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AN ASSESSMENT OF FLOOD RISK FACTORS IN RIVERINE CITIES OF TURKEY: LESSONS FOR RESILIENCE AND URBAN PLANNING (1)

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1. This paper is based on the author's PhD thesis completed under the supervision of Prof. Dr. Murat Balamir in 2009. However, in the course of preparing the paper, the references as well as the data and information have been updated to the extent possible.

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INTRODUCTION

Significant amount of the world's population is under a severe risk of hydro-meteorological disasters, and this is expected to continue in an increasing rate due to climate change as observed in the last sixty years. From 1955 to 1975, annual average of worldwide flood events were around 15, while two decades later this average almost quadrupled as reaching 57 events per year. It is followed by another increase in the last twenty years and reached up to 156 events per year (CRED EM-DAT, 2016). Weather-induced natural events like typhoons, storms, cyclones, heat waves, floods and droughts are expected to increase in occurrence and to spread out more extensively in the near future. It is mainly the coastal and riverine cities that are at most risk of weather-induced natural events. The increasing concentration of economic activities and human populations in such cities is likely to intensify the economic and social impacts of such events in years to come (Nicholls et al., 2007). According to estimations of Jongman et al. (2012) global economic exposure to both river and coastal flooding would increase at high rates in 2050, reaching to 158 trillion USD. As the Intergovernmental Panel on Climate Change (IPCC) states in its 5th Assessment Report, there has been a remarkable increase in number of heavy precipitation and flood events worldwide during the past century (IPCC, 2014). Thus, it is of vital importance for cities to find out ways to cope with adverse impacts of climate change, including various sorts of floods. Cities, which develop and employ appropriate policy responses to address flood risks and introduce new and alternative ways of living with flood hazards as part of their mitigation and adaptation actions, would probably become more resilient against today's and upcoming flood disasters.

Turkey, as a disaster prone country, has earthquakes on top of the list of the most destructive disasters happened so far. However, based on reported losses since 1900, floods are the second most frequent and effective disasters among others (**Figure 1**).

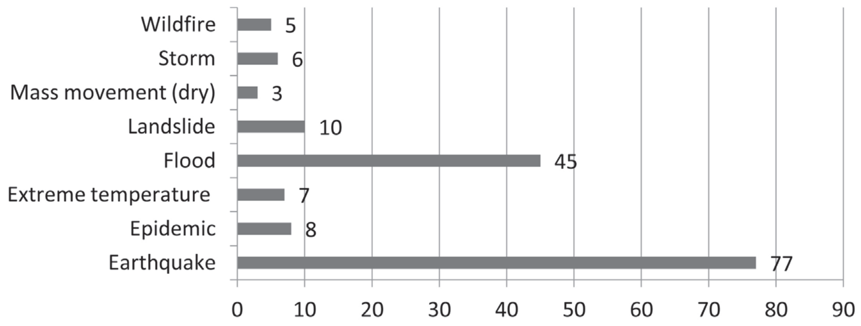

Figure 1. Number of events in Turkey by disaster type from 1900 to 2016 (CRED EM-DAT 2016)

2. Data and information are based on the recent interview with officials of the State Hydrological Works (SHW), conducted in 2015.

Most of the cities in Turkey are prone to flood risk, and their vulnerabilities are increasing, although several protective measures like detention dams, river reclamation and drainage projects have been implemented. Almost all cities have been affected at least once by a flood event as per records since 1955 (Gökçe et al., 2008). Specifically from that year, based on the official records, around 43 flood events have taken place annually, and these events have led to 25 casualties and inundation of 42,000 hectares land every year (**2**). As of 2015, CRED EMDAT (2016) estimated the annual average economic loss by floods in Turkey at around $296 million.

One reason for flood losses in Turkey might be the increase in occurrence and impact area of extreme events due to climate change, yet more scientific research that reveal the direct impacts of climate change in Turkey are required (Balaban and Şenol-Balaban, 2015). Another reason might be the shortcomings of the prevailing urban planning system, which considers flood issue as a technical problem to be solved by structural measures. Based on the second assumption, one can assert that most of the Turkish riverine cities of today have chronical flood disaster histories and that this trend will most likely continue in future, if there is no considerable change in urban development and planning practices in Turkey. In order to discuss this assertion, this paper has been developed based on the findings of a PhD research completed and submitted in 2009 (Şenol-Balaban, 2009). The paper investigates into the flood issues of the four selected Turkish cities in an historical manner with the intention to identify urban planning experiences, institutional circumstances and growth-related factors that contributed to flood risks and associated vulnerabilities. To do this, it is necessary to find out the major reasons behind continual flood losses in the selected cities in the light of international up-to-date experiences and academic literature. Therefore, the main purpose of this paper is to reveal the major causes of flood losses in four Turkish riverine cities that are known to experience continual flood events and disasters. The similarities and differences among the case cities with regard to flood effects and approaches to risk management are also identified and discussed, keeping in mind the different features of case cities, such as climatic conditions, population, land area occupied, location within the river basin.

FLOOD RISK MANAGEMENT ISSUES IN THE LITERATURE

Current literature on flood risk management (hereafter FRM) including river basin management and land-use planning describe the framework that defines mainstream approaches to cope with flood risks and achieve resilience. International experiences of risk mitigation and management are also informative and helpful, despite the variety of mitigation examples in different countries. So, within the scope of this paper, the practical experiences of some leading European countries will help constitute the main focus of the literature review.

Risk Management In River Flooding: Definitions and Main Aspects

The United Nations-International Strategy for Disaster Reduction (hereafter UNISDR) defines the term of risk in the context of disaster management is simply defined as the probability that a hazard will turn into a disaster (UNISDR, 2004). As being a function of hazard and vulnerability, disaster risks can be managed by a sequence of such actions as identifying the possible damages, estimating how much risk is concentrated in particular places and taking the necessary measures to reduce risks before the real event occurs (UNISDR, 2009a; Kaplan and Garrick, 1981; Mileti, 1999; Balamir, 2001). In order to mitigate disaster risks in effective and economic ways, priorities are defined in three sub-areas of disaster management, which are risk avoidance, risk reduction and sharing of risks (Balamir, 2000; Balamir, 2009).

The contemporary approach to FRM that is still being developed and becoming widespread in many countries is based on integrating structural and non-structural mitigation measures within the whole watershed (basin) area where the hydro-meteorological system belongs (Sayers et al., 2015). After the Mississippi flood disaster, Cigler (1996) claimed that depending on structural measures alone may solve the problem in the short term but it may lead to even more severe impacts in the long run. Based on the lessons learnt from the critical turning points in the history of flood events in various countries, it is widely acknowledged in the related literature that (Sayer et al., 2015) the wise combination of structural and non-structural measures in a holistic manner is crucial. Furthermore, climate change adaptation efforts have led to diversification of measures of FRM as well (European Environmental Agency-EEA, 2012). The structural measures in this respect are usually grouped in two categories; namely grey and green infrastructure, whereas the non-structural measures are also referred to as the soft measures. As mentioned in EEA (2012), grey infrastructure includes physical interventions or construction measures like dams, levees, dikes, embankments, channel alterations, elevation etc., while green infrastructure prefers more room for rivers by naturalization of rivers and more use of vegetated elements; like parks, gardens, wetlands, natural plantation, green roofs and green walls (**3**). Soft measures that can facilitate the implementation of grey or green measures cover management policies, land-use plans, programs, insurance procedures, information dissemination, financial incentives and capacity building etc.

According to the previous academic work (**Figure 2**), FRM process requires a comprehensive information base of climatic conditions that could be generated by means of a dynamic and holistic modeling, detailed recording of precipitation and discharge rates, and regular monitoring for identification and assessment of the risks (Cigler, 1996; Pilon, 2003; Schanze, 2006; Merz, 2007; Samuels et al., 2010; Sayers et al., 2015). Although high rainfall quantities may have a direct impact on flood events, floods do not necessarily cause losses merely due to rainfall quantities. Therefore, such factors as inundation depth (by discharges from a flood frequency curve), flow velocity (geomorphology), duration of flood situation (rate of soil infiltration, drainage capacity based on land-use), and rate of water rise (rainfall intensity) have be taken into consideration when delineating flood prone areas (Frampton et al., 1996; Merz, 2007).

3. The policy shift in the Netherlands since 1993 and 1995 floods (Room for River, 2016).

On the other hand, studies on flood vulnerability focus on determination of monetary values of the assets as well as on the population that would probably be affected. Since the depth of flood water on flood prone areas is the major determinant, such studies are conducted on an assumption of how much of a dwelling unit or building would be affected. Jongman et al. (2012), for instance, suggest various ways to formulate vulnerability calculations.

International Agenda and Resilience

As the international disaster policy has shifted its main concern to pre-disaster mitigation of risks, it is commonly agreed that necessary policies such as estimating possible risks in settlements, developing scenarios for future state of cities, and considering socio-spatial countermeasures need to be embraced in order to survive towards today's natural hazards (Yokohama Conference, 1994; Kobe Conference, 2005; and Hyogo Framework of Action, 2005-2015). Moreover; the term resilience that is frequently used by studies that focus on climate change adaptation measures has gained more attention recently, as in the example of the Third UN World Conference on Disaster Risk Reduction held in Sendai. Resilience is basically defined as "the ability of a system, community or society exposed to hazards to withstand, absorb, accommodate to and recover from the effects or impacts of a hazard in a timely, faster and effective manner, including through the preservation and restoration of its essential basic structures and functions" (UNISDR, 2009b). The Sendai Framework for Disaster Risk Reduction (2015-2030), which was adopted in the 2015 Sendai Conference, underlines that more investments have to be made on disaster risk reduction for resilience in order to achieve sustainable human settlements in the near future (**4**). The recent developments in the literature on disaster management have expanded the definition of the term of the disaster risk. Recently, disaster risk is not solely defined by the interaction of hazard and vulnerability but also by inverse effects of the coping capacity of a place, community or institution, setting a direct link with resilience (UNISDR, 2012).

Contemporary Approaches to FRM Framework

Through centuries, the most common measures to deal with flood disasters have been protective walls, levees, dunes heights of which were defined depending on the highest water level observed in previous events (Cigler, 1996; Jorissen, 1998). However, each consecutive flood event has shown that only with structural measures flood disasters cannot be prevented sufficiently and that more devastative losses could occur contrarily. In addition, "so-called absolute safe areas" behind the levees usually leads to high attraction of economic investments and dense populations, which, in the long term, may result in high dependency on such structural measures as dikes as in the case of Netherlands (Jorissen, 1998). The 1993 Mississippi flood disaster, which has been the milestone for FRM in the U.S., occurred due to the failure of protective levees (Cigler, 1996). Likewise, in the Netherlands, the disastrous floods in 1993 and 1995 have paved the way for a reform of flood mitigation methods by integrating risk management strategies into flood issues (Jorissen, 1998). Today's prevailing approach relies on the notion of living with floods rather than the conventional idea to keep floods away from human life. The current approach acknowledges the importance of spatial planning in flood risk mitigation and rests on the idea that flood risks could be reduced through spatial planning. It explores new ways to live with floods with the help of spatial planning

4. For the Sendai framework document see: Prevention Web (2016).

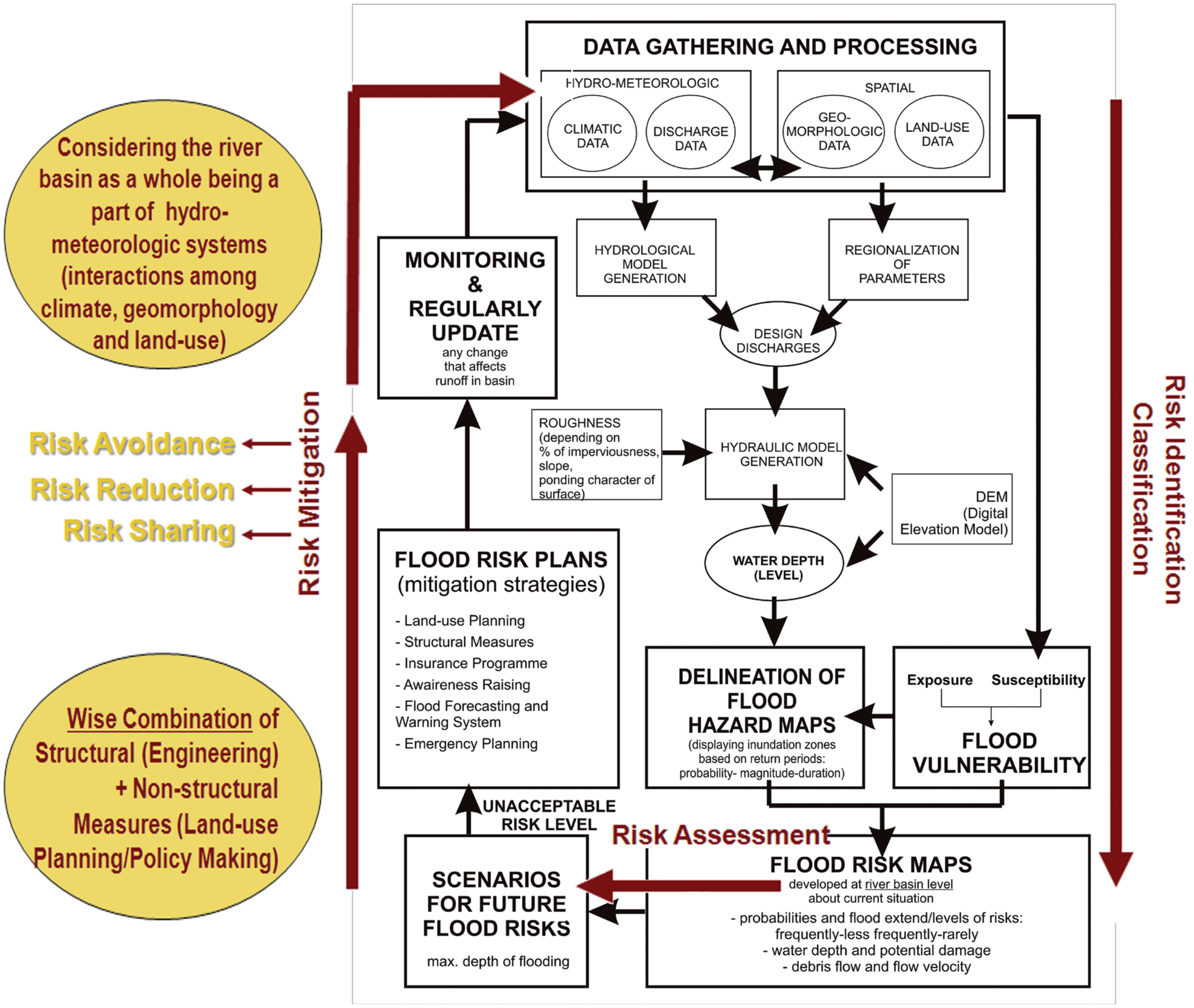

Figure 2. Conceptualization of river FRM process (Cigler, 1996; Balamir, 2000; Pilon, 2003; Schanze, 2006; Merz, 2007)

rather than to focus on flood protection that depends simply on structural engineering solutions. The international agenda also highlighted that flood risk management should be a strategic instrument beyond being just a regulatory task (Woltjer and Al, 2007; Friesecke, 2004; Tonelli and Sironeneau, 1996).

Adverse impacts of climate change, which have become evident in recent decades, are now paid great attention and placed on the agenda of many countries. The human and economic losses of the flood events that took place in Europe in July 1997, August 2002 (Kundzewicz et al., 2005) and August 2005 (**5**) have led many European countries to establish a concerted and a coordinated action at the level of major river basins. To this aim, the FRM Directive of EU (Commission of the European Communities-CEC, 2007) sets a number of principles and guidelines to be adopted by each member state. According to these guidelines, flood risk maps should be prepared and considered when deciding on urban planning activities, and FRM plans for each basin should be developed and implemented in a coordinated manner through all administration levels. Besides, public awareness should be raised and active participation of all stakeholders should be ensured by provision of flood risk maps and plans. As of 2015,

5. See the link, 2005 Alpine Floods (Air Worldwide, 2016).

based on concerted actions, most of the flood risk management plans and screening processes were completed in order to develop maps through EU countries that share major river basins (EC Report, 2015; Government of UK, 2016).

Concluding Remarks

The key steps and main principles of flood risk mitigation and management in cities are summed up below. The following highlights for dealing with flood disasters have been utilized as guiding principles and analytical framework in the conduct of the empirical research presented in this paper. They are also refereed to while criticizing the shortcomings of the legal and administrative framework of FRM in Turkey.

- FRM framework requires three major steps;
    - Identifying flood hazard, vulnerability and coping capacity (resilience) of a flood prone area,
    - Assessing the levels of risks,
    - Mitigating the risk levels by avoiding, reducing or sharing them.
- Risk mitigation measures should be considered and governed within a watershed (river basin area) in an integrated and holistic manner based on the wise combination of structural and non-structural measures (in other words; green, gray infrastructure and soft measures which were explained above).
- Such an integrated and a comprehensive basin management system necessitates commitment of all stakeholders as well as existence of an autonomous and a powerful administration and governance at the basin level. Other administrative units like provinces and districts within a particular basin should cooperate and work in close contact, similar to the framework that is defined by FRM Directive of EU.
- The most recent policies, strategies and instruments argued in the literature includes;
    - The effective use of risk maps/plans for development decisions and implementation of counter measures for risk avoidance, reduction and sharing,
    - The naturalization of river channels and regeneration of riversides,
    - The allocation of more room/space along the riverside for rivers to flood safely,
    - The provision of sustainable urban drainage and separate rain water storage systems,
    - The development of adaptable flood prevention measures like green roofs, water plazas.

METHODOLOGY

The Context of The Research and Selection of Case Cities

Turkey has 26 major river basins; most are under the risk of flooding (Gökçe et al., 2008). **Figure 3** presents the distribution of flood events and flooded areas since 1955 based on the records of the General Directorate of Disaster Affairs and the State Hydraulic Works (hereafter SHW) (**6**).

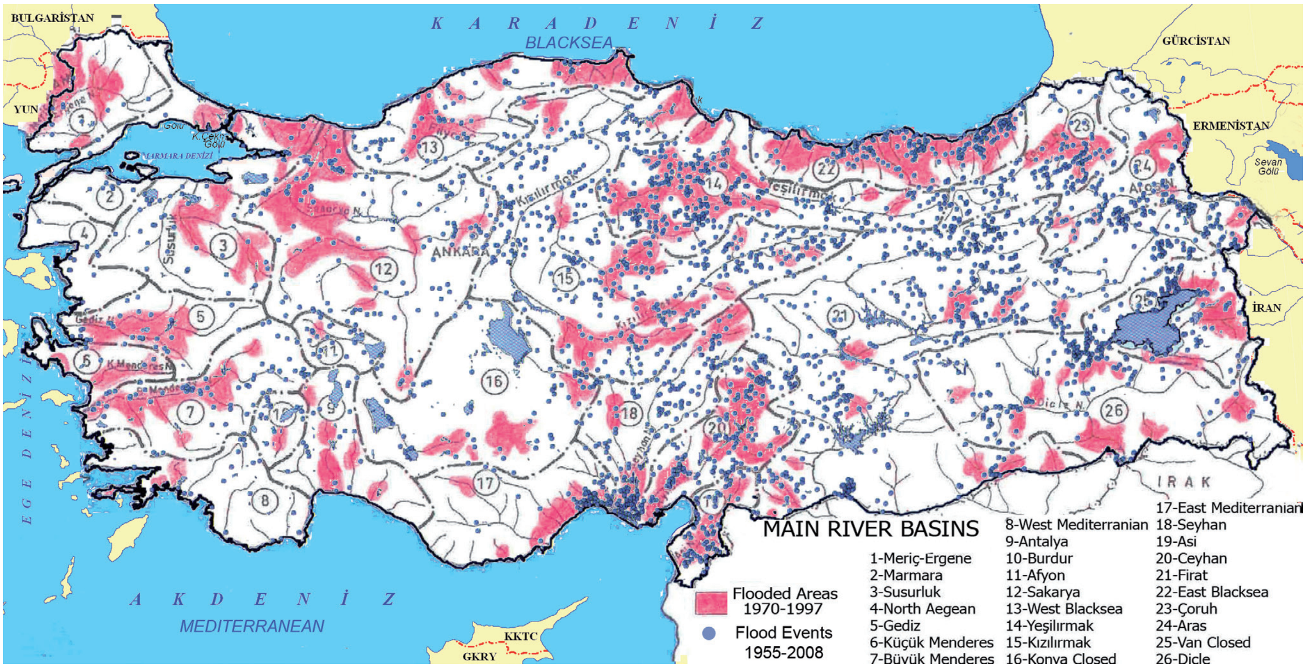

Figure 3. Distribution of flood events and flooded areas in major river basins (Superimposed by the author based on SHW, 1998; Gökçe et al., 2008)

As the most widespread hydro-meteorological hazards in Turkey, floods turn into disasters in two-ways. First of all, rivers usually overflow from their inadequate beds when heavy rainfall occurs. Second, inner city inundations in terms of flash floods are observed after sudden rainfall due to inadequate drainage and infrastructure systems. **Figure 3** shows the settlement centers (represented by dots) and flooded areas that experienced a flood event at least once since 1955. It is obvious that most of the riverine cities in Turkey are prone to chronic flood disasters and under the threat of loss of lives and properties.

Floods are triggered by climatic conditions that vary across different geomorphologic terrains due to shape of the basin and the river network (Benda et al., 2004). The extent of flood events, on the other hand, depends on land use decisions, which affect directly the capacity and velocity of river flow, soil infiltration and retention on basin (Frampton et al., 1996). Therefore, the case study analysis focused not only on the physical settings and history of flood events in case cities but also on the history of urban planning and development processes that have affected the occurrence and extent of flood disasters. So, case cities were selected among cities which have continual flood history based on official archives. Besides, it was intended to select cities with few similarities in geomorphologic and climatic settings in order to reveal common planning decisions in different settings (**Figure 4**).

At this stage, major river basins (26 in total) of Turkey were taken into consideration. First of all, statistical data for a long time period (1950 - 2005) on nation-wide flood events have been employed, and flood losses by major river basins and cities were considered (**7**). Although Sakarya Basin and East Black Sea Basin are known for higher occurrence of and vulnerability to flood events, they were excluded due to several reasons like extreme annual precipitation pattern of East Black Sea region and few flood disasters that were observed in recent years as a result of major dam projects. West Black Sea Region, which was also found in a leading position

6. In 2009, General Directorate of Disaster Affairs was terminated due to establishment of a new central agency, named Disaster and Emergency Management Presidency (AFAD), to work for risk and disaster management issues.

7. Statistics regularly prepared by SHW are based on number of flood events, flood extent/impact area and casualties.

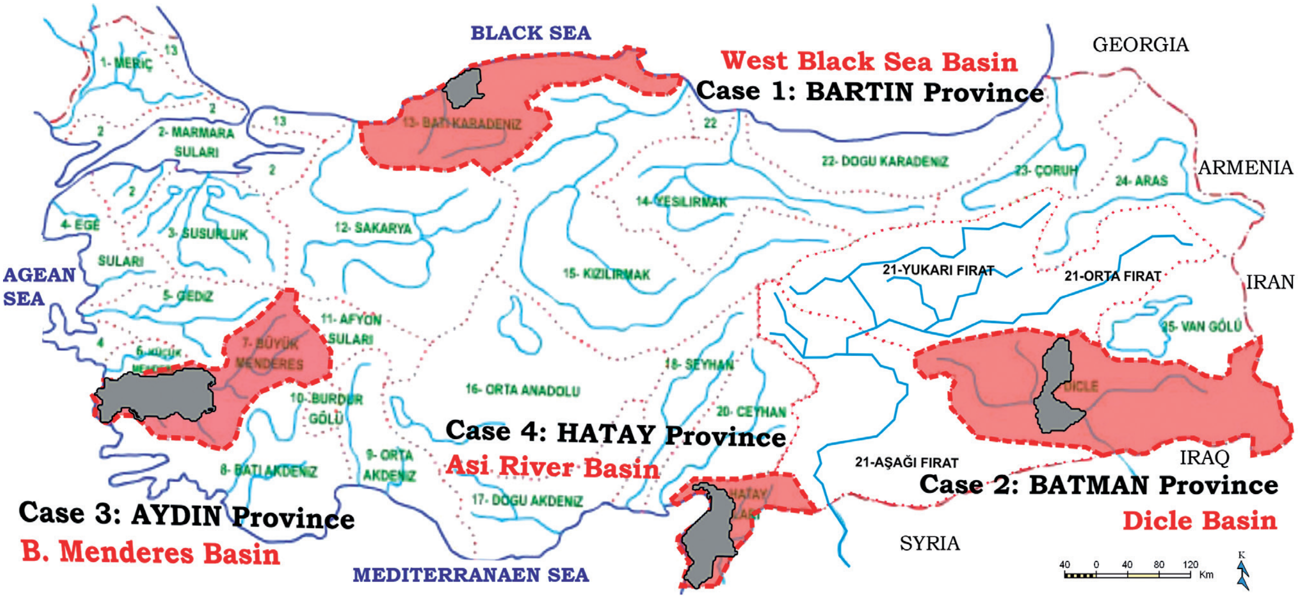

Figure 4. Location of case study cities.

Table 1. Grouping of provinces with respect to population sizes

Population Size	Number of Provinces	Case Study Areas
>= 1.000.000	19	Hatay
500.000 – 999.999	20	Aydın
250.000 – 499.999	25	Batman
<= 249.999	17	Bartın

	Case 1	Case 2	Case 3	Case 4
	Bartın	**Batman**	**Aydın**	**Hatay**
Provincial Population 2000 Census and 2012 Address Based Population Registration System (TurkStat, 2013)	184.178 188.436	456.734 534.205	957.757 1.006.541	1.253.726 1.483.674
Total Number of Municipalities – Villages in Province	9 – 265	12 – 270	54 – 493	76 – 362
Total Area of the Province	2140 km²	4654 km²	8007 km²	5403 km²
Climatic Classification by Thornthwaite Index (TSMS 2013)	B2 [60-40]: Humid	D [(-20)- (-40)]: Semi Dry	C1 [0-(-20)]: Semi Dry – Less Humid	B1 [40-20]: Humid
Catchment Area (km²)	29.682 km²	51.489 km²	24.903 km²	10.685 km²
Share of Province in Catchment Area	38%	67%	32%	13%
Location of City in the basin	Downstream	Downstream	Downstream	Downstream
Annual Mean Precipitation (1971-2000)	1025,7 mm	473,2 mm	601,7 mm	1084,1 mm
Annual Mean Discharge (1971-2000)	317,9 m³/sec	700,8 m³/sec	97,1 m³/sec	7 m³/sec
Major Rivers and tributaries that Regularly Flood	Bartın river; Arıt, Ova, Ulus, Kozcağız Creeks	İluh river; Çay, Savara, Aşağıkonaka, Şakuli	Büyük Menderes; Dandalas, Akçay, Çine	Asi, Afrin, Karasu
Percentage of Municipalities Exposed to Floods	66%	41%	44%	19%

Table 2. Key Information on Case Cities
Sources: SHW-OA (1950-2009); Aksu et al. (2006); TurkStat (2013)

8. Property values per m^2 of residential, mixed-use, administrative and educational buildings are based on the taxable values of properties declared by the Revenue Administration of Turkey (2006). Average household size was taken as 4 persons for residential buildings, 6 persons for mixed-use buildings, number of staff was considered as 75 people per hectare for other uses.

regarding the size of flooded area of all times, is selected as the first basin to focus on. Based on the statistical data on provincial flood losses, on the other hand, Bartın and Hatay were found to be the two leading cities, and thus selected as case study cities. Other two cases, Aydın and Batman, were selected based on the fact that they are on different climatic and geomorphologic settings and that they have faced continual flood losses, also acknowledged by the experts of SHW. Apart from data on flood events and losses, variety in discharge rates of major rivers is also used as a criterion for case study selection. Moreover, demographic figures (**Table 1**) were taken into account in order to ensure that cities with different sizes are selected so as to have a more representative sample ranging from small towns to big cities.

Table 2 provides key information on case cities with river basins that the cities belong. Bartın and Hatay are known for the high number of flood events they faced. On the other hand, Aydın and Batman are important examples regarding their population size, discharges rates and climatic classifications. Therefore, in terms of city size, river capacities and climatic classifications, the selected cases are assumed to represent an appropriate variety and an unbiased sampling.

Data Collection and Analysis

The data and information used to analyze the case studies have been obtained mainly through content analysis of various official documents. Content analysis constitutes a useful methodology for examining the documents developed over time with an aim to find out the underlying messages in these documents (Bryman, 2001). In addition, for some of case cities, the latest flooded areas that were determined by official surveys of SHW were mapped in GIS compared with existing land-uses including several calculations regarding population and monetary values of affected lands (**8**). Inventory of continual vulnerability of an area was made based on the latest flood extension delineated by the field survey of the SHW specialists or by using flood prone area boundaries delineated based on flood discharges. These areas were available only for the cases of Bartın and Batman. As the SHW does not provide any information on the likely value of assets under flood risks, this information is produced as part of the data analysis in this research. Probable values at risk (or valuation analysis of vulnerabilities) were calculated based on the assumption that all buildings and dwellings within the continual vulnerability area (or flood-prone area) will totally be affected in case of a flood event since there is no data about flood heights calculated. Based on this assumption, the numbers of buildings and their residents as well as the approximate values of the buildings under flood risk were calculated as probable values at risk. The total value of vulnerabilities was then compared to the annual budget of the municipality, as well as to the total cost of flood protection measures implemented.

The major documents and data (**Table 3**) analyzed for each city are;

a) The official archive (OA) of SHW,

b) Regional plans and development (1/5000) plans and plan reports, as well as aerial photos

c) Interviews and semi-structured questionnaires that were made with the officials working for planning and infrastructure

	Major Flood events (dates)	Documents in OA (amount)	Regional/ Territorial Plans and Reports 1/100'000 Scale (year and planner)	Master (Development) Plans and Reports 1/5000 Scale (year and planner)	Aerial Photos from National Mapping Agency of Turkey (year)	Interviews/ Questionnaires (institutions)
Bartın	15.6.1973 30.4.1975 1.5.1975 27-28.8.1983 6-7.7.1991 24-25.7.1995 17-18.2.1998 21-22.5.1998 3-4.6.2000	19	2006 (UTTA and Geotech on behalf of Ministry of Forest and Environment)	1970 (Bank of Provinces) 1980 (Bank of Provinces) 2006 (EgePlan)	1944 1969 1982 1998	- Freelance city planners who have worked for development plans - Technical staff from municipal governments as well as Regional Directorate of Bartın - Bank of Provinces Officers
Batman	1926 10-11.4.1969 30.4.1972 14-15.5.1972 1991 17.3.1995 31.10.2006 2.11.2006	33	Not applicable	1959 (Raşit Durak) 1976 (Yavuz Taşçı) 1991 (Barlas-Barlas) 2000 (Revision by Nevzat Uğurel) 2007 (Revision by Nevzat Uğurel)	1952 1984	- Freelance city planners who have worked for development plans - Technical staff from municipal governments
Aydın	30.1-1956-5.2.1956 20.3.1958 22.4.1965 5.5.1993 July 1995 6-8.9.1996 12-15.12.1997 17.5.1998 29-31.1.1999 19.12.2001 11.1. 2004 9-12.12.2007	48	2006 (Kutluay Planning Office on behalf of Ministry of Forest and Environment)	1951 (A. Kömürcü) 1959 (Plan modifications) 1986 (Esat Durak) 1993 (Revisions) 1996 (MetroPlan)	1959 1977 1993	- Former mayor - Technical staff from municipal governments
Hatay/ Antakya	1956, 25.2.1962 19.4.1965 17-18.4.1967 21.4.1967 13-14.1.1968 5.2.1968 6.4.1968 December 1968 March 1969 17.4.1969 April 1975 February 1976 April 1980 November 1986 March 1987 22.9.1987 8-9.5.2001 4-5.6.2002 15.2.2003 15-16.5.2004 16.4.2008	18	2006 (İşlem CBS on behalf of Ministry of Forest and Environment)	1948 (Asım Kömürcüoğlu) 1957 (Gündüz Güneş) 1978 (Yavuz Taşçı) 1985 (Rehabilitation Plan by Öner Mersinligil) 1997 (Öner Mersinligil)	1956 1973 1992	- Freelance city planners who have worked for development plans, - Technical staff from municipal governments

Table 3. Major documents investigated until 2008 for each case

departments of municipalities and related central government bodies as well as private urban planning consultants who prepared regional/territorial plans and development plans

The results of responses were mainly used to understand their way of solving flood issue and shortcomings in the flood management framework while considering it as a solely technical problem in the planning process. Major topics that were followed by the questions in the questionnaires and interviews are about the use of flood maps of SHW for development plan decisions and implementation; the difficulties that municipalities and other institutions face; opinions regarding jurisdictional conflicts among local governments due to sharing a one river basin as well as between central governmental bodies and local governments.

The archives of SHW constitute the main official records of all flood events take place in different parts of the country. Documents are organized as files and each file includes various official documents on flooding history of a particular province. A typical file of a province usually includes:

- Official correspondence among all other authorities,
- Base maps and urban development plans of municipalities requiring consultancy about flood protection facilities, irrigation sites and facilities and two-dimensional data about the actual flood prone areas drawn on a map without information about the depth of flood water,
- Survey reports and flood protection plans prepared by SHW in order to assess the feasibility of any of flood protection facilities,
- Damage reports, flood extension areas and visual data about a particular flood event,
- Related legal documents like decrees, laws and protocols that were used to understand the institutional framework regarding flood management

Furthermore, urban planning and development trajectory of case cities were also examined thoroughly in order to understand the likely links between flood vulnerability and urban development decisions of each city. At this step, all key documents of urban planning and development including planning surveys, analytical reports, plan decisions and reports were examined in a historical manner.

CASE STUDY ANALYSIS

Factors of Flood Vulnerabilities in Case Study Cities

Bartın is located in West Black Sea basin, which is characterized by very steep mountains parallel to coast line and receives relatively higher rainfall compared to the mean rainfall of Turkey (Usul and Turan, 2006). Most flood events occurred during spring and summer months, mainly after continuous rainfall and rapid snowmelt (SHW-OA, 1950-2009). High rainfall regime and semi-permeable soil structure are also the major physical factors that affect flood events in the region. Intense rainfall is usually followed by large volumes of water and debris dragged from upper basin, where tributaries flow on steep and narrow valleys originating from mountains in south and south-east (Tunçer, 2006). The built up area of

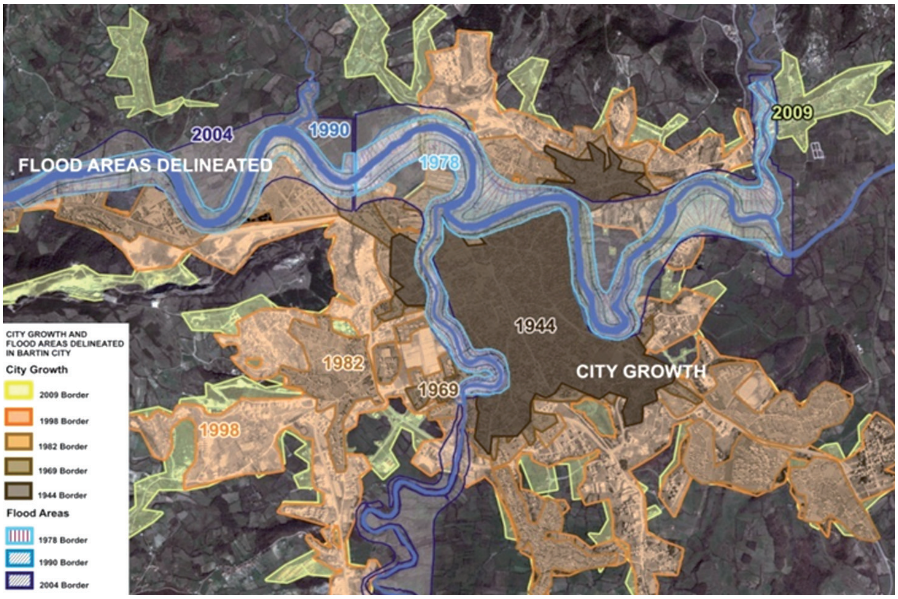

Figure 5. Bartın City

City growth schema prepared by superimposing aerial images taken by NMA from 1944 to 2009

Bartın, located 15 km away from shore, is mainly located on the delta of three valleys and partly on their slopes (**Figure 5**).

The analysis of flood history and urban growth trajectory of Bartın indicates that anthropogenic factors have been quite significant in occurrence of floods and their associated losses (SHW-OA, 1950-2009). First of all, the improper discharge of solid wastes in and around the city appears as a key factor. Discharge of solid wastes into the riverbed and high sedimentation originating from land-use change from forestry to agriculture at upper basin result in blockage of surface water runoff pathways. Likewise, the crossing bridges, which were not properly designed and constructed, constitute another blockage to the natural river channel during high river flow times. An interesting example to anthropogenic factors that reduce flow capacity of the river is the construction of military port facilities on the coast where the natural form of estuary of Bartın River has changed. Most of the flood prone areas have been occupied by the settlers without mitigation measures, as flooding issue is neglected in some of master and urban development plans of the city.

The shortcomings of urban planning in mitigating flood risks in Bartın are rooted in the history of urban development. It had been a district of Zonguldak province until 1991, the year when it was declared as a province. The rapid urban growth started in the late-1960s following the decentralization of industrial facilities from inner city to city skirts, which led to spatial expansion of commerce and service sector. During the 1970s, the settlement pattern began to change, leading to residential settlements approach to the Bartın Creek, crafts industry replaced by commercial activities and industrial facilities expand towards the Bartın Strait. The rapid urban growth in 1970s resulted in transformation of low-elevation agricultural fields into residential areas, which was prevented until 1970s. Such transformation is now one of the major causes of flood events in the city, as low-elevation agricultural plains are characterized by inadequate drainage, high groundwater level and flood risk. Although there was enough capacity to accommodate additional urban population in old settlement area at relatively higher elevation, the municipal authority encouraged and permitted the planning of low-elevation agricultural plains as new residential areas due to the demands and pressures from landowners and developers.

In the following years, the municipality welcomed similar demands for greater development rights in terms of increased heights and floor space. In addition, the 1980 Development Plan proposed new residential areas on flood-prone areas, despite the mentioning of the 1978 Flood Hazard Map in the development plan report. The land use map prepared in 2004 indicates that only a few of the proposals made by the flood hazard map were realized. After renewal of the hazard map based on the impacted areas of 1998 and 2000 floods and surveys in 2004, the 2006 Urban Development Plan designated flood-prone areas as "special project areas" in order to avoid residential developments (Uyar, 2006). However, as such zoning definition was not clearly defined in the plan so as to direct implementation plans and projects, flood prone areas were eventually invaded by new residential developments.

Aforementioned urban planning and development decisions have increased the economic value of likely flood losses in the near future in Bartın based on valuation analysis of vulnerabilities. In central district area, the economic value of properties was found under high risk corresponds to 15% of the annual budget of the Bartın Municipality. Besides, total cost of previous structural investments, which were insufficient to mitigate flood risks, is equal to 20% of the current value of vulnerabilities.

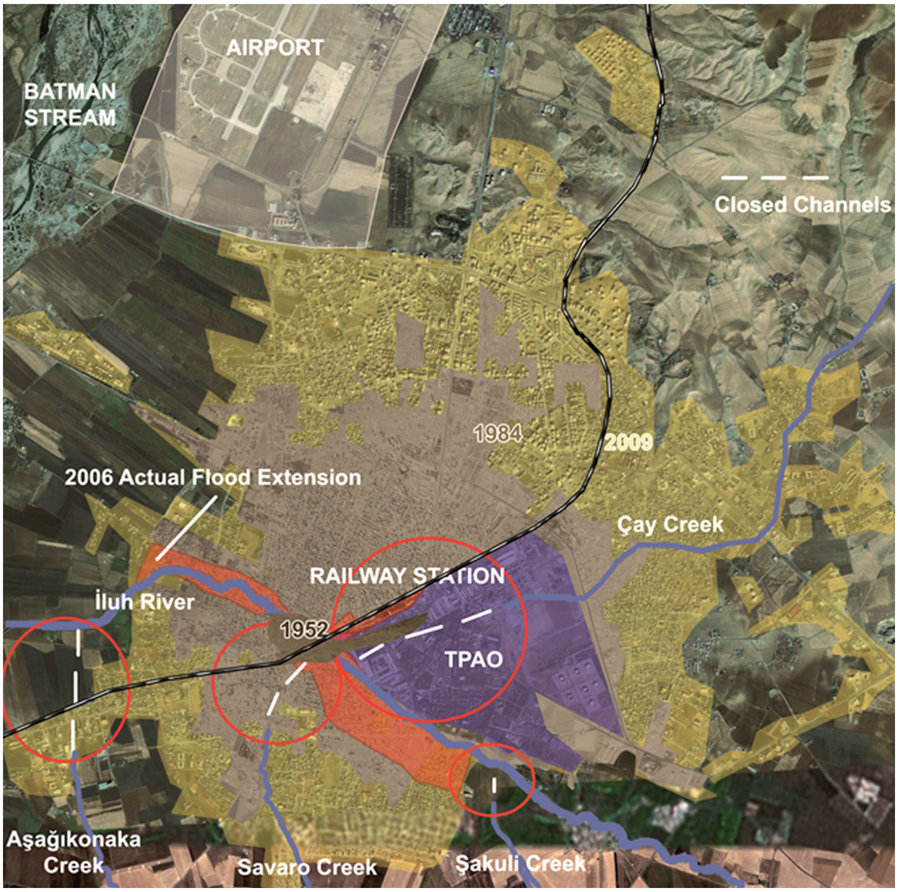

Figure 6. Batman City

City growth schema prepared by superimposing aerial images taken by NMA from 1952 to 2009

Batman city is located in Dicle Basin including two major rivers; namely Batman and Iluh Rivers in southeastern Turkey. Batman River, which defines the boundary between Diyarbakır and Batman provinces, usually inundates Batman plain in winter and spring due to its irregular riverbed. Iluh River, which discharges into Batman River in northwest of the province, passes through Batman city, the central urban settlement of the province (**Figure 6**). The city is developed on almost flat lands at 540 meters above sea level and characterized by both continental and desert climate (TSMS, 2013). The city is very poor in forest cover and the main soil type is unstable and highly impermeable, leading to quick erosion. Despite being dry in summer time, rivers in Batman province receive high rainfall in spring and autumn and cause floods due to high discharges. Such floods are mostly observed along Iluh River, which passes through the city.

From 1959 to 2007, İluh River and its tributaries were flooded 6 times causing many casualties and property losses. Although physical factors seem to be an essential part of the problem in Batman, detailed analysis of previous flood events documented in the SHW-OA (1950-2009) indicates that human actions have also affected size of flood losses. Such actions are direct discharge of waste water, construction debris and solid wastes into riverbed; installation of discharge conduits of waste water of petroleum refinery into riverbed; design and construction deficiencies of crossing bridges that block high flow of the river; partial or full cutoff connections of tributaries in dense urban areas to open up land for streets, public services and residential developments; inefficiency of existing rain water and sewage systems; ineffectiveness in maintenance and clearance of debris agglomerated on riverbeds.

Surveys made by the SHW experts after each flood event have provided municipal officials with significant recommendations to mitigate floods. Most of them were not realized due to lack of coordination between urban development decisions and FRM efforts. Three major urban development plans and revision plans were prepared over time in order to manage urban development tendencies. Neither was the concept of risk management considered in key decisions of these plans nor have the plans successfully been implemented. The rapid urban growth due to high migration from surrounding rural settlements undermined the implementation of these plans. The establishment of the oil refinery in 1954 contributed to the problem of uncontrolled urban growth. Mushrooming of unauthorized residential areas over flood plains and dry riverbeds not only increased vulnerabilities but also prevented the implementation of a critical decision of 1976 plan that was an urban green network within the built-up area (Uğurel, 2007). Such a network would have been useful to reduce surface runoff during heavy rainfall. Subsequent urban development plans and plan revisions were proved to be ineffective in solving the problem of unauthorized developments over flood plains; instead the plans legalize such developments, leading to densification of the urban core.

Valuation analysis of vulnerabilities in Batman city was made based on boundaries of the inundated area after the flood event in 2006. Current vulnerabilities and probable values at risk are calculated as 3 times higher than the total cost of previous structural investments, which remained insufficient to mitigate flood risks. One option to reduce flood risks in the city might be to relocate residents of floodplains to safer locations. However, the prevailing property ownership patterns and socio-economic profile of residents (extended families with poor household income) in flood-prone areas makes such an option difficult to realize.

Aydın city is located on lower basin of the B. Menderes Basin (**Figure 7**). As the city is developed on the northern part of a huge valley on east-west direction, mountainous tributaries on the north produce high load of sediment and debris on the way to south due to soil condition. Besides, sudden snow-melt creates high runoff on lower parts of the basin during spring seasons. Although the amount of snowfall is limited, water provided by rapid snowmelt is sometimes in extreme volumes. Throughout the valley, the annual precipitation is between 500-700 mm. while on higher altitudes this increases to approximately 1000 mm. Flood events mostly occur in spring and winter seasons. Tabakhane and Kemer Brooks, two tributaries of the B. Menderes River, are proved to cause continual flood events and associated losses in Aydın city despite improvements in structural protection measures. After each flood event reforestation and terracing of the upper basin slopes, preservation of prevailing vegetation, erosion and debris control, increasing riverbed capacities and revision of urban development plans based on river rehabilitation projects are some major preventive measures recommended by the experts (SHW-OA, 1950-2009). Due to weak enforcement, only few of them have been realized.

Similar to previous cases, certain human actions constitute a crucial vulnerability factor in Aydın city. For instance, historical records indicate that land-use change or river reclamation in settlements located on upper basin directly affected settlements in lower basin. In addition, uncontrolled and extensive sand removals from riverbeds for raw material support to construction sector have destroyed the natural runoff the main river. Thus, coordinated action within the entire basin is crucial for effective flood mitigation, as highly emphasized in contemporary risk management approaches. Particular urban development decisions and shortcomings of urban planning actions also seem to have exacerbated flood losses in this city. Highway infill at east-west direction, for instance, blocked the river flow and rainfall runoff from north to south in city center. Likewise, partial covering of the river channel in dense urban area to open up land

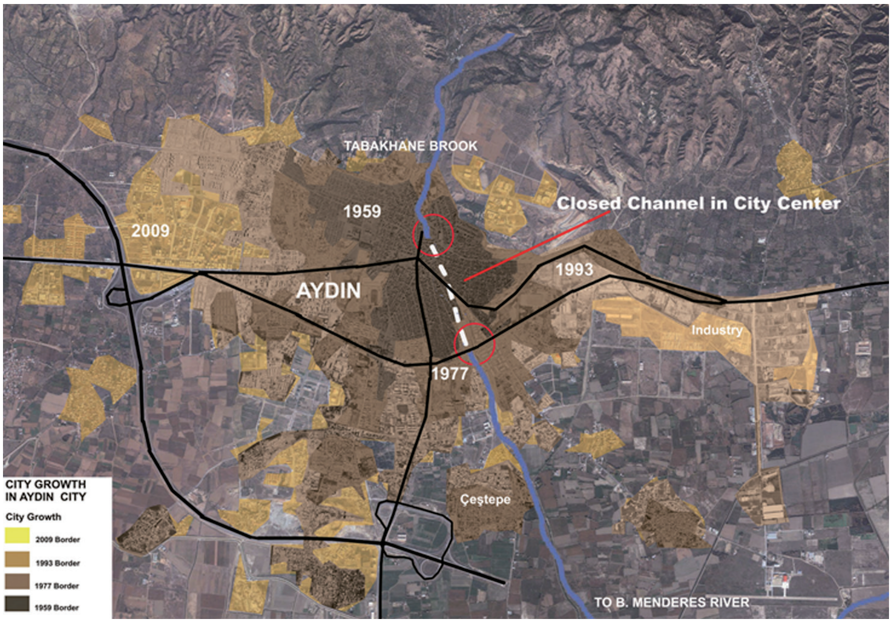

Figure 7. Aydın City

City growth schema prepared by superimposing aerial images taken by NMA from 1959 to 2009

for public services, buildings and roads by municipality is another risk and vulnerability factor (**Figure 7**). Interestingly enough, the decision on partial closure of the river channel was approved by the SHW, although it is found a major factor that affects the flood vulnerability.

The city also suffered from uncontrolled and unauthorized urban development due to rapid population increase since 1960s growing at unprecedented rates owing to economic revival based on improvements in textile industry. During rapid urbanization period, the city started to develop towards south and west where valuable agricultural lands existed. Despite the contrary decisions in urban development plans, unauthorized residential developments on southern agricultural lands continued. A critical decision of the 1993 revision to the master plan of the city is worthy of mentioning here. It concluded the increase of building floors within the city without providing additional social and technical infrastructure (Aydın Metropolitan Municipality, 1996). Such increase in development rights results in infrastructural insufficiencies especially in rain and wastewater drainage, which in turn cause flash floods during sudden and heavy rainfall.

Antakya, the central urban settlement of Hatay Province, is located in downstream of Asi River Basin. Having Mediterranean climate, which is hot and dry in summers, mild and rainy in winters, the province receives annual mean precipitation of 1000-1200 mm as of the year 2004 (SHW-OA, 1950-2009). Asi Basin is mostly large flat area surrounded by mountains from the west, south and east. The upper basin in Syria has 3 large

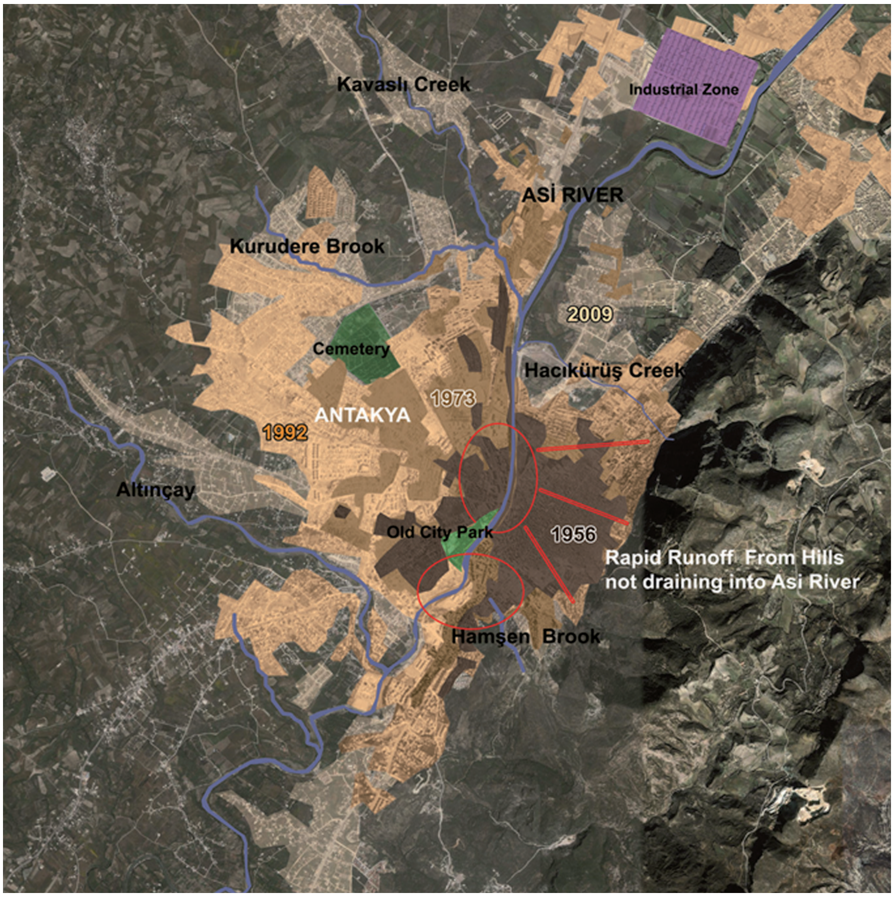

Figure 8. Antakya City of Hatay Province

City growth schema prepared by superimposing aerial images taken by NMA from 1956 to 2009

reservoir facilities on Asi River used mostly to lower flood discharges. On the other hand, 3 dams and 2 pond facilities in Hatay have been exposed to continual floods of Asi River and its tributaries. This case is different than others as the basin and some tributaries are transnational. Therefore, any actions in Syria like dam breaching and opening spillways for precaution may have significant impacts on settlements in Hatay province. High precipitation and uncontrollable rainfall volume in a very short time are also known to be the main reason of some of the previous flood events and extraordinary flood discharges.

Asi River is highly affected by river capacity shrinkage caused by high sedimentation and debris, since soil erosion is widespread due to land-use change from forestry to agriculture at certain parts of the upper basin. Besides, solid waste discharges into riverbed exacerbate such shrinkage. However, the major anthropogenic factor for continual flood events and losses is the draining of the Amik Lake to obtain land for agriculture between 1966 and 1972. Following the drainage, vacant lands were not only used for agricultural purposed but also invaded by unauthorized rural settlements, which have been exposed to floods continually since 1970. Likewise, uncontrolled urban development is also a crucial factor in vulnerability. Some parts of tributaries of Asi River have been occupied by settlements, blocking the natural connections (**Figure 8**). In addition, dense urban pattern with few green and open areas in Antakya is known to have caused losses in previous flood events.

Several urban development plans have been prepared and implemented in Antakya city since the late 1940s. The third plan (approved in 1978) brought about significant amendments to decisions of the previous plan, which had proposed new developments on northern plains where agriculture should have remained as the dominant land use. This plan also proposed to conserve historical core on eastern bank of Asi River and encouraged new high-rise developments on western bank (Mersinligil, 1996). However, unauthorized urban development could not be avoided on both sides of the river. Several rehabilitation plans were then prepared to regulate unauthorized settlements. Yet the plans were proved to be ineffective due mainly to pressures from interest groups as increased development rights, as in most Turkish cities. With the additional plans to existing master plan of the city, the municipal authorities have responded positively to demands of pressure groups and approved critical development decisions like increase in number floors and densities, reduction in setback distances, opening of urban greenery to residential development. Such decisions have paved the way to serious flood vulnerabilities and continual flood losses in Antakya. Reduction in total area of urban green spaces increased surface runoff and the increase in number of floors and densities led to inefficiencies and insufficiencies in sewage and rainwater collection network.

Overall Evaluation of The Case Studies

Although each case has its own flood history and urban growth pattern as summarized in **Table 4**, it is possible to point out common causes of flood vulnerability in all cases. Cases were evaluated based on FRM framework that was explained in the literature review section of this paper.

Based on the analysis of the selected cases, the list of common human actions that exacerbate the flood problem and increase flood losses are given below. It can be said that uncontrolled urban development, loose

		SELECTED CASE AREAS			
Criteria for FRM framework		Bartın	Batman	Aydın	Hatay-Antakya
Flood Risk Identification	Factors increasing hazard, vulnerability and decreasing coping capacity	- Solid waste disposal in river channel (RC) causing pollution and low drainage capacity - Land-use changes like forest to agriculture in upper basin area causing high sedimentation in RC - Improper design of bridges creating blockage effect during high flow - Deterioration of natural form of the estuary due to military area creating back-flow blocking discharge - Increase in urban density on low grounds	- Direct disposal of waste water, solid wastes into RC and ineffective maintenance - Design and construction deficiencies of bridges that block high river flow - Closed section solutions that block the natural connection of tributaries for providing additional space like opening up land for streets, public services and residential development - Inefficiency of rain water and sewage system that are not separated - Pipeline of oil refinery that were installed into RC decreasing discharge capacity	- More frequent and sever flood losses at lower basin settlements after land-use changes and river reclamation works in upper basin - Deterioration of natural runoff in RC due to uncontrolled and extensive sand removals from riverbed for construction sector - Infill construction works of highway causing blockage effect on river flow and rainfall runoff in the city - Closed section solution that blocks the natural flow of RC for proving additional space like opening up land for streets, public services and residential development	- Land-use changes like forest to agricultural lands along the coasts of RC in the upper basin areas causing soil erosion and high sedimentation in RC - Draining of Amik Lake in 1972 to obtain land for agricultural activity has exacerbated flood losses in following years - Some tributaries and green/open spaces occupied with unauthorized settlements - Increase in urban densities and decrease in greenery creating inefficiencies and insufficiencies in rainwater and sewerage systems that are not separated
Flood Risk Assessment	Mapping the risk levels	- Mapping only extension of actual flood events	- Mapping only extension of actual flood events	- Mapping only extension of actual flood events	- Mapping only extension of actual flood events
Flood Risk Mitigation	Avoidance (exist or not)	- After 1970 rapid urban growth on low agricultural lands creating settlements on flood prone areas, not avoiding the flood hazard	- After 1954 rapid urban growth due to migration from nearby villages after establishment of oil refinery	- After 1960 due to the attraction of new establishments of textile factories uncontrolled and urban development observed on valuable agricultural lands on south and west of the city	- 1978 Development Plan was ineffective for implementing its decisions like preserving agricultural land and historical core due to political pressure of interest groups for new development demands on flood prone areas
	Reduction	- Designated flood prone areas defined in recent development plans with low enforcement power	- Green Network Project in the master plan of 1976 but failed due to mushrooming of unauthorized residential areas on floodplains and dry riverbeds	- Reforestation and terracing of the upper basin slopes - Preservation of flora - Erosion and debris control	- Several dams, reservoirs and ponds constructed
	Sharing	- Projects regarding early warning systems (TEFER) and flood control measures covering whole river basin	- Lack of coordination between SHW and local governments - Ineffective development plans and revisions for solving problem of unauthorized developments over floodplains as well as legalizing such developments with densification of urban core	- 1993 Revision Plan offering new property rights about overall increase in number of floors within the city without providing additional social and technical infrastructure creating infrastructural inefficiencies like drainage problems of waste and rain water systems	- Several flood losses due to prompt and unexpected actions in Syria (upper basin) without noticing Turkish side

Table 4. The summary of research results

land use decisions and development controls have affected substantial flood vulnerabilities.

- Capacities of infrastructure systems were reduced and the systems have become insufficient overtime due to unplanned increase in building heights (number of floors) and densities within existing built-up areas,
- Permeable surfaces like green spaces, parks, forests and valleys in cities were gradually lost and replaced with hard surfaces due to various reasons. Besides, agricultural areas around cities were transformed into urban land uses not only for meeting the demands of increasing population but also for profit-oriented attempts.
- Riverbeds, flood-prone areas and valley bottoms were usually occupied by unauthorized developments as well as by public facilities and services including streets and public buildings. In almost all cases, it is observed that some parts of river channels within the city centers were converted to closed sections, which in turn created high flood losses due to blockage effect.
- Flow discharges of rivers were reduced by a number of inaccurate interventions like direct discharging of sewage and rainwater, damping of solid wastes and debris, and insufficient cleaning and maintenance of services.
- Infrastructural deficiencies created by such inaccurate and discrete engineering interventions as improper design of transport bridges and concrete channel constructions were observed among main sources of flood losses in most of the cases.
- Inappropriate interventions of municipalities on flood prone areas and riverbeds through urban development plans contribute much to flood losses. Besides, independent and discrete attempts for mitigation; such as river channel reclamation activities, construction of flood walls, seem to generate illusory feeling of safety, which aggravates vulnerabilities.
- Local ad-hoc interventions may temporarily solve the flood problem at a specific location. However, this may lead to transfer of flood problem to another location based on the rules of hydro-meteorological system in a basin. For instance, deforestation and inefficient or lack of erosion control at upper basin area lead to increase in rapid accumulation of debris and sedimentation in riverbeds, which then reduce the carrying capacity of river courses in areas within lower basin.

The abovementioned factors that have caused chronic flood losses in riverine cities indicate three major areas to be focused on by policy intervention in Turkey. The first one is related to the administrative framework that organizes central institutions, local governments and other local actors within a river basin. The second one relates to the types of interventions to be made, implying that policy interventions should not only include technical measures but also embrace soft and non-technical policy responses in a holistic manner. Thirdly, flood risk management together with integrated river basin management should be reconsidered as an integral part of urban planning and development rather than assuming it as an obstruct on the way of urban development.

THE DISCUSSION: POLICY IMPLICATIONS AND RECOMMENDATIONS

Figures on current vulnerabilities derived from two case cities, Bartın and Batman, show that rational decision-making is required to avoid urban developments on flood-prone areas. Once development is permitted over flood zones, potential volume of losses in terms of human life and properties increases. Besides, structural measures mostly remain insufficient to reduce risks and prevent losses. Therefore, in case of a serious flood event substantial amount of resources including the money spent on both existing urban development and structural measures are very likely to be lost. It is clear that urban development should be avoided on flood-prone areas in order to mitigate flood risks in riverine urban environments. These areas should be designated for urban functions requiring large open areas such as urban parks, sports and recreation areas. Such urban functions increase the supply of permeable surfaces within built-up areas. Therefore, an urban land-use planning approach which considers and enforces such strategic spatial decisions combined with engineering solutions in any river basin area should be regarded as the key flood mitigation tool, which is defined in the FRM framework.

The analysis of institutional system and planning legislation indicates that Turkey's current flood protection system is based on the surveys and assessments of a central authority, the SHW, as well as its limited powers of intervention. This sole responsible institution has regional directories, which are in charge of areas including several provinces but their jurisdictions do not correspond to boundaries of major river basins. Thus several directories might be responsible for management of a single river basin, leading to significant coordination problems. Besides, the responsibility of the directorates is just limited to collection or generation of data on flood events and losses, conduct of flood protection project surveys. The directorates are also in charge of assisting local governments in decision-making for land-use planning by making recommendations based on conditions in river basins. However such recommendations are of voluntary nature and mostly remain unattended by local governments. Since there is a lack of institutional organization and administrative mechanism to monitor, control and coordinate major river basins, both development decisions and partial flood protection measures in any part of the basin may cause flood losses in other parts. The municipal administrations, on the other hand, are under pressures from interest groups for more development rights and permissions according to interviews. Besides, neither urban development plans nor flood hazard maps (in case they exist) are equipped with necessary measures to mitigate flood risks.

Municipalities are not successful in avoiding urban developments in flood-prone areas, although they tend to delineate flood-prone lands and riverbeds as public areas as parks and open spaces, as become evident in interviews and questionnaires. The flood protection measures of municipalities cover only post-disaster activities like the so-called flood emergency plans, warnings and SAR activities. This is because local governments believe it is SHW's responsibility to prepare flood protection projects and avoid flood losses.

Recent disastrous events have shown that future flood events would be more frequent and destructive in cities due to climate change. Therefore, it is crucial to mitigate such impacts as much as possible and be prepared for the worse case scenarios beforehand. As highlighted in the literature review on importance of risk management concept that help identify, classify, assess and mitigate risks effectively, there is an urgent need for implementing such concept in Turkey. In particular, a need for preparation and active use of flood hazard, vulnerability and risk mapping is clear. Such maps are useful tools for directing mitigation policies both in newly developing and already developed areas. Flood hazard maps should be prepared for main river basins across the country by central governmental agency namely SHW. Local authorities have to employ such maps while preparing and implementing urban development and land-use plans. One policy option here could be to force municipalities to declare flood vulnerabilities within their jurisdictions. Such declaration could be defined as a requirement for application to special grants and subsidies, and thus could help raise awareness and curb further vulnerabilities. Moreover, local governments should conduct vulnerability analysis in order to find out the extent of likely economic losses in flood-prone areas. Calculation and declaration of likely economic losses may help local governments cope with pressures of interest groups and hence avoid urban development on flood-prone areas. Relevant vulnerability analysis would make developers know the extent of investment risks on floodplains. That is in turn would also be effective strategy to increase resiliency of a local area.

One major policy area in Turkey today is the legal and institutional framework of risk management. The case studies have highlighted the need for reorganization of the current legal and administrative system in order to establish an integrated FRM system. In such a system, each major river basin could be managed and controlled by a commission, as part of the wider integrated river basin management organization, which is not currently exist. The commissions can be founded based on the Law on Union of Municipalities (No. 5355) and be responsible for preparation of Flood Mitigation Plans based on flood hazard and risk maps prepared by other related agencies like regional directorates of the SHW. Moreover, the jurisdictions of regional directorates should be revised so as to overlap with boundaries of major river basins instead of provincial borders.

Flood mitigation plans should be prepared at the same scale as territorial plans so as to take into account basin-wide establishments, settlements, strategic spots and decisions. The decisions concluded in flood mitigation plans should be carried over to territorial plans and urban development plans of urban settlements within each basin. However, preparation of plans is not enough for effective risk management. The decisions and strategies concluded by mitigation as well as urban plans have to be implemented thoroughly. Thus, both flood mitigation and urban planning frameworks require effective enforcement mechanisms, which should be covered in another research paper.

CONCLUSION

The prevailing flood protection and urban planning approach that considers flooding as a technical issue appear to be the main causes of high flood losses in Turkish cities. If necessary measures are not taken, flood events and their impacts would be more intense and widespread due not only to climate change but also to increasing concentration of population in cities. The rate of urban population in Turkey is expected to reach 84% in 2050 (UN, 2014). Since riverine and coastal cities are the hotspots of population and economic activities, FRM is an urgent issue and needs to be given priority in urban policymaking in Turkey so as to increase resilience of cities to future flood events.

Despite the policy shift at the international level and emergence of contemporary approaches to FRM, conventional approach that depends on protection with mainly structural measures is still prevailing in Turkey. Thus, before anything else, high dependency on structural measures has to be terminated. Structural measures encourage urban development on flood-prone areas. Besides, people are usually unaware of safety standards of such measures which are not based on accurate and updated assumptions and extremes. There are some recent policy responses led by the SHW as initial steps towards a contemporary FRM approach. Among such steps are nation-wide forestation campaigns, pilot projects on preparation of hazard and risk maps, investments on geographical information systems and flood modeling software for spatial analysis. However, such attempts still remain in their infancy. Besides, what is needed more is a paradigm shift in urban planning and development system of Turkey. It should be reformed in order to ensure integration of structural and non-structural measures across any river basin to mitigate flood risks.

Future policies to set up an effective FRM in Turkey should follow a comprehensive work plan that covers short-, mid- and long-term objectives and strategies. The work plan should be developed and implemented collaboratively by central and local public agencies as well as other relevant stakeholders. Until long-term strategies are realized to settle contemporary FRM approach in the current administrative system, the following strategies could be pursued in short- and mid-term.

- Since many settlements have common river course and/or basin, institutional collaboration and coordination are crucial for FRM in Turkey. Thus, an institutional environment that includes effective planning, monitoring, participation, cooperation and coordination among governmental and non-governmental organizations should be created. Local government unions and river commissions that would be established might lead this environment.
- Absolute dependence on flood protection structures can never be sufficient for mitigation of flood risks. So, effective use of standard hazard mapping based on possible risk scenarios, vulnerability analysis and risk zones for whole basin areas should be ensured before any further actions within zones.
- Tasks and responsibilities of central and local government agencies with regard to flood risk mitigation should be redefined. The mismatch of responsibilities and powers for flood mitigation and urban development needs to be avoided. The SHW, which is the sole authority to deal with flooding, has almost no power to influence development decisions and actions within flood-prone areas. Whereas, local governments, who have the power to perform urban planning and manage urban development, mostly lack the institutional and technical capacity to deal with flood related issues. In view of this institutional shortcoming, the SHW could be given a central role to provide local governments with updated data, hazard maps, supervision and financial support for large structural projects. Local governments, on the other hand, should be encouraged and forced, if necessary, to take into account the data and supervision

provided by the SHW in decision-making for urban development. Both agencies should also cooperate and collaborate in conduct of vulnerability assessments and risk estimations as well as in declaration of results to local public.

The paper argues that historical spatial decisions with no consideration of flood risk in riverine cities of Turkey have created contemporary flood issues and increased flood risks. Without any attempts for implementing an up-to-date FRM framework, similar or worse flood events and disasters are very likely to occur in the near future in riverine cities of Turkey. This paper highlights the underlying factors for the current chronic flood damages based on four case studies. However, such research might be extended in order to cover all major river basins using a similar methodology before any spatial development decisions taken in a city. By this way, data for any basin and its cities could be updated regularly and used for preparation of flood risk maps and development decisions that maintain flood mitigation measures.

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AN ASSESSMENT OF FLOOD RISK FACTORS IN RIVERINE CITIES OF TURKEY: LESSONS FOR RESILIENCE AND URBAN PLANNING

Turkey's river flood protection system is based on surveys and assessments of a central authority as well as its limited powers of intervention. The local governments, which are the closest units of public administration to flood risk areas, are under various pressures for development. However, it is crucial to integrate flood risk mitigation efforts with local planning system and involve local governments in all stages of risk management starting from estimations of risks and determination of risk areas, as the contemporary international approaches point out. This paper was based on a sample survey of four case cities; namely Bartın, Batman, Aydın and Hatay. It aims to evaluate the main factors that contribute to the risk of flooding in riverine cities in Turkey, as well as to take some lessons for improving existing system.

Research findings indicate that river floods usually turn into destructive disasters in Turkish cities mainly due to improper land-use planning and management. Ad hoc and discrete land use development within and through the river basins results in serious and chronic flood losses. At the same time, the loose relationship between urban planning and flood risk management is another factor observed. Currently, urban development plans are not equipped with necessary measures to mitigate flood risks. More to the point, the illusory feeling of safety that originates from independent and discrete efforts of mitigation adds to flood vulnerabilities of city residents.

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Anahtar Sözcükler: Taşkın risk yönetimi, dirençlilik, kent planlaması, Bartın, Batman, Aydın, Hatay.

TÜRKİYE’NİN AKARSU KENTLERİNDE YAŞANAN TAŞKINLARIN RİSK ETKENLERİ ÜZERİNE BİR DEĞERLENDİRME: DİRENÇLİLİK VE KENT PLANLAMA İÇİN DERSLER

Türkiye’nin akarsu taşkınları koruma sistemi, merkezi bir otoritenin etüt ve değerlendirmelerine, aynı zamanda bu otoritenin sınırlı müdahale gücüne dayanmaktadır. Kamu yönetiminde taşkın riskine maruz alanlara en yakın birimler olan yerel yönetimler ise çeşitli gelişme baskıları altındadırlar. Ancak, güncel uluslararası yaklaşımların da işaret ettiği üzere, yerel planlama sistemi ile taşkın risk azaltma çabalarının bütünleştirilmesi, risklerin tahmininden ve riskli alanların belirlenmesinden başlayarak risk yönetiminin tüm aşamalarına yerel yönetimlerin dahil edilmesi can alıcı öneme sahiptir. Bu yazı, Bartın, Batman, Aydın ve Hatay olmak üzere 4 örnek kentin derinlemesine incelenmesine dayanmaktadır. Akarsu kentlerindeki taşkın riskine katkıda bulunan temel etmenlerin değerlendirmek ve sistemin iyileştirilmesine yönelik dersler çıkarmak amaçlanmaktadır.

Araştırma sonuçları şunları göstermektedir; Türk kentlerinde yaşanan akarsu taşkınları temel olarak yanlış arazi kullanım planlaması ve yönetimi sonucu çoğunlukla yıkıcı afetlere dönüşmektedirler. Akarsu havzalarında ve havzalar boyunca anlık ve ayrık arazi kullanım gelişmeleri ciddi ve süreğen taşkın zararlarına yol açmaktadır. Aynı zamanda, kentsel planlama ve taşkın risk yönetimi arasındaki ilişkinin gevşek olması da başka bir etken olarak gözlemlenmektedir. Günümüzde, kent imar planları taşkın risklerini azaltmaya yönelik tedbirlerle donatılmamıştır. Dahası, birbirinden bağımsız, ayrık önlem çabalarından kaynaklanan aldatıcı güvende olma hissi kent sakinlerinin taşkın karşısındaki zarar görebilirliklerini artırmaktadır.

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