Review Article

Strategic Approaches for a Sustainable Future in an Earthquake Zone: A Comparison Between Japan and Türkiye

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Abstract

Japan, one of the world's most earthquake-prone countries, has long implemented a value-based urban development strategy known as Land Readjustment (LR), or Tochi Kukaku Seiri. This model uses scientific valuation methods to ensure that land values are fairly calculated and redistributed before and after urban development. It aims to reduce earthquake risks, promote social justice, and support economic sustainability. In Japan, LR is strengthened through transparency, public participation, GIS-based digital maps, and AI-supported analysis—making the process more effective in building resilient cities.

In Türkiye, the need for value-based regulations has increased, especially after the 1999 Marmara Earthquake and the 2023 Kahramanmaraş earthquakes. Although the Ministry of Environment, Urbanization, and Climate Change has launched some pilot applications, a comprehensive and holistic policy transformation has not yet taken place. In Japan, these processes have been made more effective through CBS-based digital maps, artificial intelligence-supported analyses, and mechanisms based on public participation.

The study compares the LR policies of Japan and Türkiye in terms of their historical, legal, technical, and social dimensions. The findings reveal that Japan's value-based, participatory, and transparent approach can serve as a guide for Türkiye. It has been observed that Türkiye's current system, which is based on equal proportional cuts, is insufficient in terms of sustainability due to social injustices and limited transparency. In conclusion, value-based standards adapted from Japan could make significant contributions to ensuring social justice, strengthening economic sustainability, and building resilient cities in Türkiye's post-disaster urban transformation processes.

Keywords: Land Readjustment (LR), Sustainability, Tochi Kukaku Seiri, Value-Based Distribution (Equivalence/Equivalence), Zoning Practices.

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İnceleme Makalesi

Deprem Kuşağında Sürdürülebilir Bir Gelecek İçin Stratejik Yaklaşımlar: Japonya ve Türkiye Karşılaştırması

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Özet

Dünya genelinde en yüksek deprem riskine sahip ülkelerden biri olan Japonya, Arazi ve Arsa Düzenleme (AAD) yöntemi aracılığıyla kentsel gelişime yönelik değer temelli yaklaşımıyla uzun süredir tanınmaktadır. Tochi Kukaku Seiri olarak bilinen bu model, kentsel düzenlemeden önce ve sonra arazi değerlerinin adil bir şekilde belirlenmesini ve yeniden dağıtılmasını sağlamak için bilimsel değerleme tekniklerini kullanmaktadır. Yaklaşım, deprem risklerini azaltmayı, sosyal adaleti teşvik etmeyi ve ekonomik sürdürülebilirliği desteklemeyi amaçlamaktadır. Japonya'nın AAD uygulamaları, şeffaflık ve halkın katılımı mekanizmalarının yanı sıra CBS destekli dijital haritalar ve yapay zeka tabanlı analizlerle güçlendirilerek dirençli şehirler inşa etme konusundaki etkinliklerini daha da artırmaktadır.

Türkiye'de ise özellikle 1999 Marmara Depremi ve 2023 Kahramanmaraş depremleri sonrasında değere dayalı düzenlemelere ihtiyaç artmıştır. Çevre, Şehircilik ve İklim Değişikliği Bakanlığı bazı pilot uygulamalar başlatmış olsa da kapsamlı ve bütüncül bir politika dönüşümü henüz gerçekleşmemiştir. Japonya'da ise CBS tabanlı dijital haritalar, yapay zekâ destekli analizler ve halkın katılımını esas alan mekanizmalarla bu süreçler daha da etkin hale getirilmiştir.

Çalışmada Japonya ve Türkiye'nin AAD politikaları tarihsel, hukuki, teknik ve sosyal boyutlarıyla karşılaştırılmıştır. Bulgular, Japonya'nın değer esaslı, katılımcı ve şeffaf yaklaşımının Türkiye için yol gösterici olduğunu ortaya koymaktadır. Türkiye'nin mevcut eşit oransal kesinti esaslı sisteminin, sosyal adaletsizlikler ve sınırlı şeffaflık nedeniyle sürdürülebilirlik açısından yetersiz kaldığı görülmüştür. Sonuç olarak, Japonya'dan uyarlanacak değer temelli standartlar, Türkiye'nin afet sonrası kentsel dönüşüm süreçlerinde sosyal adaletin sağlanması, ekonomik sürdürülebilirliğin güçlendirilmesi ve dirençli şehirlerin inşası için önemli katkılar sunabilecektir.

Anahtar Kelimeler: Arazi ve Arsa Düzenlemeleri (AAD), Sürdürülebilirlik, Tochi Kukaku Seiri, Değer Esaslı Dağıtım (Eşdeğerlik/Eşdeğerlilik), İmar Uygulamaları.

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INTRODUCTION

Earthquakes are among the natural disasters that affect many countries around the world. Especially countries located on fault lines are more vulnerable to the destructive effects of earthquakes. In these countries, various strategies are implemented to reduce the effects of post-earthquake destruction and to reconstruct the urban fabric. In this context, urban sustainability and disaster management in earthquake-prone regions are of great importance in terms of increasing social resilience and protecting environmental balances. Urbanisation process is a critical factor affecting ground suitability, infrastructure durability and post-disaster recovery speed in earthquake-prone regions.

Japan is in one of the most active earthquake zones in the world. In Figure 1, the National Seismic Hazard Maps for Japan predict and illustrate the consequences of earthquakes across the country (HERP, 2018). For this reason, in order to reduce earthquake risks, Japan has adopted a value-based land regulation method called 'Tochi Kukaku Seiri', and with this approach, they have ensured social equality and economic sustainability by redistributing real estate fairly before and after the regulation. This model has been widely used, especially after devastating events such as the Kobe Earthquake (1995) and the Tohoku Earthquake and tsunami (2011), integrating disaster management and urban planning. Supported by Geographic Information Systems (GIS) and artificial intelligence-based analyses, these strategies aim to create resilient cities by addressing not only physical risks but also social inequalities. In addition, public participation was ensured in the regulation process, which strengthened the social acceptance of the process.

Turkey is one of the countries located in the earthquake zone. Turkey Earthquake Hazard Map published by AFAD in 2018 is given in Figure 2. Especially after the 2023 Kahramanmaraş earthquakes, there has been an increasing awareness of urban sustainability and disaster management. However, current practices are generally based on equal land deduction and lack a value-based approach. This situation leads to injustices among property owners after the regulation

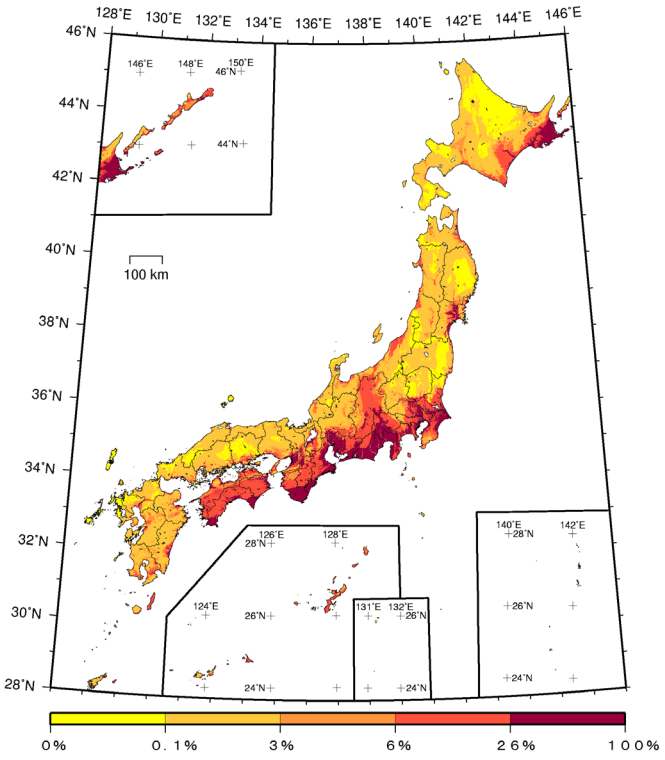

Figure 1. Earthquake risk map of Japan from 2012 to 2042 (HERP, 2018).

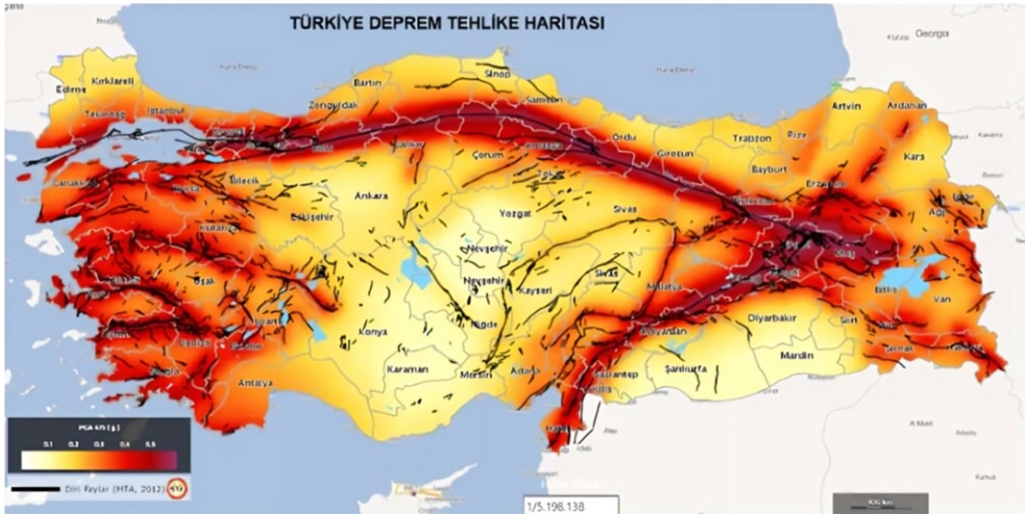

Figure 2. Türkiye earthquake hazard map (AFAD, 2018).

and increases social dissatisfaction (Köktürk & Köktürk, 2009). Although pilot projects are working on value-based LR applications, a comprehensive policy change has not yet been realised. Factors such as technological infrastructure deficiencies, lack of implementation of scientific standards, and insufficient social participation are among the main factors preventing the achievement of sustainable urbanisation goals. In this context, Japan's experiences will serve as a model for Türkiye, providing social justice and promoting economic sustainability in post-disaster transformation processes (Ülger, 2010).

MATERIAL AND METHOD

The study aims to compare the historical and legal bacöktürkkground, implementation mechanisms and social impacts of the LR practices in Japan and Türkiye. The criteria selected for making comparisons are grouped by analysing the contents of the relevant laws. In this context, the legal legislation of Japan and Türkiye are analysed in the context of urban regeneration and land use practices. A comprehensive comparison has been made between the two countries in terms of legal infrastructure, social participation, land valuation methods, financing models, and post-disaster urban reconstruction. The differences, advantages and deficiencies between the Japanese and Turkish urban regeneration practices will be presented visually with tables and graphs, and the necessity of a new zoning implementation method that will be effective in shaping Türkiye's post-earthquake urbanisation policies will be revealed.

Historical Process of Urban Regeneration in Japan

Japan has experienced radical transformations in the process of transition from a feudal period to a modern industrial country. This transformation brought about a rapid urbanisation process, leading to the concentration of population in industrial areas and uncontrolled land use. Especially the devastation and rapid economic growth after World War II have increased the importance of urban development projects. In Japan, which has been based on agricultural communities throughout its history, inadequacies in infrastructure and social services during the urbanisation process have negatively affected the quality of urban life. With the increase in migration from rural areas to urban areas, transport systems were mainly designed to provide transport for workers from rural areas to urban areas. This situation has led to inefficient urban transport and traffic problems. Natural disasters and post-war devastation have been another important source of motivation for urban area organisation projects. Natural disasters such as earthquakes and typhoons have necessitated the

reconstruction of cities. In this process, urban development (urban regeneration) projects have aimed not only to rebuild physical infrastructure but also to create more resilient and livable cities (URL-1; Yanase, 2013; Takizawa et al., 2013).

Japan, as one of the international co-operators in the field of planning and land development, has successfully applied the Land Readjustment technique (Land Readjustment or Tochi Kukaku Seiri in Japanese) and has helped to implement it in different countries in Asia. Inefficient land use and infrastructure deficiencies in urban areas have made it difficult to build modern cities that support economic growth. In this context, the Land Consolidation Law enacted in 1899 was modelled on Germany and adapted to Japan. The practice, which was adopted in a short period, was used in the reconstruction of city centres destroyed by the Great Kanto Earthquake of 1923 and the Second World War, and started to be used as a suitable technique for urban area arrangements (Sorensen, 2000; Ohashi, 2000). This law, which was used to regulate arable land, was abolished and a more comprehensive law, the Soil Improvement Law, came into force in 1949. It was successfully implemented, especially in the context of organising arable land that had been devastated after the war (Ohashi, 2000).

By 1954, a more comprehensive programme was needed for general reconstruction and the formation of new urban structures, and the Land Readjustment Law (LRL) was implemented after a comprehensive extension. This law increased landowners' rights in land regularisation projects; project implementation bodies, local public expenditure and programme review and re-planning were more broadly empowered (Nagamine, 1986; Larsson, 1997; Sorensen, 2000). The law aimed at financing infrastructure projects, stabilising landowners' contributions and ensuring that properties would benefit from the increase in value after regulation (equivalence/equivalence). In 1968, the Urban Planning Act came into force, revising the Town Planning Act of 1919. The law transferred planning authority to governorates and municipalities and divided urban planning areas into two zones: urbanisation promotion areas and urbanisation control areas (Hasegawa, 2014).

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The Urban Renewal Law was enacted in 1969 to renew old and poorly infrastructured urban areas and promote social housing projects. Economic incentives were provided for the renewal of city centres and social housing projects (Kobayashi, 2007; URCA, 2023). In 1995, after the Kobe earthquake, the Earthquake Damage Prevention and Reconstruction Law was enacted to rapidly reconstruct disaster areas and develop disaster prevention infrastructure. Although this law ensured the rapid development of disaster-resistant

infrastructure and encouraged mass housing projects, there were criticisms about the lack of social justice and property rights in expropriation processes (Okada et al., 2000).

In 2002, the Special Use Areas Renovation Act aimed to implement innovative projects in commercial areas by encouraging private sector participation (Hiramoto et al., 2007). In 2011, after the Great Tohoku Earthquake and Tsunami, the Basic Law on Reconstruction after Major Natural Disasters was enacted to provide a legal framework for rapid reconstruction projects in disaster areas. Although it accelerated post-disaster reconstruction processes and ensured coordination at the national level, social and economic impacts were not sufficiently taken into account and long-term sustainability was ignored (Bayra, 2021).

Today, Law No. 119 on Land Readjustment (1954) is still in force as the basic law for implementing DRR. Projects implemented within the framework of this law are used in Japan not only to develop physical infrastructure but also to ensure social and economic sustainability (Salalı, 2023).

By preventing the irregular growth of cities after urbanisation activities, the LR practice has contributed to controlling environmental problems and making cities suitable for the ageing population. LR has been widely implemented throughout the country and has been recognised as the Mother of Urban Planning (or toshikeikaku-no-haha in Japanese) in Japan. In the nearly a century since its introduction, many projects have been carried out. This model aims to distribute economic activities from the centre to the periphery and to create more livable cities (URL-1; Yanase, 2013).

Historical Process of Urban Regeneration in Türkiye

Urban regeneration practices in Türkiye started with accelerated urbanisation after the Second World War, especially to combat the problems of regular construction and slums (Yıldız, 2011). The Shanty Law No. 775, which entered into force in 1966, was the first legal regulation initiated to prevent regular construction and divide the existing slums. Urbanisation, which has accelerated since the 1980s, was tried to be put into a more systematic framework with the Zoning and Slums Law No. 2981 in 1984 (repealed in 2012) and the Housing Law No. 2985. However, these systems were insufficient due to the lack of social, economic and participation dimensions (Ülger, 2010; Genç, 2008; İnam & Salalı, 2021; Ceylan & Kutlu, 2007).

After the 1999 Marmara Earthquake, studies on disaster-resistant technologies were intensified, and the North Ankara Entrance Urban Transformation Project Law No. 5104 was enacted to implement a special area in 2004. With this law, only physical transformation, redefinition of zoning rights and regulation of property were aimed (İnam & Salalı, 2021; Ülger, 2010). In the same year, the Land Office Law No. 5273 and the Mass Housing Law, TOKİ, were authorised for implementation.The Law No. 5226 on the Protection of Cultural and Natural Assets, also enacted in 2004, does not contain any regulations on transformation (Yılmaz, 2016). Law No. 5216 on Metropolitan Municipality was one of the laws enacted in 2004, and its content drew attention to the metropolitan organisation (Özdemir, 2008).

In 2005, only conservation areas became the focal point with the Law No. 5366 on the Renewal and Protection of Worn-out Historical and Cultural Immovable Assets. However, due to the gaps in the law, it has remained far from being a legal basis (Kentleşme Şurası, 2009; Ülger, 2010; Genç, 2008; Seydioğulları,

2016). In the same year, the Municipal Law No. 5393 entered into force. The rights granted to municipalities by this law created problems. In 2005, the Draft Law on Transformation Areas, which was at the centre of all criticisms, offers a rent-oriented purpose rather than solving the problems experienced in urban areas. This situation reveals an understanding of regulation that is contrary to the objectives of Urban Transformation and contrary to the understanding of sustainable city (Genç, 2008).

In Türkiye, a general transformation process has gained momentum with the Law No. 6306 on the Transformation of Areas Under Disaster Risk, which entered into legislation in 2012. This law granted wide powers to the Ministry of Environment, Urbanisation and Climate Change and the Housing Development Administration (TOKİ). It created the legal infrastructure for the transformation of cities and buildings but was criticised for the lack of social participation and concerns over property rights (Seydioğulları, 2016; Daşkıran & Ak, 2015).

During so many legal interventions in the space and the city, the gap of how and by which method the transformation should be carried out could not be closed. In this context, LR applications, one of the zoning implementation methods, have gained importance. In 1985, the Zoning Law No. 3194 was enacted and has remained valid until today by being amended for the necessary regulations.

Japan Land Readjustment (Tochi Kukaku Seiri) and Its Stages

The LR applied in Japan is regulated under the Land Readjustment Law No. 119. The law is an effective public-private partnership model that provides benefits in areas where existing land use models are inadequate, where governments and landowners jointly undertake urban development costs. This regulation was developed to control irregular construction, develop infrastructure and create modern urban areas (Salalı et al., 2022). The law protects the rights of landowners and ensures that urban transformation projects are carried out in a fair, sustainable and efficient manner. It determines the application standards in processes such as improving urban infrastructure and post-disaster reconstruction. In this context, LR applications are based on the following basic stages:

Project preparation and planning

Determination of targets: The main purpose of the law is to contribute to economic development by prioritizing the public interest by encouraging the expansion of sound urban areas and planned growth, by allocating project and implementation costs to regulatory projects for the improvement of existing infrastructure and the creation of post-disaster reconstruction and safe settlement areas (Art. 1).

Project program and approval: The project draft is prepared with the cooperation of landowners (Art. 2). The draft is based on a basic plan including road layout, infrastructure needs, public facilities and a rough timeline (Art. 6.8). Consensus must be reached among all landowners and tenants in the project area (Art. 4.1). The project is submitted to the provincial governor's office with the approval of a 2/3 majority of the landowners in the project area (Art. 18). The provincial governor's office is obliged to exhibit the project openly to the public for two weeks and the objection process begins at this stage. This requirement may be waived in projects carried out by the public sector, but the city master plan is taken into account. (Art. 20.2, 55.2, 69.2, 71.3.5) (Larsson, 1993; Sorensen, 1999; Çölkesen et al., 2007; MLIT, 2020).

Land assessment and financial planning

Land assessment process: Land assessment is critical to ensuring justice in the reserve land contribution, compensation calculation and re-subdivision process (Art. 65, 71, 71.5) (Sorensen, 2000; De Souza & Ochi, 2018; MLIT, 2020). Parcel assessment methods are as follows:

Market value: Land prices in the area are calculated according to market conditions.

Street value: A value is determined according to the street and environmental conditions where the land is located. This method was developed in the 1950s and was formalized as the "LR Land Assessment Standard" in 1978 (Archer, 1989; Tamano, 2005). Street value;

- Accessibility Coefficient: Proximity of the land to public facilities, transportation and other areas,
- Street Coefficient: Road width, infrastructure status, presence of sidewalks and street trees,
- Land Coefficient: Factors such as topography, sunlight, infrastructure connections and general environmental conditions affect (De Souza & Ochi, 2018; Tamano, 2005).

Financial planning: In order to prevent landowners from being harmed, the financial dimension of the project should be examined in detail and the financial resources required for successful implementation should be determined (Art.91). All expenses that may arise at all stages of the project (land acquisition, infrastructure works, transportation arrangements, tourism facilities, etc.) and the estimated revenues that the project will bring should be calculated in detail and a comprehensive budget that can be approved by the Ministry of Land, Infrastructure, Transportation and Tourism should be prepared. The analysis to be carried out within this scope;

Income sources: Income from the sale of reserve lands, government support (national, provincial and local level) and private sector investments are considered as income sources.
Expenditures: Expenditure items should cover all works to be done within the scope of the project. In this context; in addition to direct costs such as construction of facilities, dismantling and moving of existing facilities, research to be done during the project development process, project design and implementation costs, indirect costs (financing expenses, taxes and fees, etc.) should also be taken into account (De Souza & Ochi, 2018).

Preparation of land re-parcelling plan

Parcelling principles: In land regulation projects, while allocating new parcels, each real estate is protected "in terms of location, area, soil, water supply, land use, environment and other conditions" (Art. 89). With this practice, known as the principle of suitability, the original characteristics of at least a part of the real estate are protected. With the principle of equivalence, after the arrangement, the real estate of each landowner is allocated in a way that is equivalent to its previous value (Art. 65; Dharmavaram, 2013; De Souza & Ochi, 2018). During parcelling, the creation of small parcels should be avoided, especially by taking into account sanitary conditions and disaster situations (Art. 91). The design, characteristics, equal and appropriate payment commitments and determination of reserve areas of the new parcels formed with the parcelling plan are ensured (Art. 87).

Temporary subdivision: New parcels created temporarily during the project process are proposed to the real estate owners, and the draft plan is completed through individual negotiations. During this process, the project council and evaluation consultants create a fair reallocation plan (Art. 70).

Reserve land management and cost sharing

Reserve land contribution: A reserve land contribution is requested from landowners to cover project costs. These reserve lands include areas reserved for public facilities and lands to be sold for financing. The contribution rate is calculated by taking into account the previous and subsequent status of the land value (De Souza & Ochi, 2018).

Protection of property balance: The total benefit obtained from the project is distributed equally among landowners. Theoretically, it is ensured that a landowner does not profit from his property but does not suffer any loss either. This cost sharing analysis is the final analysis for regulatory projects (De Souza & Ochi, 2018).

Project implementation and objection process

Establishment of the LR council: An LR Council is established for the implementation of the project. The Council has the authority to decide on issues such as replanning, provisional and final parcelling proposals, and reserve land allocation (Art. 56, Art. 70; MLIT, 2020). The aim is to balance the costs that the project will cause and the benefits that will be obtained after the regulation.

Objection process: Project-affected persons reserve the right to object, and these objections are generally based on issues such as land valuation, use definitions (development rights) and difficulties experienced during construction. Objections are submitted in writing to the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) (Art. 20.2, Art. 71.4.3; Doebele, 1982).

Allocation and project completion

Compensation and sharing of results: After the reserve land allocation and contributions are completed, the final allocation values are calculated for all landowners, and new parcels are allocated to the rightful owners. In order to prevent landowners from suffering losses, compensation is calculated and paid based on the contribution rate (Art. 91.4, Art. 91.5, Art. 94). The income obtained from the reserve lands is used to cover the project costs.

Reporting: After the project is completed, the implementation results are presented to the ministry in a detailed report. This report includes project costs, income distribution and final land evaluation (Doebele, 1982).
A simple model explaining the method in light of the research and explanations about the Japanese model is given in Figure 3.

Türkiye Land Readjustment (Article 18 / Parceling Plan) and Their Stages

The problems experienced in the urbanization process have become an important agenda item worldwide as well as in Türkiye. Problems experienced in issues such as land acquisition, planning, financing, and infrastructure prevent the formation of a sustainable environment and cause the weakening of development strategies (Köktürk & Köktürk, 2005).

In the land readjustment method applied in Türkiye, parcel borders in a region are rearranged; public areas such as roads and parks are created and brought into compliance with the construction conditions specified in the zoning plan. In this process, the principle of "equal proportional land deduction from

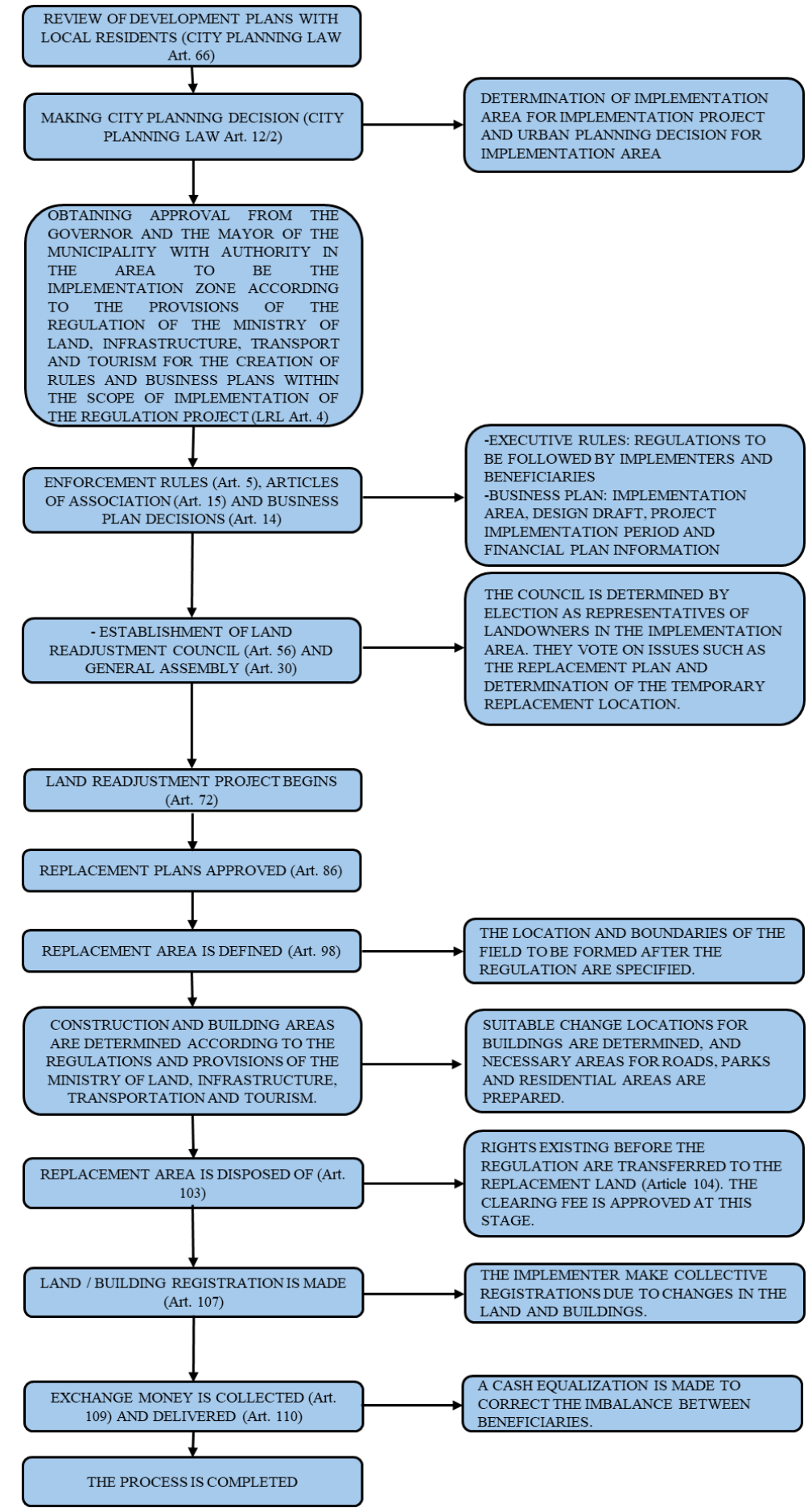

Figure 3. Japan LR application model (Salalı, 2023).

each parcel" is generally adopted. This principle means an area transferred to the municipality as the Regulating Partnership Share (RPS) in return for the increase in value resulting from the regulation. Although this situation is likened to expropriation by some circles, it is not a legal expropriation process (Köktürk, 2007). Since zoning transactions are transactions in which public power is used, land readjustment is also a transaction that restricts property rights for public benefit (Aksay, 1999; Türk & Türk, 2006).

The RPD rate has increased over time according to urban development needs. However, although the expression "in return for the increase in value in the parcel" is used in the implementation legislation, not every parcel shows the same rate of increase in value. Because the zoning status of each parcel is different, the value of the new parcel obtained after the arrangement will also be different (Salalı et al., 2022). This situation causes criticism that the RPD rate is not fair. Article 18 of the Zoning Law No. 3194 is an important tool in urban transformation and arrangement processes. However, it is also clear that some regulations are needed for this application to be carried out fairly and transparently.

FINDINGS AND DISCUSSION

The examinations show that the law that Japan enacted in 1954 is still in force today as the basic law regulating land regulation practices. Regulation/ transformation projects implemented within the scope of this law are used not only for the development of physical infrastructure in Japan but also to ensure social and economic sustainability. As a result of the literature review and legislative reviews, the effectiveness and sustainability of LR practices in Türkiye and Japan, how they vary according to the geographical, social, and economic conditions of the region, the policies implemented, and the methods used are compared in Table 1.

Table 1. Comparison of regulation studies in earthquake zones.

Criterion	Japan	Türkiye
Historical Process	It has been implemented systematically for many years.	It gained momentum after the 1999 Marmara earthquake.
Legal Framework	There are comprehensive and up-to-date legal regulations.	Legal regulations are constantly being developed.
Planning Approach	A long-term, holistic and participatory approach is adopted.	There is a tendency to focus on short-term solutions.
Valuation Methods	Scientific and transparent valuation methods (street value, etc.) are used.	More subjective methods based on market value are often preferred.
Social Participation	Active participation of citizens in decision-making processes is ensured.	Citizen participation may be limited.
Technological Use	Technologies such as Geographic Information Systems (GIS) and remote sensing are widely used.	Technological infrastructure development continues.
Funding Sources	It is financed by joint contributions from the state, private sector and citizens.	State-supported projects are more common.
Sustainability	Long-term sustainability is targeted.	Sustainability issues may arise due to focusing on short-term solutions.
Economic Sustainability	The increase in value is distributed fairly and contributes to the economy.	The public share in the increase in value is limited.
Risk Management	Measures are taken to reduce earthquake risks.	The focus is on post-earthquake recovery efforts.

LR applications applied in earthquake zones are of great importance for the reconstruction of the region and the reduction of future risks. The model that Japan has been successfully implementing for many years is an important example for Türkiye. A similar approach can be adopted in Türkiye and more

effective and sustainable LR applications can be implemented. Especially when the laws enacted by the two countries are compared (Table 2), the results of the laws used within the scope of urban transformation are compared according to certain criteria.

Table 2. Comparison of current urban transformation laws.

Criterion	Japan	Türkiye
Main Law	**Land Readjustment Law (LRL, 1954)**	**Law No. 6306 on Transformation of Areas at Disaster Risk (2012)**
Purpose	Post-disaster reconstruction, infrastructure development and standardization of urban transformation projects.	Transformation of risky structures and areas, creation of disaster-resistant urban areas.
Application Area	Disaster zones, urban renewal areas and areas with infrastructure deficiencies.	Risky areas, risky structures and other areas determined by the Ministry.
Authorized Institutions	Local governments, Ministries (MLIT), private sector associations, Urban Renaissance Agency.	Ministry of Environment, Urbanization and Climate Change, TOKİ, municipalities.
Social Participation	Direct participation of landowners in projects, support with income from reserve land sales.	66.7% majority of the right holders' approval is required for project decisions.
Financing Model	Reserve land sales, contributions from landowners, public and private sector cooperation.	Public resources, reserve land sales and urgent expropriation method.
Positive Aspects	Balanced cost sharing between public and private sectors with the reserve land model.	Focusing on transformation of structures at risk of disaster.
Negative Aspects	Lack of social participation, problems in protecting property rights.	Weakness of control mechanisms, violation of property rights and lack of transparency.
Disaster Management	Rapid post-disaster reconstruction and infrastructure improvement processes.	A comprehensive legal framework for disaster risk reduction.
Legal Basis and Transparency	Detailed regulations and legal framework, balanced financing with the reserve land model.	Excessive authority granted to central authorities, lack of control and social justice problems.

The main differences and similarities between Japan's Land Readjustment Law No. 119 (LRL, 1954) and Türkiye's Zoning Law No. 3194 (1985) are analyzed and presented in a table (Table 3). This comparison provides an important basis for understanding the urban transformation processes of the two countries, using the effectiveness of LR practices efficiently and presenting improvement suggestions.

Urban sustainability is an approach that aims to develop the economic, social and environmental dimensions of a city in a balanced way and to leave a livable environment for future generations. Disaster management is the set of measures taken to reduce the negative effects of natural disasters, to be prepared and to accelerate the recovery process. The combination of these two concepts in earthquake zones is of great importance in terms of making cities more resilient to disasters and ensuring sustainable development in the long term. Urban sustainability and disaster management in earthquake zones is not only an engineering or planning issue but also a complex issue that includes social, economic and environmental dimensions. Therefore, an interdisciplinary approach should be adopted in this regard, and all stakeholders should cooperate.

Table 3. Analysis of the basic laws of the LR practices in Japan and Türkiye.

Criterion	No. 119 Japan LRL	No. 3194 Türkiye Zoning Law
Year of Entry into Force	1954	1985
Purpose	Developing infrastructure by making land arrangements in urban areas, creating cities that are resilient to disasters.	Arrangement of zoning plans in urban areas and planning of construction.
Main Area of Application	Post-disaster reconstruction, arrangement of irregular urban areas.	Arrangement of construction based on zoning plans.
Financing Model	Reserve land use and contributions from landowners.	Public budget and arrangement Regulating Partnership Share (RPS) method.
Social Participation	Direct participation of landowners in the processes and sharing of income from reserve land sales.	Participation is generally limited to suspension processes and limited information.
Equivalence Principle	After arrangement, each landowner's property is allocated in a way that is equivalent to its previous value.	Equivalence principle is not taken into account in land arrangement; an area-based system is applied.
Reserve Land Use	An important source of financing for projects; self-financing system with reserve land sales.	Reserve land method is limited and is generally related to the land share allocated to infrastructure projects.
Implementing Institutions	Local governments, central government (MLIT), private sector.	Ministry of Environment, Urbanization and Climate Change, TOKİ, municipalities.
Disaster Management and Risk Reduction	Rapid post-disaster reconstruction and infrastructure improvement.	Although it does not include comprehensive arrangements for disasters, it is completed by other laws.
Control Mechanisms	Processes are carried out transparently by local governments and independent auditing bodies.	Control mechanisms are usually dependent on the central authority and there is a lack of independent control.
Social Justice and Protection of Rights	**Equivalence principle** and compensation mechanisms to prevent damage to landowners.	**Area-based** methods that may lead to social inequalities.

This study comparatively examined the LR policies of Japan and Türkiye, especially in terms of sustainable land management for a sustainable future in the earthquake zone. The strengths, opportunities, weaknesses and threats of the methods applied in the two countries were tried to be revealed with SWOT analysis (Table 4); and the processes were examined within the scope of both legal and practical improvements in Türkiye.

Table 4. Evaluation of Japan and Türkiye LR policies in terms of sustainable future in earthquake zones.

SWOT	Japan	Türkiye
Strengths	- Scientific and value-based approach - Advanced level of technological use (GIS, artificial intelligence applications) -Participatory and transparent operations -Long-term policy system (LRL 1954) - Success in risk management	- Potential for rapid implementation - Experience of post-disaster reconstruction - Continuous development of the legal framework - TOKİ's work
Weaknesses	- High cost and complex solutions - Long implementation period - You can adapt to local settings	- Lack of community participation - Lack of valuation standards - Transparency issues - Technological deficiencies
	- Technology and knowledge transfer - International collaborations - Creating economic revitalization	- Learning from the Japanese model - Global financing support - Increasing disaster awareness
Threats	- Demographic challenges (aging population) - High risk of natural disasters - Legal conflicts	- Legal and regulatory complexity - Social resilience - Economic opportunities - Earthquake risk and time pressure

When the model applied in Japan is examined, it can be said that the success of the LR application is directly related to the existence of legal legislation. In the applications, the process is regularly shared with the public and participation is ensured. The process is open and transparent. This model, which has effective real estate valuation systems, also has serious legal penalties. There are special 'land readjustment boards' for the application. However, since the application is for the purpose of 'field-based infrastructure and superstructure development', the application periods are long (Salalı et al., 2022).

The application of a value-based model is a bit more complicated than the ratio-based method. The main idea is to share the benefits of urban development between the landowner and the public. The method is based on the simple fact that the real estate owner makes neither profit nor loss. However, this theoretical condition cannot be realized. Landowners obtain the profit resulting from the increase in land value over time as a result of the 'real estate maturation' that occurs through the LR (Salalı et al., 2022).

CONCLUSION

Urban transformation and land regulation processes are one of the cornerstones of sustainable development, especially in earthquake-prone regions. The success of these processes depends on the balanced management of economic, ecological and social dimensions. Sustainable urbanization aims not only to transform physical space but also to improve social and economic structures.

In land regulation works implemented in Türkiye, public areas are provided by making a deduction of up to 45% of the free regulation partnership share (RPS). However, the problems experienced in the application of this method, especially the objectivity and fairness of the methods used in determining the RPS rate, cause discussions. In addition, the protection of the rights of real estate owners and ensuring their participation is also an important issue.

In land regulation applications carried out within the scope of Article 18 of the Zoning Law No. 3194, valuation processes are of great importance. Currently, there is no sufficient infrastructure in our country regarding real estate valuation as the basis for land regulation. This situation makes it difficult to use objective criteria in determining RPS rates and causes legal disputes. The Real Estate Valuation Department, established in 2019 within the General Directorate of Land Registry and Cadastre (TKGM), has taken important steps in this regard; however, there is still much work to be done.

For sustainable land management, a value-based implementation method should be adopted. In this method, the increase in value resulting from the regulation should be distributed fairly among all stakeholders. In addition, the opinions of all stakeholders should be taken into account in the regulation processes, considering the principles of citizen participation and transparency. The experiences of countries like Japan that have taken precautions against earthquake risk can be an important reference for Türkiye. In these and similar countries, more comprehensive and participatory methods are used in land readjustment processes. In particular, the strategies developed by Japan in risk management and post-disaster recovery are inspiring for Türkiye.

In this study, it is summarized and examined how the LR policies that can be implemented in a sustainable future in the earthquake zone are handled in two different geographies, such as Japan and Türkiye. The obtained examples show that Japan's value-based approaches are quite effective in terms of ensuring

social justice and encouraging economic sustainability in the reconstruction. It has been revealed that Türkiye is in a process of transition from its traditional ratio-based regulations to a more understandable, participatory, transparent, controllable and scientifically based model.

The increased sensitivity following the 1999 Marmara Earthquake and the 2023 Kahramanmaraş Earthquake in Türkiye has necessitated the re-evaluation of LR policies. However, current regulatory systems are generally based on an application where equal land deductions are adopted. This situation leads to injustices and social resistance, especially among property owners. Although Türkiye's RPS (Regulation Partnership Share) system ensures the rapid implementation of the system, factors such as lack of valuation standards, transparency problems and limited social participation necessitate intervention in this system.

In this context, the lessons that can be learned from Japan's experience provide an important guide for eliminating Türkiye's current deficiencies. In particular:

- Adoption of a Value-Based Approach: Valid application methods such as Japan's 'street value' provide a workable model for Türkiye. Such a system can ensure that the increase in value after the regulation is distributed fairly among all units.
- Strengthening Participation and Transparency Mechanisms: In Japan, the involvement of real estate owners in distribution decisions and the open sharing of the value gained have increased trust in projects. Türkiye needs to adopt a similar approach.
- Development of Technological Infrastructure: The widespread use of technologies such as Geographic Information Systems (GIS) and artificial intelligence allows for rapid analysis. It is important for Türkiye to address its shortcomings in this area.
- Legal and Institutional Reforms: Türkiye's LR policies need to be restructured in a more detailed, transparent and sustainable manner. A solid legal infrastructure should be established, especially for real estate valuation systems.

It seems possible for Türkiye to promote social justice and economic sustainability in post-disaster transformation processes by adopting Japan's value-based LR model. In addition to legal reforms, technological infrastructure needs to be strengthened and social participation needs to be increased. It is thought that methods such as reserve land financing can support the financial sustainability of transformation projects in Türkiye. However, the public sector needs to be strengthened in particular.

This model of Japan is an exemplary system in terms of social justice, economic sustainability and environmental harmony in urban transformation projects. However, the harmony of local and central authorities and the participation of rights holders play a decisive role in the success of these processes. Japan's experiences are also an important reference for other countries like Türkiye. However, it should not be forgotten that each country has its conditions and problems. Therefore, it is impossible to implement the Japanese model by adopting it one-to-one. Instead, it would be correct to develop a new regulation for Türkiye, taking into account its special social and economic differences. The necessary changes in legislation and implementation regulations will be possible with correct valuation methods (within the scope of the Expropriation Law) and an effective control mechanism.

As a result, Türkiye, as a country in the earthquake zone, needs to set a sustainable goal and use the current LR practices once. Creating an original regulation system for Türkiye inspired by Japan's model will enable the construction of more resilient, livable and sustainable cities against earthquake risk by ensuring social justice and economic sustainability in the long term.

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