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Full Length Research Paper

Ownership problems in establishing the routes of urban infrastructure facilities in Turkey: The case of Trabzon city passage tunnel

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Modern Turkey has been experiencing rapid urbanization and together with increasing technological developments and there is a need to construct more infrastructure facilities in urban areas. In this process, the degree of restrictions to be applied on limited and valuable urban lands, gains more importance. In Turkey, the loss of ownership rights due to the impact of restrictions resulting from the direct or indirect effects of infrastructure facilities is mostly compensated by ownership expropriation or by establishing a continuous right of access on real estates. However, it should be stated that, in general, there is insufficient three dimensional information for the construction of infrastructural facilities. This study investigates the phases for establishing a relationship between urban infrastructure facilities and ownership in the context of the case of Trabzon City Passage Tunnel. In the vicinity of the tunnel, there is a protected area, a settlement area that is open to improvement, and other buildings. Most of the property around the tunnel, which were subject to a loss of value were private ownership and were to be compensated by establishing continuous right of access. In this study, the direct effects of tunnel on ownership are investigated in terms of usage, utilization, and possession rights. This research demonstrates that objective criteria can be used to determine the effects of tunnel on ownership. Furthermore, those situations requiring establishing continuous access rights or ownership expropriation are classified. Lastly, some defective aspects of the existing applications to resolve the property problems of infrastructure facilities are presented with examples from Turkey.

Key words: Urban infrastructure, tunnel, ownership, rights.

INTRODUCTION

The changing concepts of land ownership have accounted for many developments in the course of civilization. The economic and social status of persons and nations, as well as their physical well-being, are often directly related to the ownership of a portion of the surface of the earth. From the earliest times, ownership of the surface of the earth carried with it by necessity the sole right to occupy the space above it since the possession and use of the surface would be impossible otherwise and the right to use the subsurface for any purpose consistent with the rights of neighboring landowners.

Indeed, the vertical unity of land remained so economically and politically important that substantive laws governing these rights related to land ownership has changed very little over the centuries. But that doctrine has no place in the modern world (William, 1979). This concept called the ad coelum doctrine derives from Lord Coke's maxim: Cujus est solum, ejus est usque ad coelumet ad inferos; translated: "To whomsoever the soil belongs, he owns also to the sky and to the depths" Black's Law Dictionary 341(5th ed. 1979). This extension of surface ownership was common in British, French, Germanic, Jewish, and Roman law, and was cited as

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early as 1250 A.D. However, the limitation to the depth of that ownership varies and the following four main conditions appear to exist (ITA, 1991).

1. The surface owner also owns all the property to the centre of earth.
2. The surface owner owns the property as far as reasonable interest exists.
3. The surface owner owns the property only to a limited depth beneath the land surface (as little as 6 m).
4. Private land ownership is almost nonexistent and, hence, the underground is also publicly owned.

Therefore, it can be seen that ownership does not necessarily give the right to use the land or the underground space. The right to use the underground space is often restricted in some way, either through land-use plans or legal praxis. Neither does the ownership of land necessarily give the right to oppose activities of other users under the surface (ITA, 2000).

The tunnel, one of the most important subsurface engineering projects, is one of the important technical infrastructure facilities. Most commonly they are conduits for transportation and allow passage through mountains, rivers and seas (Satir, 2007). The first tunnel was constructed in Ancient Greece in Chios in 687 BC. In Turkey one of the early tunnels an arched brick structure was built in 200 B.C. (Küçükoğlu, 2006; URL-1, 2007; URL-2, 2007) under the Euphrates River, The tunnel, located in a part of the river that is 200 m wide, is about 3.8 m wide and 4.8 m height and has a length of almost 960 m.

In England in the 18th and 19th centuries the industrial revolution led to an improvement in the construction of tunnels, especially in terms of transportation applications (Satir, 2007); in London the first tunnel to accommodate an underground railway used a cut and cover method and the railway opened in 1863 (Kehne, 2003).

Along with the increasing density in the traffic, highway tunnels gained more and more importance especially in the developed countries as the USA, France and Germany where some very long tunnels were constructed (Küçükoğlu, 2006; URL-1, 2007; URL-2, 2007). Significant projects were launched both in Turkey (Satir, 2007). In implementation phases of these projects, there were serious issues concerning the establishment of ownership in relation to technical infrastructure facilities which resulted in delays to the completion of the work.

In Turkey, at the end of the Ottoman Empire, during the transition period to the Turkish Republic there was a transfer of land from state to civil ownership. In this process, lands except that under the rule and possession of the state which could never be subject to private ownership, were returned to those who were able to prove their ownership according to the Civil Code, by the state authority. In this way, the users of the land obtained the rights of use, benefiting and possessing through the receipt of a title deed which was registered with the state. This right of ownership gives the owner the necessary rights to manage the land according to his/her desires based on law.

Ownership rights can sometimes be restricted especially in favor of public interest and it can also be legally limited in exceptional situations. In article 35 of the Turkish constitution, one of the basic rights of the individual, is that everybody can own and inherit land, and these rights can only be restricted for public interest by law, thus, this ownership right cannot thereby be used against the public interest. For instance, land use types, dictated by development plans in urban areas, are a kind of limitation on the usage and utilization rights of the parcel owners for the required public interest.

Certain government departments may be able to restrict the usage, utilization and possession rights and warrants for the reason of public interest. Similarly, for land parcels through which pass energy transport lines, subways, tunnels, water and sewer systems the rights of the owner(s) can be adjusted or restricted in terms of the underground usage of the parcels. In Turkey, this is usually achieved by expropriation or establishing rights of access and ownership problems originating from these restrictions are very common.

The problems faced during the implementation of engineering projects in terms of technical infrastructural facilities do not only affect only the place where the particular facility is located. In today's global world, there are international dimensions, for example with natural gas and petroleum pipelines a problem with the construction of the pipeline or distribution facility in one country can affect the economy and social structure of several other countries. The same situation exists for urban projects although the scale is smaller for example constructing an integrated transport system across the whole of a country. In order to avoid these problems a data infrastructure that will help us choose the optimum route should be established. The database should include; information about land structure, a three dimensional ownership base, geological conditions, plant cover, natural life data through the passing route of urban infrastructure, the properties of urban and rural areas, and data about the parcel ownership in order to create convenient infrastructure facilities in terms of healthy sustainable land management.

It is necessary to form information systems that are devoted to infrastructure facilities, determination of optimum routes and implementation of engineering buildings towards infrastructural facilities properly, and establishing their association with ownership. At this point, cadastral work should be conducted in a way that covers three dimensional and urban infrastructure facilities. Similar ownership applications should be performed by establishing the association of natural gas and petroleum pipelines and tunnels with ownership.

Therefore, a model developed to solve the ownership problems of the urban infrastructure can be applied to the others. The route of a tunnel may directly or indirectly affect the use, utilization and possession rights of relevant land owners.

In Turkey, according to the degree of effect, the loss of owners is compensated by expropriation or establishing a right of access however, this practice does not effectively resolve the problem. Consequently, there are frequent objections from landowners and many resulting law suits in which the court decision is not in favor of the state but of the private plaintiff. Thus, the determination of objective criteria and realizing the implementation of projects which can be applied from the point at which the route of urban infrastructure facilities is being determined and continuing until the association of ownership with these infrastructures is established.

In Turkey there are some legal, technical and institutional problems about implementation of infrastructure facilities and a continuing discussion about the boundaries of ownership of subsurface and upper surface. Therefore, this study focuses on finding a way to resolve ownership problems related to tunnels using a case study of a Trabzon city passage tunnel project undertaken in Turkey.

MATERIALS AND METHODS

Applications related to urban infrastructure facilities in the World

The subway system was introduced in Japan because the streetcar system could not be expanded to cope with increased load in the major cities. The first subway line was opened in Tokyo in 1927, between Ueno and Asakusa a distance of 2.2 km. This was followed by a 3.2 km line between Umeda and Shinsaibashi, in Osaka. Since then, the subway system has been growing steadily; 1994, there were a total of 34 lines in 11 cities throughout Japan, covering a total distance of 524.8 km, with a further 107 km under construction.

To build subterranean facilities in Japan, the company must pay compensation to owners of the surface land to acquire the right to use the subsurface. However, because of the enormously high land prices and of the time required to locate new underground facilities in large cities, underground construction typically utilizes the subsurface of public land and according to Takasaki et al. (2000) this becomes a barrier to the systematic development of urban infrastructure.

In Italy, for tunnels near the surface public utility works can be achieved by “servitude” this is an easement imposing certain restrictions on the land owner to help protect against possible damage caused by the tunnel. These easements can be handled in different ways depending on whether the surface owner is a public body or a private landowner. In the case of a public body, the easement is granted by means of an agreement and for a private body, an indemnity is due to the land owner (ITA, 2000).

Copenhagen's first subway system opened in October 2002 with the second and third phases completed in 2003 and 2007 respectively The system extended to Copenhagen Airport in the southeast and had a total of 22 stations 21 km of track of which 11 km was in tunnels.

According to Stoter et al. (2004) “for the project special tunnel servitudes, station servitudes and emergency-exits servitudes were developed. These laid down limitations to the owners of parcels above the construction and to the owners of neighboring parcels. To meet the conditions defined by the Danish Law on Expropriation costs for compensation because of the servitudes needed to be as low as possible. Therefore, as few limitations as possible were defined which were necessary to protect the constructions against damage ("need to have and not nice to have")”.

According to Dutch Administrative Law (Belemmeringenwet Privaatrecht) the owner of land can be obliged to tolerate construction for public good for infrastructure components, lampposts, electrical cables, water pipes and telecommunication cables. The General directorate of Land Registers registers the establishment of this restriction in property on a parcel. The restriction is stored in the administrative database and this only applies to the parcel under which a cable or pipe is situated and not the exact (horizontal and vertical) location of the cable or pipe.

The obligation of toleration does not cause a horizontal division in the property. Consequently, if there is no question of horizontal accession to real estate, the owner of the parcel becomes owner of the subterranean construction, and can, therefore, be held responsible for any damage.

The administrative registration of the locations of cables and pipes creates a few problems and limitations. When the parcel is subdivided, it is not known in which part of the parcel the cable or pipe is situated. Therefore, the database becomes polluted when the parcel is subdivided, because in that case, all child parcels are charged with a restriction due to the (potential) presence of a cable or pipe. Those registrations are less accurate in comparison to the real situations.

Furthermore, to manage the use of space below the surface, it is important to register the 3D information about cables and pipes. For example, knowledge of the location of cables and pipes can avoid damaging them during digging activities. In addition, by means of 3D information, a more exact limitation could be laid on the owners of the land to prevent any action that could damage the cables or pipes (Stoter, 2002).

Legal aspects of ownership association of urban technical infrastructure facilities in Turkey

Urban technical infrastructure facilities, one of the indicators of development and an important factor in improving the quality of life in cities, are continuously increasing in both quality and quantity along with developing technology as shown in Table 1. Urban technical infrastructure facilities pass through public areas (road, square, green areas, playgrounds etc), state owned land, other treasury land and land owned by private and legal persons. The passage may be on the surface, under the surface or upper surface of the land.

A code of civil law (CC) envisages lands, independent rights on real estates, and independent sections that are subject of condominium ownership as real estates (CC, article. 704). Therefore, technical infrastructure facilities are evaluated as being in the real estate class. Cadastre does not deal with real estates that are not drawn on cadastre sections, not registered in the land registry and not subject to ownership. Therefore, measuring underground facilities and mapping them are not seen as cadastral activities.

Lines as pipelines, electric power transmission lines and sewage lines passing through public areas such as roads, squares, parks, parking lots, green areas, and children’s playgrounds are only measured and mapped with these maps being used when necessary. Since this land belonging to the public are under the possession and rule of government are ownerless and therefore,

Table 1. Urban infrastructure facilities and their types.

Urban technical infrastructure	Type
Roads	Boulevards, main streets, streets, squares, bridges, subways, tunnels and cable cars
Water facilities	Drinking and used water, water tanks and fire extinguisher systems
Waste facilities	Sewer systems, channels for rain water, solid waste collection management stations and chimneys
Electricity facilities	Electrification, illumination, traffic signalization, advertisement boards
Communication facilities	Telecommunication facilities, base stations, television and internet cables
Natural gas	Natural and coal gas facilities
Pipelines	Petroleum pipelines, natural gas pipelines, and clean water pipelines
Traffic facilities	Stations, tramcar lines, cableway facilities, underground and above surface parking lots.
Historical infrastructure facilities	Old underground bazaar, underground roads, underground cisterns, water transport pipelines, and water arches.
Underground shopping malls and environments	Underground closed shopping areas, subways, passage bazaar and shelters.
Natural infrastructure facilities	Caves
Others	…

have no title deeds according to article 715 of the Turkish Civil Code. The relation of infrastructure facilities with cadastre is only considered in the case when they pass through land with a title deed. The land is either expropriated or right of access is established on the land when the route passes through real estates which belong to private and legal persons (CC, article. 727; 744) (Tüdeş and Biyik, 2001).

According to the Civil Code, a person who owns real estate also owns the subsurface, surface, upper surface, any kinds of complementary parts, products and details of that real estate. This ownership can only be restricted by private laws. Therefore, establishing right of access on any infrastructure facility that causes inconveniences in utilizing real estates is required to be carried out by law (Karataş et al., 2006).

In the Turkish code, there are various laws governing infrastructure facilities. The establishment of infrastructure facilities, designed as right of access is generally included in the Civil Code, Expropriation Law, and Public Works Law in the following rights (Dörtgöz, 1996):

a. Watercourse right,
b. Air (construction) right,
c. Right of way,
d. Resource right.

Watercourse right

Right of access is established for the course of technical infrastructure facilities such as water, gas, electricity and suchlike, according to the Turkish Civil Code article 727 (Dörtgöz, 2003). If these courses are in the open air, registration in the land registry is not required. However, they should still be registered if required. If it is an underground facility, the establishment in the land registry as real right is required (Karahasan, 2002).

If passing the route through another place is impossible, extremely expensive or requires substantial effort, and the owner of neighboring parcel does not approve the course, the allowance of mandatory course establishment could be demanded from the court on condition that the other party's loss is paid. If the court accepts the demand, it is registered in the land registry based on a definite court decision (Dörtgöz, 2003).

Air (construction) right

This is a right of access that provides the owner with the rights to construct a building above the surface or under the surface or to protect an existing building and own that building on a land that belongs to another person (CC. article 726, 826). This right of passage is an exception for the rule that concerns ownership of land with buildings constructed both underground and on the upper surface (Gürzumar, 1998). The air right can be transferred and inherited unless stated that it cannot. Air right can be established in two different ways; independent and permanent air right. Independent air right that has been at least for 30 years, namely the continuous air right, can be registered on the land registry upon the request of the owner of the land.

Right of way

Right of way is the right that a real estate owner obtains by consent or court decision from one of the neighboring parcels which has proper position to establish right of way because of the need or necessity to pass through to access to the main road, in exchange for the value of the right of way (Tüdeş and Biyik, 2001). This right can be registered in the land registry as rights of access according to the Turkish Civil Code article number 748.

The most common right of access in practice is the right of way which can be established in favor of real estate or a person the latter, could be real or legal person. The right of way is established with an official bill prepared by the Directorate of the Land Registry upon the agreement of parties. The content of this right, such as which part of the land the right owner will pass through, should be drawn in a map (alteration manifesto) (Dörtgöz, 2003).

Figure 1. (a) Private real estate where drilling was done (URL-4, 2006). (b) The hole made in subway tunnel from the drilling (URL-5, 2006).

Resource right

Resource right is a kind of access right that gives authority to take and distribute the water from spring located on other parties' real estates (CC. article. 837, 756). As a real estate access, this right can be established in favor of a real estate or a legal or private person. If it is established in favor of a person, it can be inherited or transferred to other people. However, the reverse could also be decided by agreement. If it is independent and continuous, it can be registered as a real estate to a separate page in the land registry. In this situation, it is processed just like a real estate (Karahasan, 2002).

The resource is not the subject of ownership right by itself. This right is an exception of the principle of the necessary part since it is obtained with the ownership of the land, from which it emanates (Karagöz, 1995). Rights of access that are established on real estate and restricting the use of ownership, have become subject of objections because of the way in which they are established and many law suits have been filed as a result of those disagreements. Watercourse right and right of way are the most common suits that are filed for the latter 2,666 law suits were filed in local courts in 2002 (DİE, 2002).

The relationship between urban infrastructure facilities and cadastre in Turkey

According to the cadastral law in practice in Turkey, there is no mandatory regulation to measure the borders of underground facilities only the surface borders are measured. Therefore, the cadastre databases, not showing technical infrastructural facilities, are limited to the surface area and prepared in two dimensional forms (Karataş, 2007).

According to article 1 of the Turkish Cadastre Law, number 3402, and by law titled "large scale map and the production of map information", topographic cadastral maps are to be produced by obtaining location information in three dimensions. In practice, some information about the third dimension is gathered and archived and the production of three-dimensional maps, carrying also topographic quality for the places whose technical works are awarded with a contract and undertaken by private sector companies, is demanded by the state (DPT, 2005).

Unfortunately, there is no compliance with this requirement and three dimensional (3D) cadastre bases are not produced in cadastral work only corners of parcels are positioned in three dimensions. Furthermore, three-dimensional data about the facilities and details on the surface, upper surface and subsurface of parcel are not measured for the cadastre base.

In Turkey, a new regulation, appearing in the goals section of the Cadastre Law in 2005, brought a mandatory obligation to measure and archive all information necessary for infrastructure of spatial information system. In this sense, realizing cadastre by including three dimensional and urban infrastructure facilities also became mandatory. This change was perceived as an important improvement in Turkey since nowadays, there is dense use of the surface, subsurface and upper surface of urban land to meet their increasing demands of the inhabitants and users of urban areas. Therefore, three-dimensional cadastre information gained more and more importance in terms of ownership rights, subsurface and upper surface plans, implementation of subsurface and upper surface engineering projects, land management, and providing protection for human life and property. In this context, recording the increasing complexity of urban land use, and designating ownership rights by more accurately determining the rights and limitations on the land requires cadastral work to be performed three dimensionally.

A recent example was a problem that occurred during excavation work; an extension to the Istanbul subway system. On the Taksim to 4th Levent part of the route, as a result of drilling, a hole was made in the roof of an existing subway tunnel; two trains were partly damaged however, a potential disaster was averted (URL-3). Thus, it can be seen that not establishing rights of access on the subway route and the lack of information system based on three dimensions data can cause such problems (Figure 1a, b).

Ownership relationship in the route of technical infrastructures facilities (TIF) in Turkey

There are various ways to manage the ownership associations of

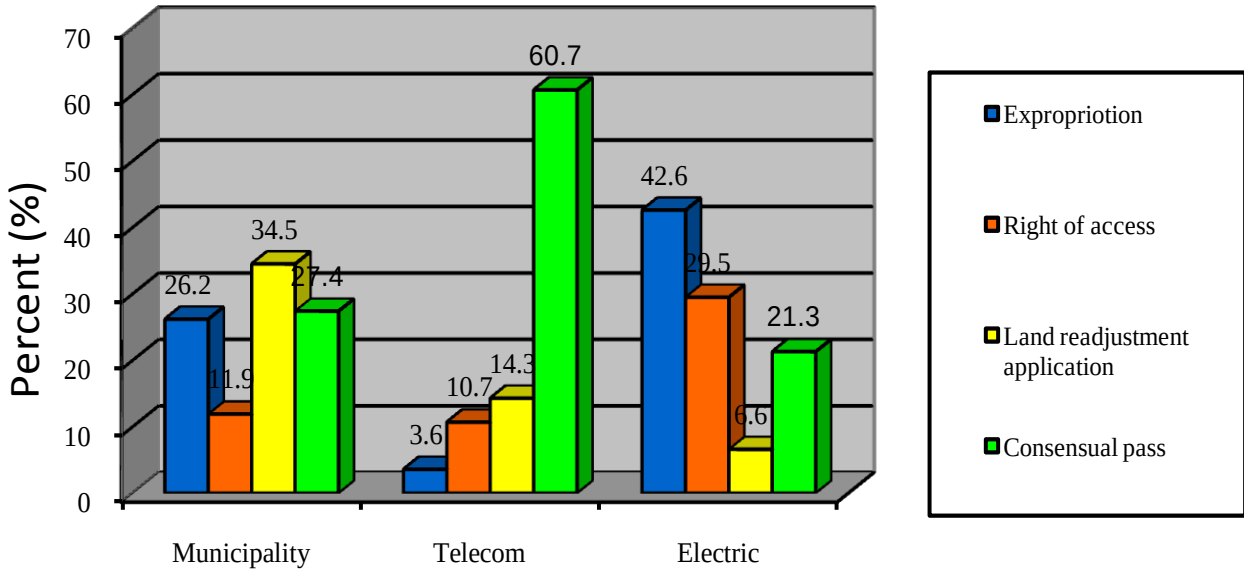

Figure 2. Methods of resolving ownership problems faced in construction of TIFs.

technical infrastructure facilities in Turkey, some of the techniques are given as follows:

Expropriation: Acquiring ownership or establishing right of access, by force, in relation to the real estate or resources in accordance with decisions made by authorized organs, by paying compensation to the value of the right in advance (Tüdeş and Biyik, 2001).

Rights of access: These are restricted real rights, preceded by ownership rights, which need to be registered in the land registry. These rights provide owners with restricted authorities rather than complete rights and authorities provided by ownership rights. These rights include use and utilization authorities on real estate. They restrict the owner's rights and authorities on real estates on which they are established (Karagöz, 1995). Therefore, right of access is a restriction operation on the owner's use and utilization rights that were gained by the owner upon the acquisition of the real estate.

Improvement practice: According to the improvement law, municipalities are authorized to put together the lands and building lots with or without buildings, road surpluses with land belonging to public offices or the municipality, for the purposes of improvement without the need for the permission of land owners or other right owners. They are also authorized to re-separate the joined land into new parcels and city blocks according to the improvement plan and redistribute them to the original owners independently, jointly or in a condominium and carry out the registration operations ex officio. If the places in question are outside the borders of the contiguous area, the governorship has the authority. If there is an increase in the value of parcels because of this rearrangement, a rearrangement partnership share is acquired from the parcel owners. This share cannot exceed 40% of original parcel's size calculated before rearrangement.

Partnership shares may be utilized to construct buildings and facilities such as schools, roads, squares, parks, parking lots, playgrounds, green areas, and prayer buildings that might be needed by the public in places that have been rearranged. The area cannot be used for other purposes except from those mentioned above. In an application area, any part of the rearrangement partnership share exceeding 40%, is expropriated by paying its value to the parcel owners.

Consensual passage: This relates to operations carried out with the owners' permission.

Current solutions used in TIF'S associations with ownership in Turkey

In order to determine the problems that institutions or corporations (Municipality, Telecom-landline Phone Company, Tedaş-electricity Company) have faced and the work performed by those institutions to solve those problems, in 2005 a public survey was conducted in 81 different provinces, 16 of which were metropolitan cities. In addition, 24 districts having high or fast increasing populations and others having a seasonally changing population participated in the survey. The responses provided by the infrastructure institutions to questions about how they solve ownership problems (Figure 2).

Urban technical infrastructure facilities pass through the public areas that exhibit a changing ownership pattern, state lands, other treasury lands and lands owned by private or legal persons. Some ownership problems arise from the route of those facilities in the course of time. Institutions and corporations dealing with technical infrastructure works undertake different methods in solving those problems. As shown in Figure 2 municipalities have solved 26.2, 11.9, 34.5, and 27.4% of the ownership problems with expropriations, right of access, improvement applications and consensual passing, respectively. On the other hand, the Turkish Telecommunications Center (TELECOM), within the 13th and 14th article of Telegraph and Telephone Law, numbered 406, most frequently used consensual pass to solve ownership problems whereas the Province Directorates of Electricity Delivery Institution mainly used expropriation in solving ownership problems, but also used right of access and consensual pass.

Figure 3 shows the differences in the methods chosen to resolve ownership problems that arose during the construction of technical infrastructure facilities. The Water and Sewerage administrations of Metropolitan Municipalities (MM) tended to use expropriation, followed by right of access. Opposite to expectations, TELEKOM preferred to use the improvement application (47.1%).

The results of the survey suggest that the institutions, connected

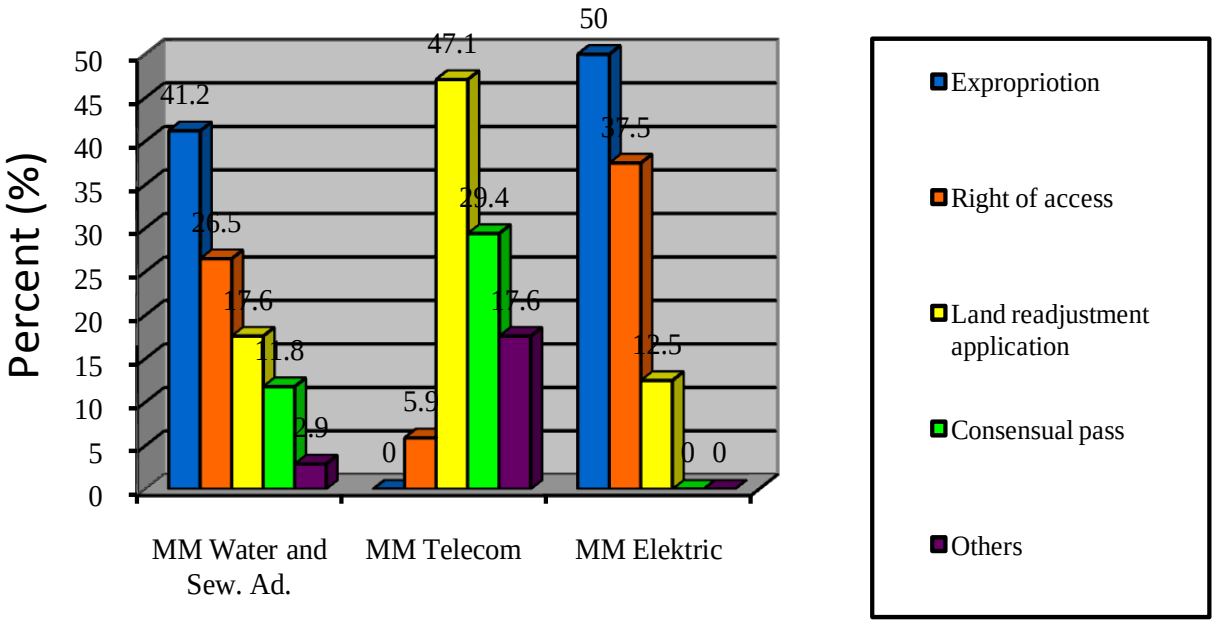

Figure 3. Methods of resolving the problems faced in construction of technical infrastructure facilities (MM).

with technical infrastructure, have used known methods in solving problems faced in construction of technical infrastructure facilities. Preferring other methods apart from consensual passing, applied with the permission of land owner, would be appropriate to avoid problems that might arise from that method.

The necessity of data in TIF`S association with ownership

In Turkey, after the determination of parcels that are directly or indirectly affected by TIF, the operations for expropriation or establishment of rights of access are realized on the parcels, in practices. Here, the subject matter consists of issues such as in which situations the ownership should be expropriated and in which rights of access should be established, and how their value should be determined. In order to do this, trustworthy positional and value data is needed.

Considering technical infrastructure facilities, partial or complete expropriation operation is conducted on parcels directly affected by the routes of technical infrastructure facilities. In other situations, right of access is established in the cases in which the technical infrastructure routes either affect the parcels in positive or negative way or affects a buffer zone. In this process, the expropriation value is determined by considering similar parcels in the same area and their unit price per m^2 is used in calculating the equivalent value.

For land where access rights have been established, the difference between the values of the parcel before and after the construction of the infrastructure facility is determined to be paid to parcel owners as their losses caused the establishment of access rights. However, even though this process seems to be convenient, there have been some problems in the process of objectively determining the degree of restrictions resulting from the construction of the infrastructure facilities on the use, utilization and possession rights of parcels.

It was determined that prior to expropriation, 3D data were not taken into account in determining the parcels where the access right was established and thereby a proper decision was not made. The decision about whether to expropriate or establish access rights on relevant parcels should be made after assessing the surface structure together with the security of the urban infrastructure and real estate by establishing the 3D relationship of parcels with infrastructure facilities. A database for these kinds of projects cannot be created to the desired standards in Turkey, until some problems have been resolved.

In urban areas the rise parcel value is highly unstable. Improvement data is also taken as a criterion when the parcel values are being determined. For instance, parcels that fall within a green area and those that fall into an improvement block are substantially different in terms of value. However, during expropriation, subjecting a parcel, which falls within a green area, to an evaluation process as a regular improvement parcel, except for those parcels in which improvement is well arranged or poorly arranged, should be considered as important in terms of public interest as the parcels in an urban area. One important issue that emerges is forming the land object concept that was developed in the scope of 2014 vision (Yomralioğlu et al., 2003).

Along with determining the owners and borders of parcels in the cadastre phase in the sense of land objects, all the subsurface and upper surface objects need to be determined and registered. Thus, the losses resulting from the restrictions that are established on the parcels could be compensated by determining the values of parcels as objectively as possible. In order to achieve this, the scope and content of the cadastre need to be enlarged, evaluated in the sense of land object and land registration undertaken accordingly.

Relation of technical urban infrastructure to the improvement plan and ensuing problems

For the feasibility of the construction of urban infrastructure facilities and in order to be able to establish their relationship with ownership without any problems, the route of these facilities should primarily be registered in the development plans. For this aim, it is vitally important for planner to prepare development plans by taking data about the route of infrastructure facilities into account, in the same way as ownership borders and existing maps in the phase of

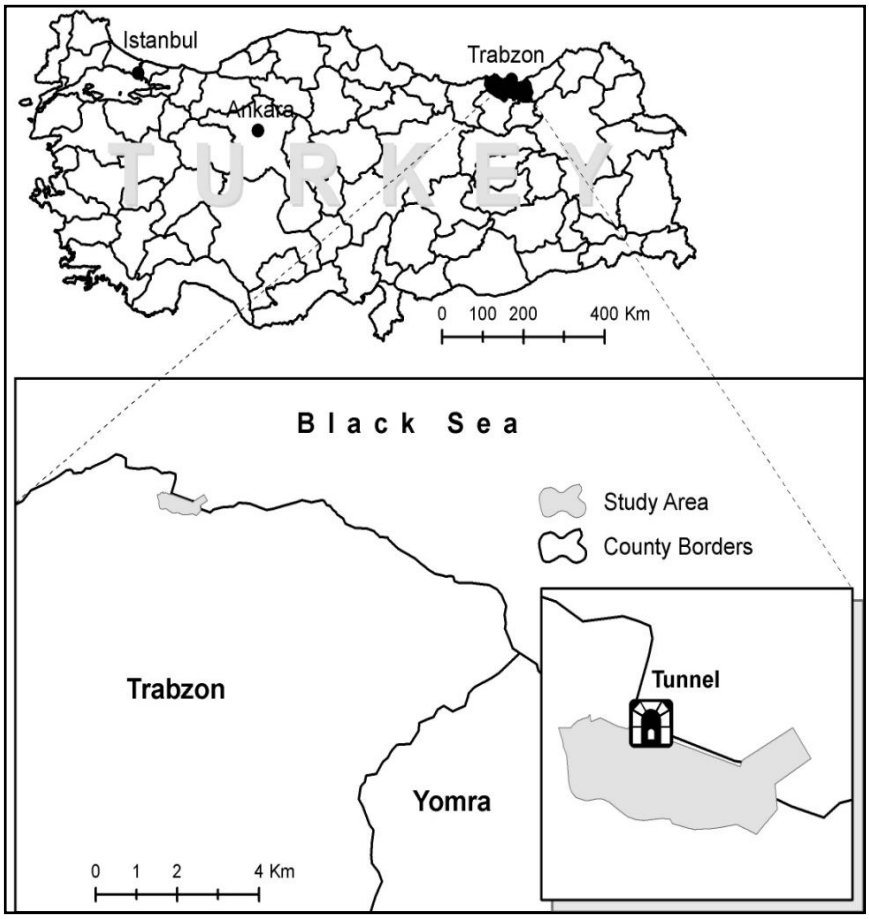

Figure 4. The location of study area in Turkey.

planning urban or urbanization improvement areas are considered. For instance the route of infrastructure facilities should be planned to pass through as many roads or green areas as possible in planning phase in this way there will be minimal problems during infrastructure facility construction.

Furthermore, there will be economic benefits because there is no need to pay compensation for the expropriation of this type of land. Additionally, there will be no delays in implementing the projects due to objections and filed cases from land owners. However, in order to achieve this, development plans including the urban technical infrastructure facilities must be prepared and acquisition of the land must be undertaken as soon as possible and the public areas should be removed from public use.

Unfortunately, in Turkey urban technical infrastructure data is disregarded and not taken into consideration as input data during the planning of development and this results in problems being experienced in relating development plans to technical infrastructure plans.

The most important phase of planning technical infrastructure facilities is to determine the optimum route that best suits the projected facilities. At this stage, possible routes complying with properties of urban infrastructure route, between the start and end of facilities, are determined. Among those possible routes, the most feasible and economic one should be chosen. Here, the route that presents the minimum of damage to land use, and to the rights of both urban and rural land, needs to be chosen. The mistakes made at this point are rather difficult to correct especially after the facility is constructed. For example, the route of these facilities could have angles or have pressure effective route according to their start and end points.

Lawsuits filed against these facilities hardly ever end in favor of plaintiff if the parcels that are the subject of lawsuits are evaluated separately. After this point, plans, particularly those for urban areas, are determined according to the existing technical infrastructure facilities. Even if a better route is observed on another land, except for land that is the subject of a lawsuit, the routes are mostly evaluated and properly planned as a whole considering the route from start to finish. This shows that, if the route of technical urban infrastructure facility is appropriately chosen according to the criteria, lawsuits will generally end in finding against the plaintiff. Here, the most important detail lays in the fact that the optimum route can be formed by evaluating all the necessary data. This requires positional data systems to be formed with required standards for routes. In this way, appropriate routes can be created which will be both feasible and economic. In particular, in the phase of planning the routes, knowing parcels, their owners and access rights on the parcels is extremely important.

Trabzon city passage tunnel as an example of urban infrastructure facility application

Trabzon Coastal Road, is part of the Black Sea Coastal Highway system that passes through the center of Trabzon city is important in terms of its function of a local arterial transportation route (Figure 4). Through most of the city center the road is a dual carriageway

Figure 5. Trabzon city bypass tunnels.

however, the 135 m long and 5 m high tunnel constructed in 1965 in the Kalepark region consists of only two lanes, one for east bound and one for west bound traffic. This tunnel was unable to meet the needs of the traffic volume therefore there is a serious bottleneck in the transportation system at this point (Domaniç and Karahan, 2005).

A plan was prepared by Turkish Highways Trabzon Regional Directorate to excavate another tunnel on the south side of the existing tunnel to eliminate the bottleneck. Completed in 2006, the second tunnel is located between the 0+542,500th and 0+670,870th km of the existing road (Yalçinkaya et al., 2006). It has 3.86 m floor altitude; the altitude of ceiling is 12.42 m (Figure 5).

The construction of the tunnel attracted attention because of dense structuring and historical structures in the immediate vicinity, and also the highway bridged passages constructed near the tunnel. Furthermore, the topography of the area where the tunnel was constructed consists of patches of weak or very weak rock for this reason the Shield Tunneling method, characterized as slow digging and used in underwater tunnels, was used to create the tunnel (Domaniç and Karahan, 2005).

Expropriation works

Expropriation is a mandatory operation that completely removes the possession rights on the owned lands. In road and tunnel projects, the tunnel entrance and exit areas, road connections, the land required for tunnel security and construction, are expropriated. The first Trabzon city bypass tunnel was constructed in 1965 and the related expropriations were realized in the first place based on decision number 31.07.1958/309 made by Trabzon province governance committee. Later on, related parcels were expropriated based on decision number 31.12.1962/154 made by governance committee. For the second tunnel the expropriation decision number 12.08.1999/45, relating to the tunnel entrance and exit, and parcels directly affected by the construction, was undertaken by Turkish Highways General Directorate and expropriation process began in 2003 (Table 2).

The conducted rights of access establishments works

Establishment of right of access restricts the use of parcels. These restrictions are directly related to subsurface and upper surface construction. The security of the tunnel and buildings that could be affected by the tunnel construction is the basic factors determining the size of restrictions introduced. Here, the structure of floor between the engineering building and surface, thickness of the soil, and use of land gains is very important. If the thickness is less and the floor structure is weak, the restrictions on the parcels are greater.

In the case when the underground structure is too deep to be affected by surface construction, namely if there is a great thickness of soil and the ground is very strong, then the technical and legal operations change according to the degree of restrictions to be applied on the parcel. The whole of the first tunnel of Trabzon city by pass and part of the second tunnel passes under a Military Zone which belongs to treasury and under the park where there is a castle wall that belongs to the municipality. Another part of the second tunnel passes under parcels that are privately owned (Figure 6). Thus, access rights were established for some real estates instead of expropriation (Table 3).

In the second tunnel project, the values of effected parcels were determined by the Turkish Roads General Directorate before and after the construction. The difference between them was paid in consideration of the loss of parcel owners. The value loss was generally determined to be between 10 and 20%, but in the cases

Table 2. The parcels expropriated for the second tunnel.

Row num.	City block	Parcel	Parcel area (m^2)	Expropriated area (m^2)	Average parcel altitude (m)	Tunnel–parcel distance (m)
1	287	7	187.70	51.02	9.000	1.20
2	288	1	228.00	92.87	9.000	0.00
3	288	2	51.30	51.30	5.000	0.00
4	290	9	156.00	156.00	9.000	1.30
5	290	10	83.79	83.79	6.000	0.00
6	290	18	367.54	367.54	9.000	0.00
7	290	19	104.84	5.75	10.000	6.00
8	290	28	101.40	101.40	6.000	0.00
9	290	30	30.60	30.60	6.000	0.00
10	294	2	166.20	166.20	12.000	0.00
11	294	3	120.20	120.20	14.000	0.30
12	294	4	205.72	152.49	16.000	0.00
13	294	5	176.30	86.94	17.000	0.00
14	294	6	223.26	18.85	19.000	4.90
15	294	16	62.62	62.62	11.000	0.00
16	294	17	79.43	79.43	11.000	0.00
17	294	18	50.00	50.00	11.000	0.40
18	294	19	34.94	34.94	9.000	0.00
19	294	20	37.63	37.63	9.000	0.00
20	294	21	37.63	37.63	9.000	0.00
21	295	28	298.40	298.40	17.000	0.00
22	295	29	76.50	76.50	17.000	0.00
23	295	40	68.60	68.60	17.000	0.00
24	295	41	93.13	93.13	16.000	0.00
25	295	42	135.20	135.20	16.000	0.00
26	295	47	145.20	145.20	15.000	0.00
27	295	49	177.90	116.82	17.000	0.00
28	298	1	58.17	23.14	22.000	0.00
29	298	3	2.70	2.70	16.000	0.00
30	298	10	1.96	1.96	4.000	42.70
31	298	13	198.20	34.50	23.000	37.80
32	298	14	53.91	9.67	19.000	37.90
33	298	15	284.30	264.30	19.000	0.00
34	298	17	73.25	73.25	16.000	0.00
35	298	26	104.22	104.22	4.000	0.00
36	298	28	166.13	168.13	4.000	0.00
37	298	29	192.10	178.54	4.000	0.00
38	299	1	187.06	26.38	17.000	11.50
39	299	2	95.00	95.00	17.000	0.00
40	299	3	69.60	69.60	17.000	5.00
41	299	11	178.76	46.49	25.000	10.70
	Total		5165.39	3016.41		

where the value loss increased to 40 and 50%, expropriation was applied.

The routes of the first and second Trabzon city passage tunnels are located in a region where accommodation units exist. The first tunnel passes under the military zone and castle wall. The second tunnel, on the other hand, passes under the military zone, castle wall and accommodation units. After constructing the second tunnel, with the changes made to the development plan, the tunnel region was designed as park area to prevent construction over the tunnel and thus protect it. However, there are buildings on some of the parcels where access rights were established, but, construction of new building by demolishing the old ones on established parcels with

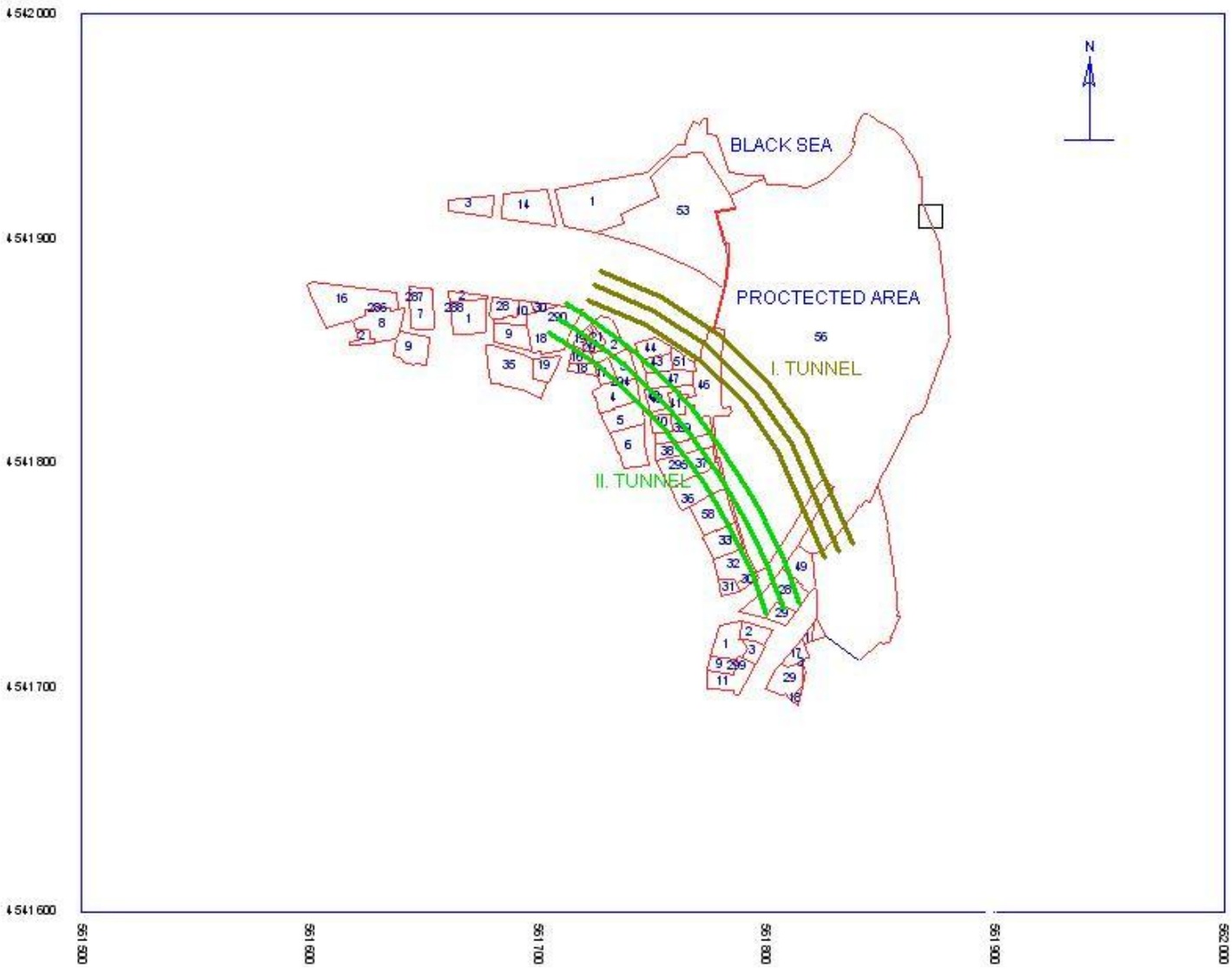

Figure 6. The status of parcels under which the Trabzon city bypass tunnel passes.

Table 3. Parcels where access right were established.

Row num.	City block	Parcel	Parcel area (m^2)	Area where access rights were established(m^2)	Average parcel altitude (m)	Tunnel -Parcel distance (m)
1	295	30	36.60	36.60	24.000	0.00
2	295	31	50.17	50.17	25.000	7.50
3	295	32	182.30	182.30	25.000	0.00
4	295	33	170.96	170.96	22.000	0.00
5	295	36	256.40	256.40	21.000	0.00
6	295	37	255.60	255.60	20.000	0.00
7	295	38	162.20	162.20	18.000	0.00
8	295	39	237.72	237.72	17.000	0.00
9	295	46	552.60	195.07	16.000	0.00
10	295	56	14147.60	2258.92	22.000	0.00
11	295	58	245.1	245.41	23.000	0.00
	Total		16297.25	4051.35		

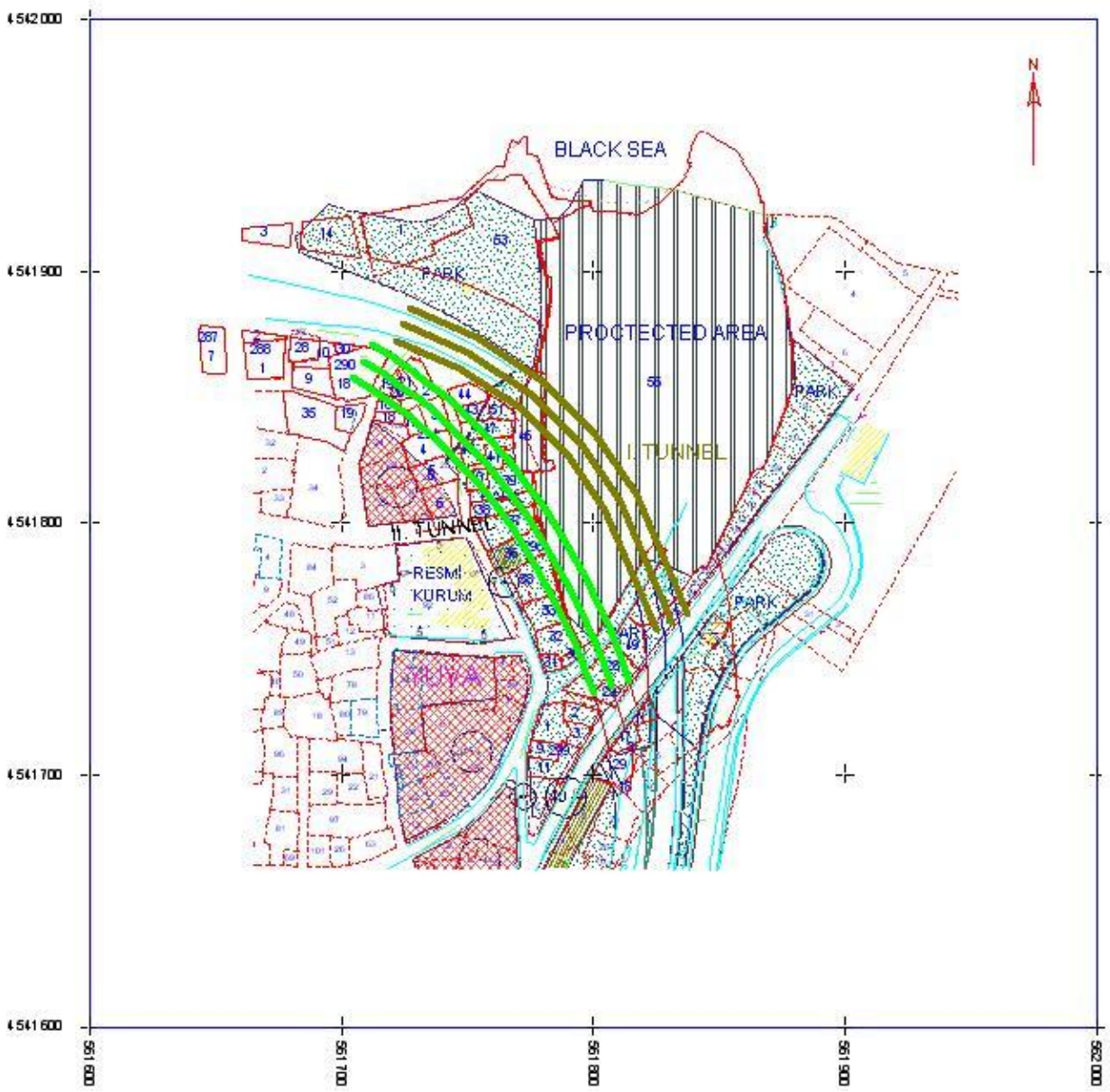

Figure 7. The improvement plan of tunnel region.

access rights is not allowed (Figure 7). Thus, important restrictions were applied on land use although, the amount paid for those restrictions is far from compensating the loss to the owner(s).

Ownership problems in construction of the tunnel

During the construction of the tunnel, many ownership problems were experienced between the real estate owners and the construction company that built the tunnel. These problems mostly occurred because of the objections about expropriation, access rights operation, or the amount of compensation that was determined. In this project, since there were parcels in Trabzon city center, where the land is limited and valuable, the objections from institutions as the municipality and landowners were mostly based on the amount of compensation paid.

In the expropriation phase of the project prepared for the second Trabzon city bypass tunnel, some buildings around the tunnel exit that were designated for demolition were deemed to be under a preservation order by The Committee of Preservation of Cultural and Natural Assets. Thus, the axis of second tunnel had to be changed (Domaniç and Karahan) (Figure 8).

As stated above access rights were established on real estates located on the second tunnel of Trabzon city passage however, because of a problem that occurred at ground level after the construction of the tunnel, 38 and 39 parcels of city blocks number 295 were expropriated. Likewise, following research into the deformation of the tunnel it was observed that 8 mm of deformation occurred on the roof of tunnel and the side walls had moved approximately 2 to 3 mm towards the axis (Yalçinkaya et al., 2006). This resulted in a number of parcels of land being expropriated.

Even though the parcels, on the tunnel in the study area, were

Figure 8. Buildings caused changes in tunnel route.

completely restricted in terms of urban land use, it was seen that access rights had been established on them. It is because of the fact that the necessary conditions were not emanated in conditions that there is a difference between the altitude of tunnel ceiling and the altitude of parcels. Conducting an access rights expropriation on these kinds of parcels causes unjust treatments in terms of land owners` rights.

RESULTS AND DISCUSSION

In Turkey, the losses of ownership rights caused by the effects of restrictions that are derived from the direct or indirect effects of infrastructure facilities are usually compensated by ownership expropriation or by establishing a continuous right of access on real estates. In general, there is not enough information for these kinds of operations. Since the people who decide which legal actions are to be taken in accordance with the restrictions that will occur on the lands are not generally experts on the subject, legal processes are applied in these kinds of operations.

The socioeconomic effects of the problem always preserve their actuality. The problem stems from not determining the restrictions that are caused by infrastructure facilities on ownership according to a realistic model. Here, the usage utilization and possession rights restrictions on real estates located on the routes of infrastructure facilities need to be examined according to objective criteria. Infrastructures at certain depths such as tunnels, subways, natural gas and sewer systems, major energy transmission lines, directly or indirectly affect the real estate on their routes in terms of usage type.

Generally, the degree of the effect is determined by factors such as type and function of infrastructure facilities, floor structure, facility-real estate interaction, security of life and asset. The most important specific point is to decide of who will determine these factors and how those factors will be defined. In order to do this, an interdisciplinary study is needed to assess the optimal association between infrastructure facility and ownership.

In general, operations on these kinds of facilities are entered in the land registry with continuous access rights. For real estate affected by these operations, the loss value caused by a restriction of access rights should be determined and compensation needs to be paid accordingly. In order to realize all of these operations in an effective way, three dimensional cadastre is needed and the third dimension should cover the infrastructure facilities.

In terms of the infrastructure, data is required that assists in the selection of the optimum route should be created. Thus, there is a need to form infrastructure data systems that will properly show information, such as land structure, three dimensional ownership base, geological status, vegetation, data for natural life on the route of infrastructure facilities, and the properties of urban and rural land. Moreover, this system is essential in terms of

determining the optimum routes and implementing the engineering projects concerning infrastructure facilities and correctly establishing the association of these facilities with ownership.

For all the reasons given in the foregoing, scientific criteria need to be obtained about which of the parcels affected by urban infrastructure facilities should be expropriated and on which of them access rights should be established. To achieve this, interdisciplinary coordination and cooperation is needed. This could be a committee, formed by people from different disciplines, to determine the size of affect caused by urban infrastructures on use, utilization and possession rights. For example, for a coastline-edge detection committee, the following people could be involved; surveying engineer, civil engineer, geological engineer, and architect, agricultural engineer, forest engineer and planners. Additionally, a specific information system should be created in relation to urban infrastructure facilities.

Conclusion

For a sustainable urban land management, the authority and the content of cadastre need to be arranged to include each of the items of the cadastral volume (3D cadastre). In this sense, today the 3D registration system, currently disputed by academicians under the topic of '3D cadastres' also needs to be developed. Besides, in order not to raise property problems on the infrastructure routes, it is very important to present urban infrastructure facilities as substrate during the stages of development plan, particularly in urban areas.

Currently, in the cadastre legislation there is no model of how it will be realized. The construction of an infrastructure system, which is a substratum of statial information system, and eventually planning the routes of urban infrastructure systems to provide optimal passage have significant importance for sustainable land management.

REFERENCES

DİE (2002). Adalet İstatistikleri, DİE Matbaasi, Ankara, s. 108, (in Turkish).

Domaniç Y, Karahan E (2005). Karadeniz Sahil Devlet Yolu Trabzon Şehir Geçişi 2. Tünel Etüt Proje Mühendislik Hizmetleri İşi Kesin Proje Ek Raporu, Bayindirlik ve İskan Bakanliği Karayollari 10. Bölge Müdürlüğü, (in Turkish).

Dörtgöz GÖ (1996). Altyapi Tesislerinin Tapu Sicilindeki Hukuksal Durumu, Mülkiyet Dergisi, sayi: 20, s. 22, (in Turkish).

Dörtgöz GÖ (2003). Yeni Medeni Kanuna Göre Tapu İşlemleri, Birlik Matbaacilik AŞ., Ankara, s. 217-223, (in Turkish).

DPT (2005). 8. Beş Yillik Kalkinma Plani Harita ve Kadastro Özel İhtisas Komisyonu Raporu (2001-2005), http://ekutup.dpt.gov.tr/harita/oik570.pdf, 10 Mart 2005, (in Turkish).

Kehne G (2003). Maintenance of Tunnels with The Help of Spatial Information Systems, http://www.fig.net/pub/proceedings/korea/full-papers/pdf/session9/kehne.pdf 28.05.2003.

Gürzumar OB (1998). Türk Medeni Hukukunda İrtifak Haklari, Beta Basim A.Ş., İstanbul (in Turkish).

Takasaki H, Chikahisa H, Yuasa Y (2000). Planning and Mapping of Subsurface in Japan, Tunnel. Underground Space Technol. 15(3):287-301.

International Tunnelling Association (ITA) (1991). Legal and Admistrative Issues in Underground Space Use: a Preliminary Survey of ITA Member Nations, Tunnel. Underground Space Technol. 6(2):191-209.

International Tunnelling Association (ITA) Working Group No. 4, (2000). Planning and Mapping of Underground Space – An Overview, Tunnel. Underground Space Technol. 15(3):271-286

Karagöz M (1995). Haritacilikta Taşinmaz Hukuku, Harita ve Kadastro Mühendisleri Odasi Yayini, Ankara (in Turkish).

Karahasan MR (2002). Yeni Türk Medeni Kanunu, Eşya Hukuku, Cilt I, Beta Basim A.Ş., İstanbul (in Turkish).

Karahasan MR (2002). Yeni Türk Medeni Kanunu Eşya Hukuku, Cilt II, Beta Basim A.Ş., İstanbul (in Turkish).

Karataş K, Biyik C, Demir O (2006). The Underground Cadastre and Its Implementations in Turkey, Shaping the Change XXIII FIG Congress, 8-13 October, 2006, Munich, Germany. http://www.fig.net/pub/fig2006/papers/ps07/ps07_08_karatas_etal_0536.pdf.

Karataş K (2007). Kentsel Teknik Altyapi Tesisleri, Kadastrosu ve Türkiye'deki Uygulamalarin Organizasyonu, Doktora Tezi, KTÜ, Fen Bilimleri Enstitüsü, Trabzon (in Turkish).

Küçükoğlu H (2006). Sonlu Elemanlar Metodu ile Tünel Modellemesi ve Bir Uygulama, Gazi Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, Ankara (in Turkish).

Satir B (2007). Tünel Deformasyonlarinin Jeodezik, Geoteknik ve Sonlu Eleman Yöntemleri İle Belirlenmesi, Yüksek Lisans Tezi, KTÜ, FBE, Trabzon (in Turkish).

Stoter JE (2002). Needs, Possibilities and Constraints to Develop A 3D Cadastral Registration System. http://www.gdmc.nl/publications/2000/3D_cadastral_registration.pdf.

Stoter J, Sørensen EM, Bodum L (2004). 3D Registration of Real Property in Denmark, FIG Working Week 2004, May 22-27, 2004, Athens, Greece.http://www.fig.net/pub/athens/papers/ts25/TS25_5_Stoter_et_al.pdf, 20.05.2004.

Tüdeş T, Biyik C (2001). Kadastro Bilgisi, 3. Baski, KTÜ Basimevi, Trabzon (in Turkish).

William AT (1979). Ownership of Subterranean Space. Underground Space 3(40):155-163.

Yalçinkaya M, Satir B, Akköse M (2006). Determining The Displacement Occurred In The Tunnels Using Different Measurement And Finite Elements Methods: A Case Study For Trabzon-2 Tunnel, In Turkey, 3 rd IAG / 12 th FIG Symposium, May 22-24, 2006, Baden, Austria. http://www.fig.net/commission6/baden_2006/PDF/MTU/Yalcinkaya.pdf.

Yomralioğlu T, Uzun B, Demir O (2003). Kadastro 2014 - Gelecekteki Kadastral Sistem İçin Bir Vizyon, TMMOB Harita ve Kadastro Mühendisleri Odasi Yayini, Ankara (in Turkish).

URL-1, www.odew.net/maden/odewnet40.doc, 14 Mart 2007.

URL- 2, http://www.odevsitesi.com/odevler/arsiv1/30508-batirilmis-tuneller---immersed-tunnel.html, 12 Nisan 2007.

URL-3, 2006. http://www.internethaber.com/news_detail.php?id=3682011.08.2006.

URL-4, 2006, http://www.hurriyet.com.tr/gundem/4904454.asp?m=1&gid=69&srid=3047&oid=1.

URL-5, 2006, http://hurarsiv.hurriyet.com.tr/goster/haber.aspx?id=4898570&tarih=2006-08-10.