Forest burning as a counterinsurgency strategy in Eastern Turkey

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Paper presented at the Kurdish Studies Conference, organized by the Kurdish Institute of Paris and Salahaddin University, Arbil, Iraqi Kurdistan, September 6 to September 9, 2006.

Abstract

Beginning in the early 1990s, the Turkish Army was reported to use the burning of forests, fields and villages as a strategy in the conflict against the insurgent PKK. A case study of armed conflict in Tunceli, Eastern Turkey was done to evaluate this claim using satellite images for the verification of eye-witness reports collected by human rights groups. This paper establishes that substantial forest burnings took place between 1991 and 1994 in the study area. Turkey follows an international trend of resource destruction as an intentional goal of its counterinsurgency strategy.

Introduction

Intentional destruction of resources is prevalent in many armed conflicts. Military, paramilitary and insurgent forces intentionally destruct forests, crops, livestock, foodstuffs, seeds, buildings, and other assets that have economic, cultural, and biological values. The destruction of these resources occurs in breach with international humanitarian law, including the 1976 Environmental Modification Convention (ENMOD) and the 1977 Additional Protocol I to the 1949 Geneva Conventions.

In Eastern Turkey, the Turkish Armed Forces have systematically used forest burning as a part of a counterinsurgency campaign directed against the Kurdistan Workers Party (Partiya Karkerên Kurdistan or PKK). In this article we will show that considerable resource destruction has taken place in Eastern Turkey in 1994. Besides showing that there is a pattern in the observed forest fires, indicating an *intention*, we explore the *motivation* of these burnings. We will relate forest burning to a change in counterinsurgency strategy of the Turkish Armed Forces.

Much has been written about the war between Turkish Armed Forces and PKK (Imset 1995; Barkey and Fuller 1998; Yüce 1999; White 2000; Özdağ 2003; Bozarslan 2004; Jongerden 2006), but little has been written from a geographical perspective. We believe that a geographical focus on environmental destruction will contribute to the understanding of the conflict in Turkey and the 'environmental strategies' of the two parties in the conflict. This article is an attempt to analyze the conflict from a geographical perspective.

Assessing the impact of war on ecological resources has to meet several methodological challenges (Biswas 2000). This article documents uses remote sensing data (satellite images) to document visible forms of wartime destruction of ecological resources. In armed conflict, the use of satellite imagery to establish ecological destruction has clear advantages. In contrast with oral accounts, data collected with remote sensors may be seen as more objective. This is especially important in the context of armed conflict; in which written and spoken information is often tainted by war-propaganda (or perceived to be). Another advantage is that obtaining remote sensing data is possible without having to visit the area. Areas of wars are generally dangerous places for researchers, while military authorities may deny access to them. Satellite imagery as a data source, however, constitutes its own methodological challenges. Working in a human ecological framework would require that airborne data be complemented with ethnographic fieldwork to interpret them in the light of local resource use perspectives (Guyer & Lambin 1993; Taylor 2003). In the end, it will be necessary to combine the remote sensing data with some type of 'local' data.

In the research reported here, satellite imagery interpretation was done with the aid of qualitative data retrieved from various sources, including interviews with Kurdish people residing in The Netherlands, and different types of visual materials. The analysis shows that remote sensing data can be instrumental in corroborating witness accounts and add to our understanding of the broader geographical patterns of counterinsurgency livelihood destruction by the Turkish Armed Forces in Eastern Turkey. We focused our study on Tunceli, an area in Eastern Turkey. This case study is based on research funded by and conducted under the responsibility of Wageningen University, and making grateful use of the collaboration offered by human rights groups and civil society organization for data collection and evaluating the usefulness of the results.[1]

[1] The research project was designed by HdV and JJ as a collaboration between the chair group Technology and Agrarian Development and the Centre for Geo-Information of the Wageningen University. These two groups also financed the project. Technical aspects of the analysis were carried out by two students as part of their MSc thesis (Van Hoeve & Klaasse, 2001). We would like to thank the GeoDesk of Wageningen University, and Frans Rip in particular, for supplying data used for the elaboration of the maps in this article.

Armed conflict and resource destruction in Eastern Turkey

Since the early eighties there has been a struggle for control over large areas in East-Turkey, between the Turkish state and the Kurdistan Workers Party (Partiya Karkerên Kurdistan or PKK), a party officially established in 1978. In the early nineties the war between state forces and the PKK began to take many lives, displace people and destroy villages on a wide and systematic scale. International human rights organizations claimed that although repression has long been the response to problems in Turkey, from 1991 onwards security forces started a full scale dirty war (Amnesty International 1996:50).

The PKK had emerged from an urban and left-wing student environment in Turkey (Ankara mainly), but did not remain confined to an urban and student environment. The party established itself at the countryside in the eastern Kurdistan region in Turkey and developed considerable support from the lower strata, in particular peasants and agricultural workers. Typical for an understanding of the PKK strategy to establish itself also in rural areas is that it did not base its politics on the idea that it could or had to take over 'the state' in a great moment of change (in analogy to the seizure of the tsar's winter palace by the Bolshevik in 1917), but on the idea of developing counter-power and counter-institutions, that would replace those of the state. This was best to be organized in areas where the state was absent or weak, e.g. rural areas (Jongerden 2006).

In order to establish itself at the countryside, the PKK successfully applied the principles of prolonged guerrilla warfare in the period 1984-1993. The strategy involved widespread and continuous attacks on the Turkish armed forces by guerrilla cells. These attacks were supposed to have the effect that the armed forces would take up defensive positions in relation to the larger settlements and communication and defense lines. Such a tactical withdrawal in effect disclosed the countryside for the PKK. The guerrilla then would build up forces in the countryside, create liberated areas, establish administration, and eventually deploy conventional warfare tactics for their defense. As its strength increased, the PKK intended to expand the liberated areas, call for a popular uprising and launch large scale attacks on Turkish positions. This final battle was to be started only when Turkish positions were untenable, its armed forces swamped, groggy, demoralized, and ready to be defeated. The PKK announced in 1993 the establishment of a provisional parliament in Botan (an area covering parts of northern Iraq and of the provinces Şırnak Hakkari, Van, Siirt) and called for a popular uprising. However, the final battle never took place. On the contrary, the PKK was faced with a crumbling off of its environment.

Before 1991, the Turkish Armed Forces had played into PKK hands by taking defensive and static positions. The army garrisoned towns and larger villages, and in effect left the smaller settlements to the PKK, which resulted in the creation by PKK forces of a supportive environment composed of small rural settlements dispersed over the region, providing monetary resources through taxation shelter, recruits, logistics, and intelligence. Occasional army sweeps sought to destroy the guerrilla but proved ineffective. As the troops got into position the guerrilla slipped away, returning after the army sweep was ended.

In 1991, the Turkish Armed Forces announced a reorganization of its war against the PKK. This implied a change of doctrine. Up to 1991 the organization of the army was based on the doctrine of static territorial defense by a standing army against a coherent mega-threat (a centrally organized and identifiable army, such as an invading Soviet Army). The bad results of the war showed that PKK was a phenomenon that did not fit these doctrinal remnants of the Cold War. To improve performance, the Turkish Armed Forces developed what is called a Field Domination Doctrine, which was based on the development of territorial control in a situation of asymmetric warfare (Tomes 2002). The doctrine was laid down in 1991, but put into practice after the reorganization of the army was finished in 1993 (Özdag 2003). Among others, this doctrine comprised a restructuring of the Turkish army.

The Armed Forces changed its relatively cumbrous divisional and regimental structure, intended to fight a war of position against a Soviet army, into a relatively flexible corps and brigade structure, aimed at more rapid response and increased mobility, as required to fight an asymmetric war of movement. The new doctrine also implied a painstaking 'clear and hold' strategy in the territories infiltrated by PKK guerrillas.

The immediate aim of the new doctrine and strategy was the destruction of the PKK's environment. A constituent element of environment destruction was village evacuation and destruction. These small rural settlements became a target because they provided (or were under the suspicion of providing) the PKK with monetary resources through taxation shelter, recruits, logistics, and intelligence. Although village evacuation occurred before 1991 as well, mainly as reprisal, after the implementation of the field domination doctrine in 1993, it started to peak (Table 1).

Village destruction and forest burning in Eastern Turkey received public attention. Civil society organizations and international and local human rights organizations claimed on basis of witness accounts that the Turkish Army systematically burned and evacuated villages, and destroyed rural livelihoods by burning fields and forests (HRW 1995; SNK 1995; IHD 1996). Also the indictment and prosecution of Nobel Prize candidate and writer Yaşar Kemal, who had expressed his indignation and amazement about the fact that a state would burn its own forests, just because guerrillas can hide in them (Kemal 1995) received considerable attention. Yet the scope and impact of the new strategy were difficult to assess because the areas where violations occurred were sealed off by the army, not only for civil society organizations willing to obtain witness accounts, but even for high ranking politicians. Evacuated inhabitants of the region were dispersed geographically, hindering comprehensive assessments (noted by SNK 1995).

The existing eye witness accounts attest to the intentional character of the destruction of fields and forests and its devastating effects.

> Twenty-four-year-old C.V. told Human Rights Watch that during the spring of 1994, helicopters were frequently used to burn down the forests surrounding Yaziören, a small village of thirty homes. "They poured gasoline or some kind of flammable liquid over the trees," he said, "and then set the trees afire." C.V. said the Jandarma [Gendarmerie, Turkish rural police force] ordered villagers not to enter into the forests, which were declared free-fire zones (HRW 1995:97).

The claim inherent in this eye witness account is that forest burning by the military was an intentional act. The following eye witness gives a vivid description of the devastating impact of forest fires in the area:

> [E]very now and then I went from Dersim, were I attended school, to Ovacık, to help my father in the drugstore. […] They burn the forests […] we were walking between burning forests. At both sides of the Munzur River the forests were burning. That was two years ago, in 1994, at the time the military burned down Ovacık. Because of the smoke flying insects came to Dersim City. Everywhere in the city were insects. Although the weather was good those days we could not see the sun because of the smoke. […] Everywhere was darkness (Jongerden et al. 1997).

Our case study will evaluate the claims of resource destruction for one part of Eastern Turkey, the province of Tunceli in 1994. This case is made because detailed eyewitness accounts were available (SNK 1995) and indicated that in 1993-1994 Tunceli suffered large scale, systematic evacuation of villages and intentional burning of villages and forests by the Turkish Army.

Case study area: Tunceli province

The province of Tunceli is situated in the Eastern Anatolian region of Turkey and covers approximately 760,000 hectares (Figure 1). The study area is part of the Munzur catchments, one of the main tributaries of the Euphrates River. The Munzur Mountains are rugged, with deep valleys and high peeks that range in altitude from 950 to 3,463 meters. The area has a continental climate with extreme temperature differences in winter and summer, and precipitation varies per district between 550 and 1100 mm/year.

Forests cover 27 percent (207.666 ha) of Tunceli, while 61 percent of this forest has a protected status.[2] The protected area contains the UNESCO Munzur Valley National Park, 8 km north of Tunceli, with 42.800 hectares of vegetation. Deciduous forests are found mostly in Tunceli, Ovacık, Pülümür, Hozat and Nazimiye. Pine trees are found especially in the North, above 1800 meters.

In 1990, the total population of Tunceli was 133,585, of whom 50,799 lived in urban areas, while the rural population amounted to 82,785. The main agricultural activities in the area are animal husbandry and farming. Most inhabitants are Alevis, members of a heterodox Shi'a branch of Islam with clear traces of pre-Islam religions. In the region the Kurdish language Zaza is spoken. The province is subdivided in eight districts, a central district dependent on the provincial town (Tunceli), and seven districts dependent on district towns (Çemiskezek, Hozat, Mazgırt, Nazimiye, Ovacık, Pertek, Pülümür, see Figure 1). There are 416 villages[3] and 804 hamlets[4] in the province of Tunceli. The province has the smallest population of the eastern provinces of Anatolia.

Initially, PKK guerrilla activity in Tunceli was low-profile. PKK guerrilla activities were concentrated southeast of the province. In reaction to the implementation of the environment deprivation strategy by the Turkish armed forces, PKK attempted to expand its area of movement westwards (Tunceli and Sivas) and northwards (Black See Coast). While PKK tried to develop a habitat for its militants in Tunceli, the army strategy was to destroy these habitats.

According to witness accounts, the military started a wave of operations in 1994, with forest fires, between July and August, and village evacuations in the autumn of 1994. By 2000, the total population had reduced with 35%. Especially the countryside depopulated heavily, with 75%, while the urban population increased slightly with 7%.

Most of the evacuation and destruction of villages took place between 1990 and 1995, while 1994 is the year with most evacuations (Table 1). Table 2 gives a detailed breakdown of village and forest destruction for the province of Tunceli. A local politician with close ties to the region claims that 25% of the forests were destructed in this period (SNK 1995).

Another source of data which may give an indication of the impact of army destruction on local resource use is given by the Platform of Unions in Tunceli (Tunceli Sendikalar Platformu 1996). This report indicates that between 1990 and 1995 acreage of annual crops and tree crops declined by a quarter (Tables 3 and 4). Size of herds also decreased by more than a half in this period (Table 5). According to the same source, protecting activities like forest monitoring, tree planting and controlled cutting are postponed due to the village evacuations. The local population is forbidden to go into the burning areas

[2] Official figures from the provincial administration (http://www.tunceli.gov.tr/ilhak.htm)
[3] A village is a settlement with a population size of more than 250 and less than 2,000 inhabitants.
[4] A hamlet is a settlement with a population size of more than 50 and less than 250 inhabitants.

because of the continuing operations. On the other hand, security forces distribute illegal cutting permits. Also, officials do not take any action in stopping the forest fires in this area.

Tunceli is an area that is difficult to visit. We have been unable to find confirmation for forest burnings from alternative data sources or to verify on the ground claims of violations. This makes a methodology based on remote sensing an appropriate choice to document forest burning in this area.

Based on the data presented in this section, we can develop several hypotheses to be tested with remote sensing data. If witness reports were right on the presence and extent of burned forests and areas with other uses, evidence of this would be clearly visible on satellite images. We can also expect that reported herd reductions were reflected in increases in area of shrubs and/or even regenerating forests. At the same time, overgrazing and land degradation may have occurred, because herds concentrate in certain areas as others become inaccessible due to the conflict (cf. Jetten & de Vos 1994, for Nicaragua).

In Turkey as a whole, forest fires are frequently originated by agricultural fires (Bilgili 2001; Kurtulmuslu & Yazıcı 2003.). However, it is important to note that in Tunceli, fires are seldom used as part of agricultural practices, as we established by interviewing agricultural experts familiar with the area. Thus, if we observe the effects of burning on land of agricultural or forest use, we may safely assume that they are not a collateral damage of existing non-military uses of fire. Also, we expect to see few effects of the use of fire in agriculture before the conflict.

Methodology

Satellite images

The Turkish state and its allies have attempted to prevent the disclosure and distribution of information, maps or aerial photography of the area. It is indicative that (the public version of) the Digital Chart of the World elaborated by the software company ESRI for the US Defense Mapping Agency does not contain roads and very few villages for the Tunceli province. Nevertheless, we were able to acquire remote sensing data for the area.

For our study we selected Landsat Thematic Mapper images, because of their relatively low costs and because they are appropriate for our object of study (forests).[5] With a resolution (minimum pixel size) of 30 meters, Thematic Mapper images have been used widely for assessing land use and land use changes. With high resolution satellites it would have been feasible to perceive overgrazing of limited areas and it is even possible to perceive destruction of villages and houses. These images were not yet available for the period we considered.

Two Landsat-5 Thematic Mapper images were selected to be able to compare pre- and post-conflict forest coverage. The first image was taken in August 1990 and represents the situation just before the change of strategy by the army (1991). The second image was taken in October 1994, representing the situation just after reported forest fires in the summer of 1994 (SNK 1995). It was easy to detect dense forest land-use in both images. For the interpretation the northern part of the image was used, covering around 95% of the Tunceli province (Figure 1).

[5] Due to limited budget a selection was made from a special discount database. At the time of the research, the total costs amounted to around 2000 Euros. The cost aspect may be interesting to human rights organizations considering using satellite imagery to corroborate eye witness accounts (see also De Vos & Jongerden submitted).

Image interpretation and data processing

Interpretation of images requires assigning pixels of the image to land use classes on the basis of their specific spectral profile. Normally geo-referenced field observations are used to link spectral profiles to specific land uses. Since it was not feasible to make field visits at the time of study, alternative sources of data were used to establish land use classes for certain areas. These known areas were used to establish spectral profiles and classify the remainder of the image, using supervised classification.

Discussions with Kurdish people originating from the province residing in the Netherlands were held to retrieve information on land use. This was done with the aid of topographical maps and printouts of the satellite images. Also, reports, photographs and movies of the area were gathered and interpreted. Information from a mining company helped to interpret limestone and flysch-sedimentary rock formations. The combination of these different types of data made it possible for the researchers to become familiar with the area and to gain detailed knowledge of particular parts of the study area. Especially photographs of areas with bare soil, rocks, debris flow, riversides, water and forests could be used to interpret the image. In addition, the presence of typical agricultural field patterns helped to establish this land use class.

Classification of selected areas based on the available information then gave spectral profiles for land use classes which could be used to classify the whole image. Table 6 shows a list of the training areas identified in the images with help of the secondary data and information from the Dersim Community. These consist out of the major land cover types identified in both images, as well as the clouds and shadow seen on the second image of October 1994 and the burned areas. A further distinction was made between areas that were expected to be burned forests and areas expected to be burned areas with other uses. Spectral profiles for land use types and burned areas were compared with those retrieved from the literature (Chuvieco 1999) and proved to be similar.

This method of image classification gave only reliable results for broadly defined land use types. It was impossible, for instance, to distinguish in a reliable way between mixed landscapes of sparse forest vegetation, brushes with trees and grazing areas. Only with more detailed field data such finer distinctions could have been made. It should also be noted that the classification method tends to include only continuous forests in the forest class, resulting in a conservative estimate of the total forested area. If the more fragmented forested areas were to be classified as forests, the forested area would be larger.

The classified image of 1994 was used to establish the size of the burned areas. By comparing the images, it was established whether areas that appeared as burned in the 1994 image were forest or another land use in the 1990 image. This enabled a distinction between forest fires and non-forest fires.

Geo-referencing witness reports

To be able to compare witness reports with remote sensing data, the reports were geo-referenced using the names of villages in which reported events occurred. To compare reported forest fires with the satellite images, villages were digitized directly on the geo-referenced images. After having spent considerable effort on finding cartographic data, we were able to obtain a detailed Russian topographical map, scale 1:100.000.[6] The map helped to locate towns from the human rights reports, of which a sample of 143 could be included in this study. Locations on the satellite image were deducted from topographical and

[6] Joint Stock Company SK-IMPEX Moscow, *Russia Glavnoe Upralenie Geodezii i Kartografii pri Sovete Ministrov SSSR,* sheets J-37-18, J-37-19, J-37-20, J-37-30, J-37-31, J-37-32, J-37-42, J-37-43, J-37-44, 1:100,000. 1970-1994.

geomorphological characteristics, as well as from color indications on the satellite image. Finally, other villages, not mentioned in the human rights reports, but clearly visible on the topographical map and satellite image were also included in the examination. Of the 143 villages, 53 were mentioned in the human rights reports without forest fire or destruction, in 40 cases fire was reported, in 20, village destruction was present. No information was present at all in the human rights reports regarding 30 villages on the map.

Comparing image interpretation with witness reports

The forest fires as identified on the satellite images were compared with incidences described in human rights' witness reports. Reports were analyzed distinguishing villages with (1) recorded forest fires, (2) village destruction or (3) villages with human rights abuse reports, but without destruction or fires. It should be noted that the absence of reporting of fires does not necessarily mean they were not present; they were only not observed by the interviewed eye witnesses. To assess the presence of forest fires around a village the study defined 'presence of fire' when within 1.2 km radius of the village (= 452 ha) a minimum of 4.5 hectare (1%) of forest fires in the satellite image was found.

Results

Image interpretation

Of the entire study area 10.3 percent of the area was classified as forest in both 1990 and 1994 (Table 7).[7] Around 0.83 % of the study area was occupied by burned forest (forest in 1990, heavily burned in 1994). This implies that 7.5% of all forests or approximately 11,000 hectares (110 km^2) were burned in 1994.[8] Even larger non-forest areas were burned, amounting to 52,000 hectares (520 km^2). These areas were especially common near areas of burned forest, suggesting synchrony and common causality of forest and non-forest fires (Figure 2 & 3). A total area of more than 60.000 hectares (600 km^2) was classified as burned.

Qualitative comparisons of the two images indicated a large increase in areas with grasslands, sparse vegetation and shrubs. This suggests an increase in the area that was affected by destruction early in the investigated period and is now in regeneration or the effect of decreased use of grasslands as access to them was denied by security forces.

Comparing image interpretation with witness reports

Witness accounts signaled that burning took place in mountain areas and along the Munzur River. The burned areas displayed on Figure 3 show that burning not only took place along all main streams of the province. The location of the interpreted forest-fires confirms witness reports that especially Ovacik, Hozat and the northern parts of Tunceli were affected, even though these were not the only areas.

It became clear that in most but not all cases reported fires by witness accounts were confirmed by the satellite image (60 %; Table 8). The high frequency of fires in case of village destruction (85%) draws the attention, because this suggests that village destruction almost always went hand in hand with burning of forests, orchards and fields around it, even

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[7] The estimate is low in comparison to the forested area given by official census data, which includes 27% in this class. The definition for forest used in the census may be different than that implied in our methodology. This was to expect, because in our classification only continuous, relatively dense forest was included in the forest class.

[8] A tiny fraction (0.04 %) of the image was 'slightly' burned *forest*. This was expected to have been non-forest in the 1990 image on basis of the spectral profile in the 1994 image (Table 6). In the subsequent analysis it was included as a fraction of the burned area of non-forest landuse.

if these fires were not reported. It is remarkable that this percentage is higher than that of observations of forest fire.

Discussion

The study indicates a considerable destruction of forests in the area in 1994. In contrast, no burned area was found for 1990, another source of confirmation for the fact that fire is not commonly used for agricultural purposes in this area.

On the basis of this study around 7.5% of the forests of Tunceli are deemed to be burned in 1994. Thus the estimate that 25% of the forests were burned made by a local politician (SNK 1995) should be considered as on the high side. Interesting though, 26.6 % of the forests that were located within the 1.2 km radius around villages were burned. Thus for those forests most relevant to local livelihoods, this estimate is indeed remarkably realistic.

It should also be noted that the methodology of this study is likely to produce a conservative estimate of forest burnings. A number of smaller forest patches may have been included in the non-forest class, given the method followed in this study (see above). This should cause caution when interpreting the numbers; the mentioned 7.5 % of burned forests refers to relatively dense forest only. A much larger portion of non-forest area was burned at the same time.

Occurrence of fires in non-forest areas also could be ascribed to destruction of harvests and orchards. A decrease in orchards in Tunceli in this period has been documented above (Table 4). Also, witness reports of destruction of harvests are present.

The crossing of the satellite data with geo-referenced eye witness accounts showed that forest burnings went often accompanied with village destruction. Burnings were present even in cases no specific mention was made of forest fire around these villages by the eye witnesses. This may indicate that destruction was not observed by villagers because it occurred after the evacuation was completed. On the other hand, 40% of the reported forest fires could not be confirmed with the method used to determine presence or absence per village. These unconfirmed eye witness reports may refer to forests outside the 1.2 km radius around the village for which they were reported or to forest fires affecting less than 4.5 ha. Also, the location of fires may be inaccurate when they are based on smoke observed from a distance. Villages in which no destruction occurred according to eye witnesses or those for which no information was available showed relatively less burned forest areas. On the basis of this it may be concluded that the overall geographical pattern of resource destruction implied in the eye witness accounts is confirmed by the satellite image derived data.

Conclusions

We have argued that the strategic change of the Turkish army between 1991 and 1993 in its fight against PKK has led to severe environmental damage in Eastern Turkey. Forest destruction was a part of an overall counterinsurgency campaign designed to deprive the rural population of its resources and empty the area to make a ‘war of movement’ possible. Additional evidence for and documentation of this destruction was given in this article by means of the interpretation of satellite imagery for the province of Tunceli. in this area round 7.5% of the forest in the area and 26.6% of the forest near villages was burned. This constitutes massive resource destruction on behalf of the Turkish Armed Forces. The more severe burning around destroyed and evacuated villages is important evidence for the intentionality behind the use of fire against civilian populations and underscores the claims of human rights abuses. When the Turkish Armed Forces “stepped outside the law” in 1991 (Amnesty International 1996:50), they did this also regarding the legal protection of ecological resources of Eastern Turkey.

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Table 1 Number of Evacuated and Burned Villages 1991-2001
Source: Jongerden (2006:62)

1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
109	295	874	1,531	243	68	23	30	30	-	3

Table 2 Numbers of villages evacuated and burned during the autumn 1994 army operations in Tunceli province
Source: SNK (1995:63)

District	Subdistrict	Total villages	Evacuated	Burned	Total affected	Affected (%)
Tunceli	Central	15	7	3	8	53
	Çicekli	11	1	0	1	9
	Kocakoç	11	3	3	4	36
	Sütlücü	11	8	4	9	82
	Çemişgezek	16	2	1	3	19
	Akçapinar	9	1	1	2	22
	Gedikler	14	0	0	0	0
Hozat	Central	29	15	10	18	62
	Çağlarca	7	4	1	4	57
Mazgirt	Central	26	3	0	3	12
	Akpazar	21	0	0	0	0
	Darikent	31	6	2	7	23
	Nazimiye	12	8	3	4	33
	Büyükyurt	12	2	2	2	17
	Dallibahçe	6	4	3	4	67
Ovacik	Central	45	26	18	37	82
	Karaoğlan	6	3	5	6	100
	Yeşilyazi	14	5	3	7	50
	Pertek	9	0	0	0	0
	Akdemir	8	0	0	0	0
	Dere	10	0	0	0	0
	Pinarlar	17	0	0	0	0
Pülümür	Central	10	0	0	0	0
	Balpayam	7	0	1	1	14
	Dağyolu	12	5	0	5	42
	Kirmiziköprü	25	10	4	11	44
	Ȗçdam	5	1	0	1	20
Total		399	110	64	137	34

Table 3 Reduction in area grown with annual crops (ha), 1990-1995
Source: Tunceli Sendikalar Platformu (1996)

Crops	1990	1995	Reduction %
Wheat	35,282	28,000	21
Barley	11,837	9,000	24
Lentils	21,300	15,000	30

Chickpeas	4,485	2,710	40
Beans	610	520	15
Total	73,514	55,230	25

Table 4 Reduction in number of fruit trees, 1990-1995
Source: Tunceli Sendikalar Platformu (1996)

Species	**1990**	**1995**	**Reduction (%)**
Pear	86,180	66,713	23
Quince	18,150	5,330	71
Prune	16,115	13,830	14
Apple	69,250	56,980	18
Apricot	25,500	20,470	20
Cherry	20,260	16,660	18
Peach	3,640	3,190	12
Sour Cherry	14,860	12,060	19
Total	253,995	195,000	23

Table 5 Reduction in herd size (number of animals), 1990-1995
Source: Tunceli Sendikalar Platformu (1996)

Species	**1990**	**1995**	**Reduction (%)**
Sheep	453,500	192,531	58
Goat	226,236	75,512	67
Cattle	71,871	34,950	51

Table 6 Training area classes and their size (number of pixels)

Class description	**1990**	**1994**
Forest	67,096	9,616
Debris flow	33,921	33,921
Water	204,327	204,327
Rock or bare soil*	115,925	54,136
Urban area or bare soil**	437,547	61,141
Field type a (fallows?)	7,221	5,821
Field type b (fallows?)	2,083	5,151
Field type c (grassland?)	8,034	20,657
River sides	7,590	7,994
Sparse vegetation	29,394	30,879
Clouds	-	22,896
Shadows	-	9,444
‘Heavily’ burned (probably forest)	-	2,739
‘Slightly’ burned (probably non-forest)	-	2,153

*Visible as blue on a false colour RGB-743 image
**Visible as pink on a false colour RGB-743 image

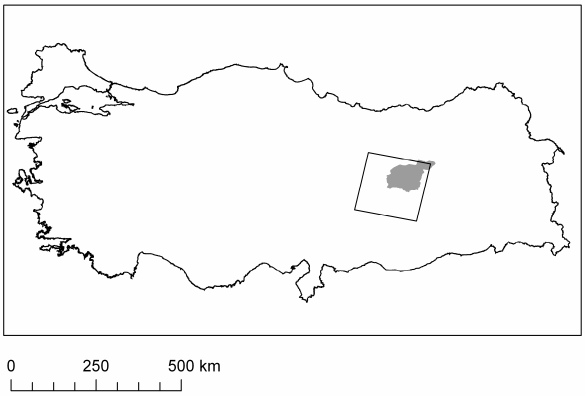
Table 7 Land cover results

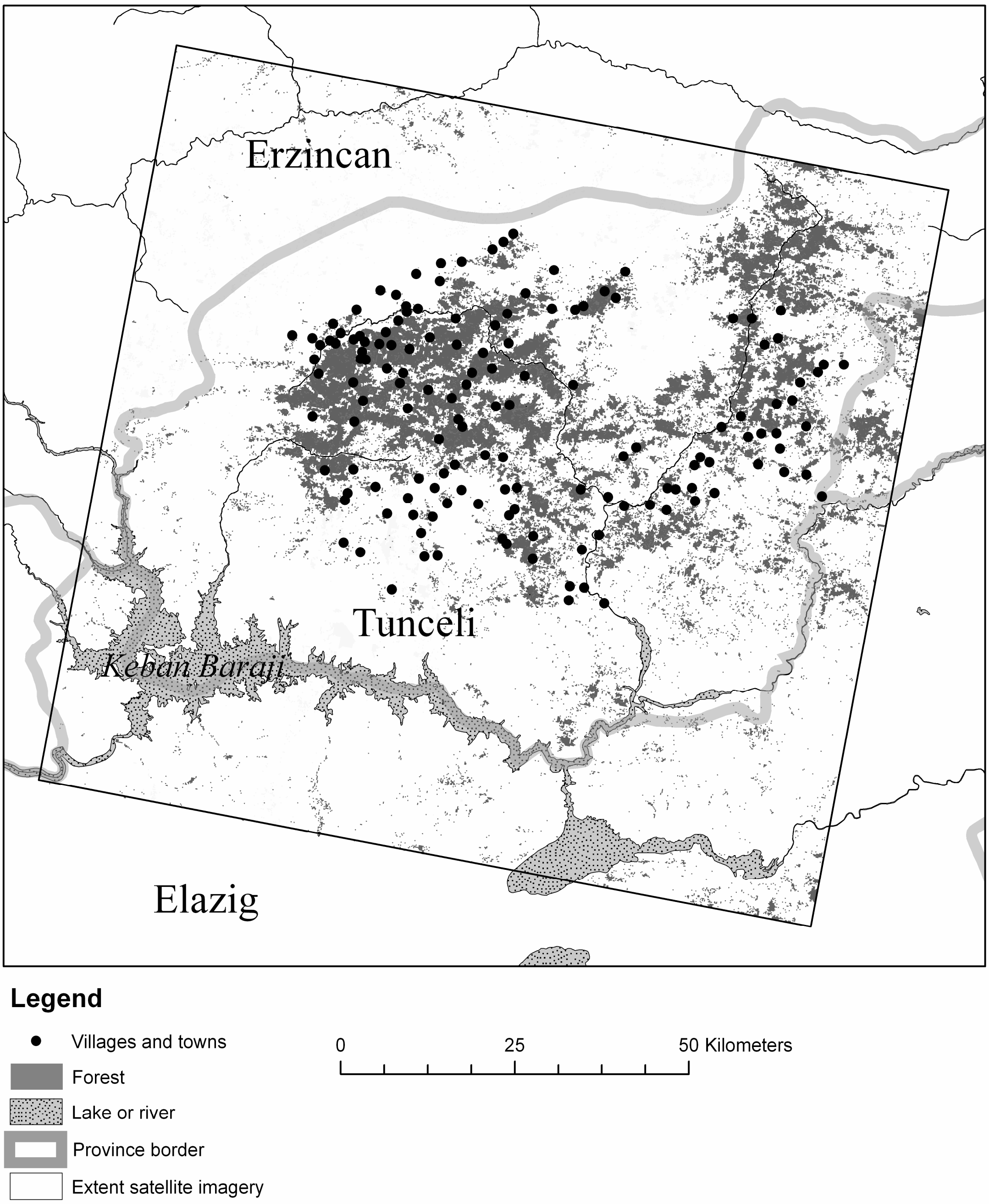
Land cover	1,000 ha	%
Forest in both 1990 and 1994	141	10.3
Forest in 1990, heavily burned in 1994	11	0.8
Other landuse in 1990, slightly or heavily burned in 1994	52	3.8
Clouds and shadows in 1994	77	5.6
Other	1087	79.4
Total	1369	100.0

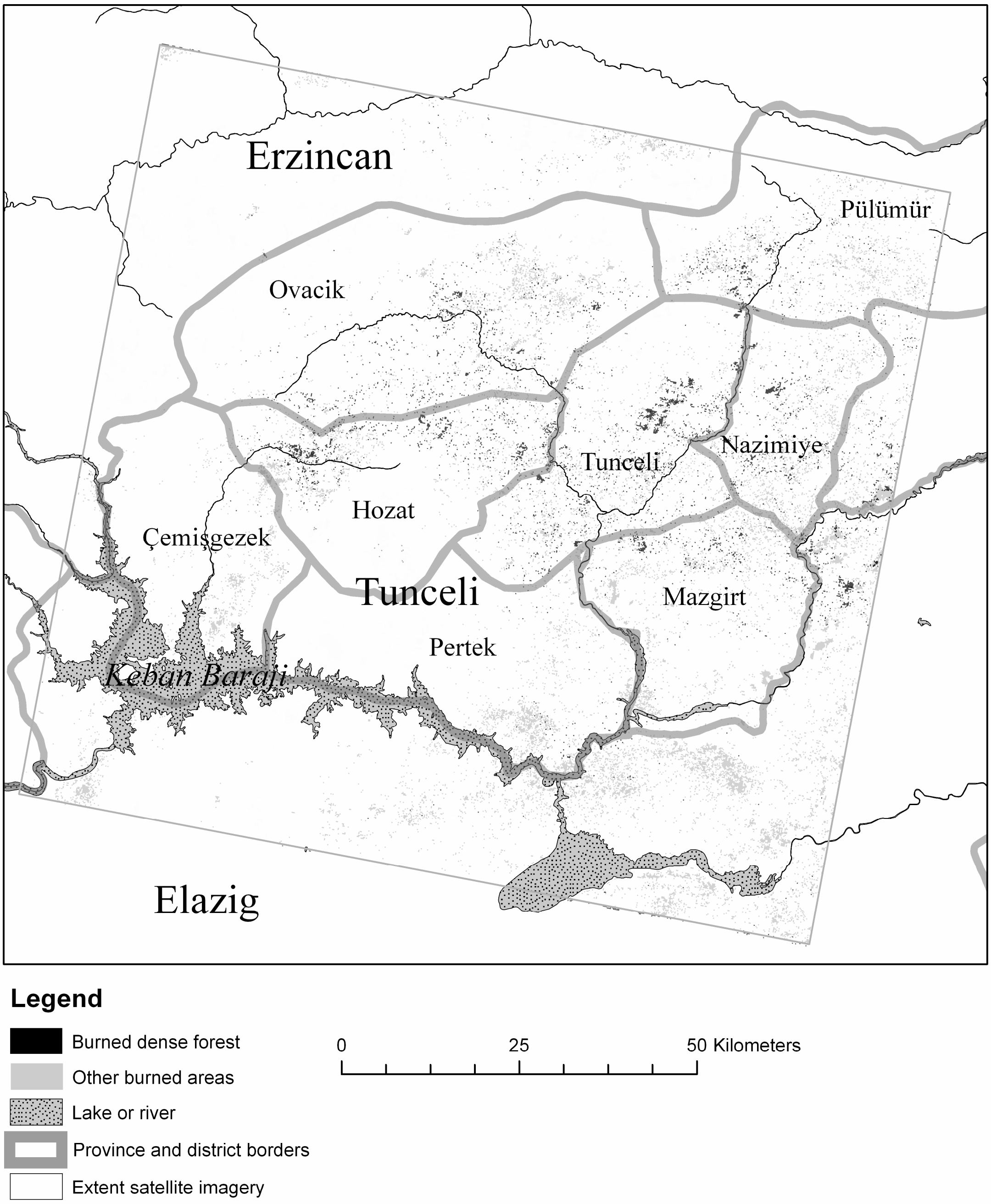
Table 8 Comparison of village reports with burned forests in satellite image

Witness reports	**Number of villages (n=143)**	**Burned forest > 4.5 ha within 1.2 km from village**
No forest fire and no village destruction	53	42%
Forest fire	40	60%
Village destruction only	20	85%
No information	30	27%

Figure 1 Study area and area covered by the satellite images used in this study
Figure 2 Forests and villages included in the study
Figure 3 Burned forest and other burned areas in Tunceli, 1994






Erzincan
Pülümür
Ovacik
Nazimiye
Tunceli
Hozat
Çemisgezek
Tunceli
Mazgirt
Pertek
Keban Baraji
Elazig
Legend
Burned dense forest
Other burned areas
Lake or river
Province and district borders
Extent satellite imagery
0
25
50 Kilometers