	12,5	36	5,8	364.892	11,5
	80-100	1.501,8	8,6	17	2,8	178.142	5,6	80-100	1.867,2	9,3	21	3,4	184.387	5,8
	>100	3.816,0	21,9	26	4,2	353.404	11,1	>100	5.383,7	26,8	35	5,7	451.487	14,2
	TOTAL	17.464,5	100	618	100	3.177.252	100	TOTAL	20.077,5	100	618	100	3.177.252	100
		Total Loss		Number of Neigborhood		Number of Business Units			Total Loss		Number of Neigborhood		Number of Business Units	
		#	%	#	%	#	%		#	%	#	%	#	%
BUSINESS	<10	1.608,8	18,9	429	69,4	268.907	42,7	<10	1.590,0	16,2	396	64,1	236.156	37,5
	10-20	1.110,7	13,1	81	13,1	111.163	17,6	10-20	1.333,6	13,6	100	16,2	121.133	19,2
	20-30	872,2	10,3	36	5,8	58.220	9,2	20-30	953,4	9,7	39	6,3	62.290	9,9
	30-40	806,9	9,5	23	3,7	41.314	6,6	30-40	765,4	7,8	22	3,6	36.729	5,8
	40-50	774,3	9,1	17	2,8	53.315	8,5	40-50	653,7	6,7	15	2,4	27.908	4,4
	>50	3.333,7	39,2	32	5,2	96.921	15,4	>50	4.500,6	45,9	46	7,4	145.624	23,1
	TOTAL	8.506,6	100,0	618	100,0	629.840	100,0	TOTAL	9.796,7	100,0	618	100,0	629.840	100,0
		Total Loss		Number of Neigborhood		Population			Total Loss		Number of Neigborhood		Population	
		#	%	#	%	#	%		#	%	#	%	#	%
TOTAL	<20	2.480,8	9,5	253	40,9	2.017.605	23,1	<20	2.239,2	7,5	224	36,2	1.688.120	19,3
	20-40	4.531,3	17,4	153	24,8	2.179.258	24,9	20-40	4.496,0	15,0	152	24,6	2.001.127	22,9
	40-60	4.253,8	16,3	87	14,1	1.483.203	17,0	40-60	4.625,9	15,5	93	15,0	1.571.204	18,0
	60-80	3.077,6	11,8	44	7,1	862.102	9,9	60-80	3.119,7	10,4	45	7,3	880.564	10,1
	80-100	2.426,0	9,3	27	4,4	669.116	7,7	80-100	3.030,7	10,1	34	5,5	610.043	7,0
	>100	9.273,3	35,6	54	8,7	1.525.689	17,5	>100	12.362,5	41,4	70	11,3	1.985.915	22,7
	TOTAL	26.042,8	100	618	100	8.736.973	100	TOTAL	29.874,0	100	618	100	8.736.973	100

As seen in the spatial distribution of losses by Kundak (2004) and the Table 2, the losses are not homogenous in the city wide. This situation has two facets. In a pessimistic point of view, some neighborhoods may receive great damages where impacts can last very long time. A complete destruction of inner zones of the city may negatively affect surrounding areas like waves. In an optimistic point of view, regarding to take necessary measures in both prevention and preparedness, these zones have already been pointed out in several studies including this one. Therefore, according to the strategic plan produced by the IEMP in 2002 and benchmarking of the Zeytinburnu Pilot Project, the steps in achieving safer settlements can be followed.

5. Conclusion

The expected economic losses represented in this study include only housing and work places indicators and are equivalent to nearly 20% of country's GDP. Other losses in infrastructure, facilities etc. can increase these costs. Regarding to economic sustainability framework, it is obvious that a large scale earthquake occurred nearby Istanbul will be able to affect not only the city but also fiscal asset of the country. The results of Istanbul case point out the emergence of a comprehensive planning process by means of spatial re-organization and administrative adjustment. Planning and implementation processes in Istanbul require long time and big budget.

Moreover, achievement of these attempts requires a well organized control and feedback system as well.

In the study area, most of the housing unites and work places are in private property so that the reinforcement process should be handled by their owners. However, despite the citizens are aware of the hazard, their risk perception remains insufficient because of various reasons. Some of them argue that "if the expected earthquake will cause a great disaster resulting through the collapse of the majority of buildings, so why shall we throw our money away to reinforce the buildings? Moreover there is no guarantee that the earthquake will occur when we are staying at home…". This is another version of the fatalist approach which has been experienced during the earthquakes of 1999s. Some of the citizens blame local and central authorities arguing that they had permitted low quality buildings and illegal settlements, so they should provide financial assistance to proprietors with reinforcing their properties. This overriding behavior drives the community not to be willing to pay more for a probable earthquake.

Sustainability measures should be well perceived by all the levels of the community. Regarding to natural hazards, in the recent literature, instead of "disaster management", "risk management" is mentioned to be achieved. This means, when the community is ready to hazards (natural or man-made), they do not need to manage disaster, because large impacts would be prevented in advance due to risk management strategies taken. The same approach is for achievement of sustainability as well. Instead of mentioning about sustainability in scarcity, the sustainability culture should be assimilated in daily life to prevent long term losses and consumption of non-renewable resources.

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Afetler ve sürdürülebilirlik

Sürdürülebilir kalkınma kavramı, Birleşmiş Milletler tarafından 1987 yılında hazırlanan "Ortak Geleceğimiz" başlıklı raporu takiben 1990'lı yıllardan bu yana çeşitli bilim dalları tarafından tartışılmış ve ortaya konulan ölçütlerle gerçek hayata bütünleştirilmeye çalışılmıştır (UN, 1987). Ancak son 20 yılda, dünyanın bir çok yerinde insanlar gerek doğal gerekse teknolojik afetlerin etkisini en şiddetli şekilde yaşamıştır. Böylesi bir durumda geleceği düşünerek hareket etmekten çok, kendi varlıklarını sürdürme çabası içine girmişlerdir. Öte yandan, sürdürülebilir kalkınma tek bir bileşenini geliştirmeyi hedefleyen vizyon sahibi olmayan girişimler uzun vadede ekonomik sürdürülebilirliği de imkansız kılmaktadır.

Depremler sonucunda oluşan ekonomik kayıplar incelendiğinde gelişmiş ve gelişmekte olan ülkeler arasında ciddi farklar göze çarpmaktadır. Örneğin 1972 Managua depremi yaklaşık 5 milyar dolarlık zarara neden olmuştur ve bu kayıp Nikaragua'nın GSMH'nın yaklaşık %40'ına karşılık gelmektedir. 1987 Loma Prieta depremi 8 milyar dolarlık ekonomik kayıpla sonuçlanmıştır ancak bu miktar Amerika Birleşik Devletleri GSMH'nın sadece %0.2'si ile temsil edilmektedir (Coburn and Spence 1992). Türkiye'den yakın tarihli bir örnek vermek gerekirse, 17 Ağustos 1999 Kocaeli depremindeki maddi kayıp 22 milyar dolar düzeyindedir ve GSMH'nın yaklaşık %12'sine karşılık gelmektedir (SED). Depremler açısından gelişmiş ve gelişmekte olan ülkeler arasındaki en büyük farklardan bir diğeri depremin etkilerinin azaltımı çalışmalarına ayırdıkları kaynaklardır. Dünya genelinde depremin etkilerinin azaltımı ile ilgili yapılan tüm harcamalar incelendiğinde gelişmekte olan ülkelerin sadece %2'lik bir orana sahip olduğu görülmektedir (Tucker ve diğerleri 1994).

Gerek nüfus, gerekse ekonomik yapı anlamında Türkiye'nin kalbi durumunda olan İstanbul, bir çok çalışmada da belirtildiği gibi deprem tehditi altındadır. Olası bir depremin yaratacağı anlık kayıpların yanında, etkileri uzun vadede çok daha net görülebilecek ekonomik kayıpların da olması beklenmektedir. İstanbul, başta 1509, 1766 ve 1894 depremleri olmak üzere, pek çok kez çeşitli büyüklüklerde depremlere maruz kalmıştır. Tarih boyunca, en önemli ticaret ve ulaşım aksının üzerinde yer alan, sayısız uygarlığa ev sahipliği yapmış İstanbul, bugün de dünyanın en önemli kentlerinden biridir. İstanbul, Türkiye nüfusunun yaklaşık %13'ünün yaşadığı, ekonomik faaliyetleri ile ülkenin gayrısafi yurtiçi hasılasının %20'i oluşturan ve toplam vergi gelirlerine %42'lik bir katkısı olan bir büyük şehirdir (IBB, TÜIK). Şehir genelindeki sanayi ve hizmet üretim düzeyinin yüksek olması, ulusal ve uluslar arası anlamda İstanbul için artı bir değer olmasına karşın, deprem olasılığı göz önüne alındığında kaybedilme ihtimali olan ekonomik gücün de ne kadar fazla olduğu sonucu ortaya çıkmaktadır.

Bu çalışma kapsamında, Istanbul Büyükşehir Belediyesi ve Japan International Cooperation Agency (JICA) tarafından hazırlanan deprem senaryoları (2002) ve bu senaryolara bağlı hasar düzeylerinden yola çıkılarak, 7.5 ve 7.7 büyüklüğündeki depremlerin konut alanlarında ve çalışma sektöründe neden olacağı doğrudan kayıplar tartışılmaktadır. Senaryo depremlerine bağlı üretilmiş olan hasar düzeyleri ağır hasarlı, orta hasarlı ve hafif hasarlı olarak gruplanmaktadır. Ağır hasarlı ya da tümüyle yıkılmış bir konut biriminin yıkılarak yeniden yapılma maliyeti yaklaşık 20.000 Amerikan Doları'dır. Yine ortalama gelir düzeyindeki bir ailenin sahip olduğu ev eşyaları, sigorta şirketlerinin belirlediği bedellere göre 20.000 Amerikan Doları seviyesindedir. Bir başka değişle, bir konut birimi kullanılamayacak şekilde hasar gördüğünde içindeki eşyalarla beraber toplam kayıp 40.000 Amerikan Doları'na ulaşmaktadır. Orta hasarlı bir konut biriminin güvenlik koşulları sağlanarak tekrar kullanılabilir hale getirilebilmesi için 8.000 Amerikan Doları; hafif hasarlı bir konut birimi için ise 3.000 Amerikan Doları masraf yapmak gerekmektedir (Dünya Bankası Raporu, 1999). Olası bir depremin ardından, faaliyetlerine devam edemeyecek durumda olan iş yerlerinin yaratabileceği kayıplar, iş yerlerinin gayrısafi yurtiçi hasıladaki oranları dikkate alınarak hesaplanmıştır (Kundak 2004).

Senaryo depremlerin yaratacağı hasar düzeylerine göre yapılan hesaplamalar sonucunda, 7.5 büyüklüğündeki bir depremin 26,04 milyar Amerikan Doları, 7.7 büyüklüğündeki bir depremin ise 29,87 milyar Amerikan Doları seviyesinde ekonomik kayıba neden olabileceği ortaya çıkmaktadır. Hesaplanmış olan kayıpların büyük bir bölümünü konut alanlarındaki kayıplar oluşturmaktadır. 7.5 büyüklüğündeki bir depremde konutlardaki kayıp 17,46 milyar Amerikan Doları iken, 7.7 büyüklüğündeki bir depremde bu miktar 20,07 milyar Amerikan Doları'na yükselmektedir. Yine benzer şekilde, iş yerlerinin maruz kaldıkları hasar nedeniyle 1 yıl süreliğine ekonomiye katkı sağlayamayacakları varsayımından yola çıkılarak hesaplanmış olan kayıp 7.5 büyüklüğündeki bir depremde 8.57 milyar Amerikan Doları, 7.7 büyüklüğündeki bir depremde ise 9,79 milyar Amerikan Doları'dır (Kundak 2004). İş yerlerindeki kayıplar hesaplanırken, iş yerlerinin sahip oldukları donatı ve ekipmanların değerleri dikkate alınmamıştır. Bu değerler ve bazı iş yerlerinin ürettiği ürünlerin bir diğerinin girdisi olması durumu da dikkate alındığında, depremin ekonomik etkilerinin uzun vadede zincirleme reaksiyona sahip olduğu görülecektir.

Daha önce de belirtildiği üzere, bu kayıplar sadece hasar görecek konut birimleri ve iş yerleri üzerine hesaplanmış oranlardır. Şehir içindeki altyapı sistemleri, donatı alanları, ikincil tehlikeler ve dolaylı ekonomik kayıplar dahil edildiğinde bu rakamların daha da yükseleceği görülmektedir. Öte yandan, İstanbul'un 2001 verilerine göre gayrısafi yurtiçi hasılaya katkısının 31 milyar Amerikan Doları olduğu gözönüne alındığında, olası ekonomik kayıpların sadece İstanbul için değil, tüm ülke ekonomisi için de çok ciddi boyutlarda olacağı açıktır.

Her iki deprem senaryosunun hasar düzeylerine bağlı ekonomik kayıp tahminlerinin mekansal dağılımı incelendiğinde, mahallelerin yaklaşık %5'inde ekonomik kayıpların 100 milyon Amerikan Doları'nın üzerine çıktığı görülmektedir. Bu mahallelerdeki kayıpların toplamı, Istanbul genelinde hesaplanmış toplam ekonomik kayıpların neredeyse ¼'ünü oluşturmaktadır. Öte yandan, gerek iş yeri sayısı, gerek gayrısafi yurtiçi hasılaya katkısı ve gerekse hasar oranı yüksek olan mahallelerde hesaplanmış olan ekonomik kayıp düzeyleri, Istanbul'un ülke ekonomisine katkısının yaklaşık yarısını oluşturmaktadır.

Çalışmanın bulguları, olası bir depremin sadece Istanbul'un değil tüm ülkenin ekonomik durumuna hasar vereceğini göstermektedir. Ancak ekonomik kayıpların kentin geneline eşit olarak dağılmaması ve belli noktalarda yoğunlaşması, gerekli önlemlerin alınabilmesi açısından önem taşımaktadır. Bu alanlarda yapılacak acil müdahaleler ile depremin neden olacağı kayıpların azaltılması mümkündür.

Ekonomik sürdürülebilirlik çerçevesinde bakıldığında, İstanbul'un büyük bir depremden zarar görmesi ülkenin ekonomik yapısını etkileyebileceği görülmektedir. İstanbul gibi büyük bir şehirde zarar azaltımına yönelik önlemlerin alınması ve uygulanması yalnız idarenin gücünde gerçekleşebilecek bir eylemler zinciri olamamaktadır. Bu noktada halkın bilgi ve bilinç düzeyinin artırılarak katılımının sağlanması önem taşımaktadır.

Sürdürülebilirlik kavramı, toplum her kesiminde doğru bir şekilde algılanmalı ve sürdürülebilirliği sağlamaya yardımcı eylemler gündelik hayatla bütünleşebilmelidir. Doğal tehditler çerçevesinden bakıldığında, son yıllarda, afet yönetiminin yerini risk yönetimi almış durumdadır. Bu durum aslında yeni bir yaklaşım tarzının göstergesidir. Deprem sonrası yaşanan yıkımının yönetimine hazırlıklı olmak yerine, daha bu yıkım olmadan önlem alarak hasar ve kayıpları en aza indirmek bir kültür olarak yerleşmektedir. Benzer yaklaşım sürdürülebilirlik için de kullanılabilir. Düzeltilemez ya da geri dönülemez noktalara gelindiğinde sürdürülebilirliği anmak yerine, sürdürülebilirlik kültürünü oluşturarak toplumun her kesimine yaymak, uzun vadede her türlü kayıpların önlenmesine ve herşeyden önce insan yaşamının "sürdürülebilir" olmasına yardımcı olacaktır.