

## Space & Environment

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## Road as tool for Balanced National Development

### 01 Megatrends and Road Policy Directions

1. Background
2. Identification of Megatrends and Recent Changes
3. Study of International Road Policies
4. Assessing the Importance of Megatrends and their Relevance to Road Policy
5. Directions for Road Policy in Response to Megatrend

### 02 Road Project Investment Evaluation System for Balanced National Land Development

1. Policy Trends of Road Investment Evaluation Systems
2. Development of Regional Deprivation Improvement Effect Indices for Balanced Regional Development
3. Empirical Analysis of Regional Deprivation
4. Policy Application of the Regional Deprivation Improvement Effect Indices

### 03 Korea's High-Speed Rail: Driving Balanced Territorial Development

1. Background of South Korea's High-Speed Rail Construction
2. High-Speed Rail Operations in South Korea
3. Role of High-Speed Rail in Promoting Balanced National Development

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## 1. Background

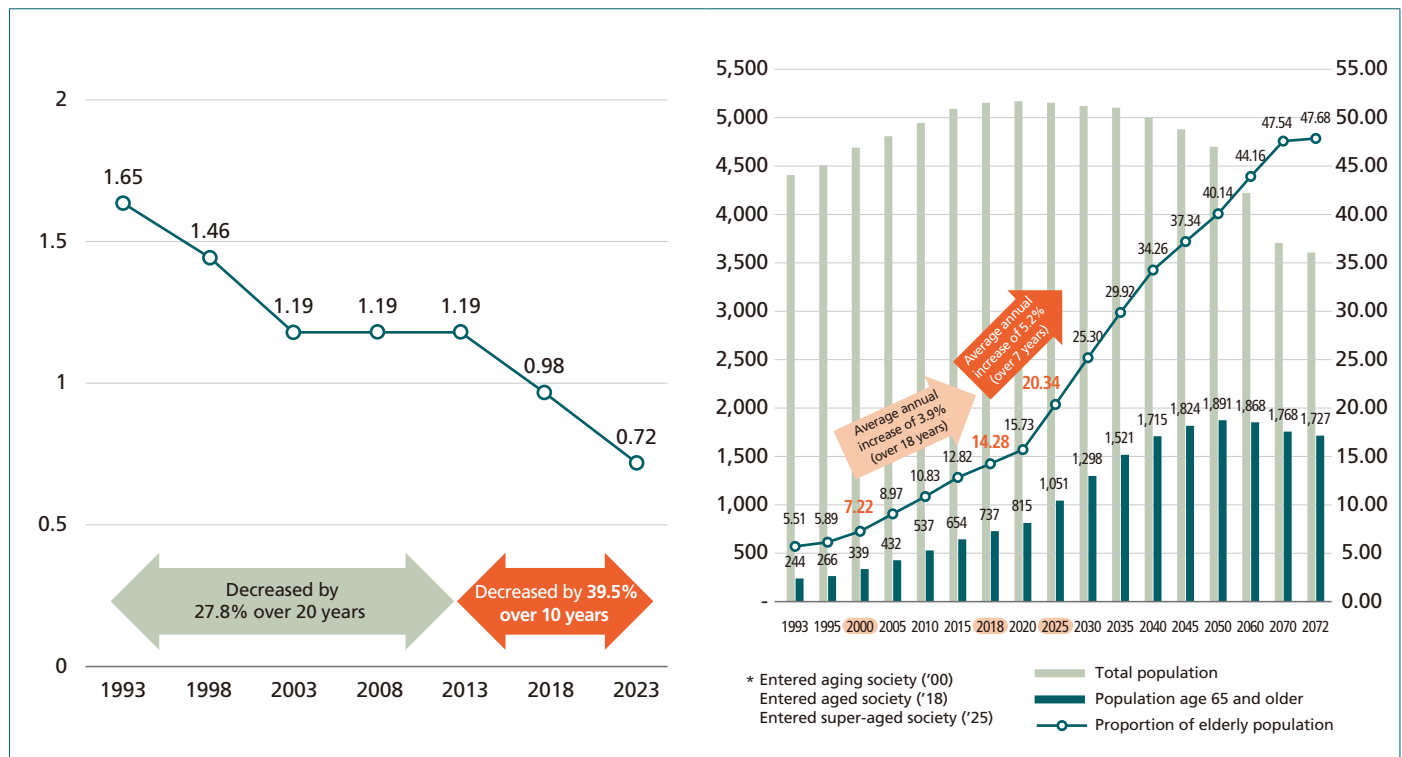
### ■ Need for new policy responses amid extreme changes and growing uncertainty in megatrends

Various megatrends-such as demographic and value shifts, climate change, the Fourth Industrial Revolution, and emergence of new future mobility-are driving societal transformation, and national policies must adapt accordingly. To date, national plans have reflected megatrends in formulating policy objectives and have devised strategies and detailed policies to address the transformation caused by megatrends.

However, recently, the extreme changes in certain megatrends and the growing uncertainty surrounding them have highlighted the need for a different approach to

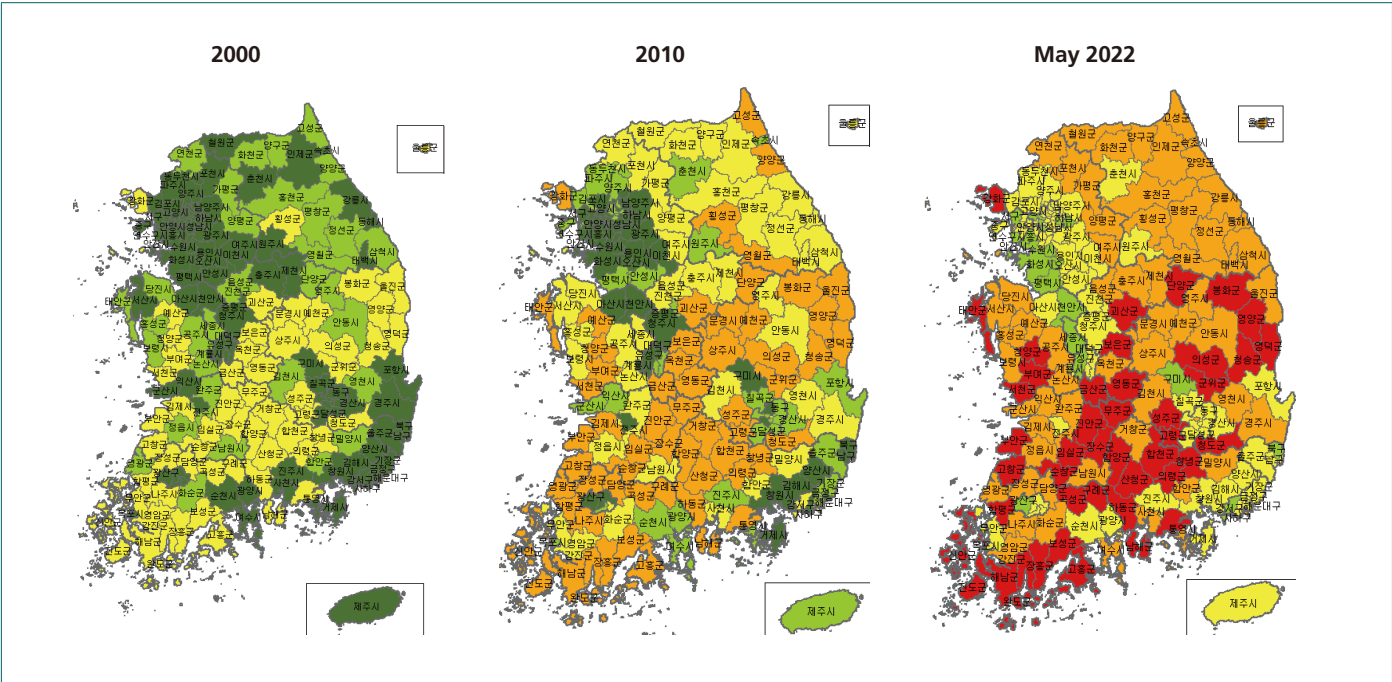
policy-making. Unprecedented declines in birth rates, the fastest transition to a super-aged society, population concentration in capital region, a rapid increase in areas at risk of extinction, and the rise of flexible work arrangements are examples of megatrends reflecting extreme transitions. Some of them have led to more compressed and structural transformations in society within a short period, particularly during the COVID-19 pandemic. The heightened uncertainty significantly complicates forecasting the future. Consequently, policymaking based on past experiences and existing data is becoming less effective. It is the appropriate time to transition toward a new direction for road policy that can respond to the changing dynamics of society and explore new road policy alternatives based on such transition. [Figure 1, Figure 2](#)

**Figure 1. Rapid changes in social megatrends (birth rate, aging population)**



Source: Statistics Korea as cited in Park et al. (2024)

**Figure 2.** Trend in municipal governments (city, county, district level) at risk of extinction



**Note** Among the areas shown in the status of regions at risk of extinction, the cities, counties, and districts shaded in orange (at risk of extinction) and red (high risk of extinction) represent the regions at risk of extinction  
**Source** Press release by Korea Employment Information Service (April 2022)

**2. Identification of Megatrends and Recent Changes**

- Identification of 10 megatrends and 19 trends in total across the social, technological, economic, environmental, and political domains

The findings from extant studies in the land and transportation sector conducted over the last decade have been compiled. Brainstorming by the research team and expert consultations helped identify megatrends and trends across the social, technological, economic, environmental, and political domains. [Table 1](#)

**Table 1.** Megatrend identification results

| Sector      | Megatrend                                       | Trends                                                                                                                                                                                 |
|-------------|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Social      | Demographic changes                             | declining birth rate/intensifying aging population/increase in single-person households                                                                                                |
|             | Transition in society and values                | greater respect for the quality of life and diverse values/labor flexibility (such as flexible work arrangements)/the spread of a contactless society/expansion of the sharing economy |
|             | Regional polarization                           | continued concentration in capital region/accelerated decline of regional areas                                                                                                        |
| Technology  | Technological advancement                       | advancements in AI and robotics/digital transformation                                                                                                                                 |
|             | Mobility advancement                            | commercialization of autonomous driving/emergence of new mobility                                                                                                                      |
| Economy     | Instability in the global economy               | Expansion of global economic cooperation and conflict                                                                                                                                  |
|             | Intensifying low growth and polarization        | entrenched low growth/worsening polarization                                                                                                                                           |
| Environment | Climate change                                  | Global warming/increase in local disasters and calamities                                                                                                                              |
|             | Energy transition                               | Continued rise in energy demand/growing use of renewable energy                                                                                                                        |
| Politics    | Increasing volatility in inter-Korean relations | Repeated cycles of reconciliation and conflict in inter-Korean relations                                                                                                               |

**Source** Park et al. (2024)

■ **Recent megatrend changes in the social, technological, economic, environmental, and political sectors are accelerating**

In the social domain, rapid demographic shifts have occurred, increasing diversity in values, greater labor flexibility, expansion of the sharing economy, spread of contactless (non-face-to-face) interactions, surge in parcel delivery volumes, population concentration in capital region, and accelerated decline of rural regions. In the technological domain, AI technology is advancing rapidly, and digital transformation is being pursued across various sectors. In the economic domain, global economic instability continues, while domestically, low growth has become entrenched, and polarization is intensifying. In the environmental domain, disasters and calamities caused by global warming are increasing, while in the political domain, inter-Korean relations have oscillated between conflict and dialogue, with tensions recently escalating.

### 3. Study of International Road Policies

■ **(The United States) Strategic alignment with administrative goals and establishment of foundations for data-driven road policy**

The U.S. federal government is enacting new legislation to respond to changing circumstances and social demands over time, thereby establishing the legal basis for road policies and investments, while the Federal Highway Administration (FHWA) develops strategic plans for the road sector according to the administration's policy priorities. Recently, in response to increasing uncertainty in future forecasting, the U.S. has been working to establish a support system for data-driven policy development. By continuously collecting and analyzing data, the country is constructing an organizational framework that can reduce uncertainty and enhance its ability to respond effectively.

■ **(The United Kingdom) Selection and management of arterial road networks, transition toward user-centered policy, and promotion of digitalization**

Since the enactment of the *Infrastructure Act* in 2015, the UK has focused on selecting and managing a strategic road network, aiming to enhance national competitiveness. Using multi-year budget planning, the country has promoted systematic and long-term road construction and management, while designating specialized agency to strengthen efficiency

and accountability. Regarding road design, construction, and maintenance, the UK places users at the center by prioritizing alignment with their needs. Additionally, a systematic digital transformation is being implemented across the complete lifespan of roads—from design and construction to maintenance.

■ **(Japan) Strengthening the functions and management of high-standard arterial roads and supporting systematic maintenance of municipal roads**

In Japan, efforts are underway to diagnose and address issues to ensure that high-standard arterial roads can fulfill their intended functions, and national funding is provided for roads managed by local governments to support maintenance and repairs. Various support systems have been implemented to subsidize the costs of maintaining these municipal roads. Currently, Japan's road policy direction can be summarized as follows: disaster prevention against natural hazards, maintenance and management of aging infrastructure, support for national spatial restructuring and transportation safety, promoting economic circulation, digitalization, decarbonization, and the multifunctional use of road spaces.

### 4. Assessing the Importance of Megatrends and their Relevance to Road Policy

■ **Among the identified megatrends, "demographic changes," "regional polarization," and "technological advancement" were found to be socially significant and highly relevant to road policy**

Using an expert survey, the intensity and direction of recent changes in megatrends and trends were examined, along with their importance (overall societal impact) and relevance to road policy. Trends rated as having the highest importance to society were "declining birth rate (8.17 score)," followed by "intensifying aging population (7.90 score)," "accelerated decline of rural areas (7.25 score)," "advancement in AI and robotics technology (7.25 score)," and "global warming (6.88 score)." Trends most closely associated with road policy were "commercialization of autonomous driving (7.94 score)," followed by "emergence of new mobility (7.51 score)," "continued concentration in capital region (7.3 score)," "accelerated decline of rural areas (7.24 score)," and "intensifying aging population (7.21 score)."

"Declining birth rate," "intensifying aging population,"

“accelerated decline of rural areas,” “advancements in AI and robotics technology,” and “digital transformation” were identified as exhibiting extreme changes with such trends expected to continue; these were also considered as having significant impacts on society and being highly relevant in formulating road policies. [Table 2](#)

## 5. Directions for Road Policy in Response to Megatrend

### ■ Establishment of seven major road policy objectives and nineteen detailed policy directions for achieving them

In response to megatrends, the following road policy directions were proposed: “restructuring governance centered on road functions,” “building a system for data-driven policy development and execution,” “strengthening support for national land and space policies,” “restructuring road space,” “improving the efficiency of road maintenance systems,” “diversifying road funding sources to ensure sustainable services,” and “enhancing disaster and calamities response systems.”

**Table 2.** Trend survey results

| Sector      | Megatrend                                       | Trends                                                                                       | Intensity of change | Direction of change | Importance | Relevance to road policy |
|-------------|-------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------|---------------------|------------|--------------------------|
| Social      | Demographic changes                             | Declining birth rate                                                                         | 7.31                | 6.71                | 8.17       | 6.64                     |
|             |                                                 | Intensifying aging population                                                                | 7.50                | 7.59                | 7.90       | 7.21                     |
|             |                                                 | Increase in single-person households                                                         | 6.45                | 6.74                | 6.30       | 6.04                     |
|             | Transition in society and values                | Greater respect for quality of life and diverse values                                       | 5.97                | 6.55                | 6.13       | 5.17                     |
|             |                                                 | Labor flexibility (i.e., flexible work arrangements) and the spread of a contactless society | 5.51                | 6.12                | 5.97       | 6.03                     |
|             |                                                 | Expansion of the sharing economy                                                             | 4.81                | 5.56                | 5.46       | 6.05                     |
|             | Regional polarization                           | Continued concentration in capital region                                                    | 6.15                | 6.36                | 6.60       | 7.36                     |
|             |                                                 | Accelerated decline of rural areas                                                           | 6.84                | 6.91                | 7.25       | 7.24                     |
| Technology  | Technological advancement                       | Advancements in AI and robotics technology                                                   | 6.87                | 7.44                | 7.25       | 6.54                     |
|             |                                                 | Digital transformation                                                                       | 6.37                | 7.13                | 6.62       | 6.21                     |
|             | Mobility advancement                            | Commercialization of autonomous driving                                                      | 5.21                | 6.25                | 6.70       | 7.94                     |
|             |                                                 | Emergence of new mobility                                                                    | 5.44                | 6.31                | 6.20       | 7.51                     |
| Economy     | Instability in the global economy               | Expansion of global economic cooperation and conflict                                        | 5.65                | 5.82                | 5.95       | 4.10                     |
|             | Intensifying low growth and polarization        | Entrenched low growth & worsening polarization                                               | 5.93                | 6.36                | 6.41       | 4.56                     |
| Environment | Climate change                                  | Global warming                                                                               | 6.36                | 6.97                | 6.88       | 6.00                     |
|             |                                                 | Increase in local disasters and calamities                                                   | 6.36                | 6.72                | 6.68       | 6.04                     |
|             | Energy transition                               | Continued rise in energy demand                                                              | 5.79                | 6.42                | 6.23       | 5.96                     |
|             |                                                 | Growing use of renewable energy                                                              | 5.14                | 6.21                | 5.84       | 5.74                     |
| Politics    | Increasing volatility in inter-Korean relations | Repeated cycles of reconciliation and conflict in inter-Korean relations                     | 5.01                | 5.02                | 5.24       | 3.97                     |
| Average     |                                                 |                                                                                              | 6.03                | 6.48                | 6.52       | 6.12                     |

**Note** For each survey item, the darker the green, the higher the score; the darker the red, the lower the score.

**Source** Park et al. (2024)

■ **The importance of “enhancing disaster and calamities response systems,” “building a system for data-driven policy development and execution,” and “improving the efficiency of road maintenance systems”**

To prioritize road policy directions, four evaluation criteria—importance, urgency, impact, and feasibility—were selected, weighted through an expert survey, and applied to assess each of the 19 policy directions. Experts assigned the highest priorities to the policy goals of “enhancing disaster and calamities response systems,” “building a system for data-driven policy development and execution,” and “improving the efficiency of road maintenance systems.” However, policy directions such as “strengthening support for national land and space policies,” “diversifying road funding sources to

ensure sustainable services,” “restructuring governance centered on road functions,” and “restructuring road space” were evaluated as having relatively lower priorities.

Regarding specific policy areas, the following were identified as high priorities: operating a mobility big data center based on road infrastructure, promoting intelligent road maintenance system, establishing a decision-making system to manage the aging road infrastructure, ensuring sustainable funding for deteriorating infrastructure, securing alternative funding sources for road investment beyond fuel taxes, updating legal and regulatory frameworks to improve road safety, and creating a disaster and emergency response management system. [Table 3](#)

**Table 3. Results of priorities for each road policy direction**

| Road policy objectives                                                | Policy direction                                                                                                        | Importance | Urgency   | Impact    | Feasibility | Priority  |
|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------|-----------|-----------|-------------|-----------|
| 1. Restructuring governance centered on road functions                | 1-1. Reforming the road management system to improve service quality                                                    | 9          | 12        | 13        | 10          | 12        |
|                                                                       | 1-2. Improving the project selection process for road infrastructure                                                    | 14         | 14        | 10        | 18          | 14        |
|                                                                       | 1-3. Running a pilot project system to facilitate new policy adoption                                                   | 18         | 13        | 19        | 9           | 19        |
| 2. Building a system for data-driven policy development and execution | <b>2-1. Operating a mobility big data center based on road infrastructure</b>                                           | <b>5</b>   | <b>4</b>  | <b>6</b>  | <b>1</b>    | <b>3</b>  |
|                                                                       | <b>2-2. Accelerating the digital transformation of road infrastructure and establishing a decision-making framework</b> | <b>7</b>   | <b>6</b>  | <b>9</b>  | <b>8</b>    | <b>7</b>  |
| 3. Strengthening support for national land and space policies         | <b>3-1. Enhancing support for the development of mega areas</b>                                                         | <b>10</b>  | <b>10</b> | <b>7</b>  | <b>12</b>   | <b>10</b> |
|                                                                       | 3-2. Strengthening support for managing capital region                                                                  | 19         | 15        | 15        | 14          | 16        |
| 4. Restructuring road space                                           | 4-1. Building road infrastructure to support the commercialization of autonomous vehicles                               | 11         | 11        | 8         | 11          | 11        |
|                                                                       | <b>4-2. Building road infrastructure to promote the use of eco-friendly vehicles</b>                                    | <b>12</b>  | <b>8</b>  | <b>14</b> | <b>4</b>    | <b>9</b>  |
|                                                                       | 4-3. Redefining road space structure to reflect changing road functions                                                 | 15         | 16        | 17        | 17          | 18        |
|                                                                       | 4-4. Establishing policies for the management and use of multi-level (three-dimensional) road space                     | 13         | 19        | 16        | 15          | 15        |
| 5. Improving the efficiency of road maintenance systems               | <b>5-1. Promoting intelligent road maintenance system</b>                                                               | <b>3</b>   | <b>7</b>  | <b>4</b>  | <b>2</b>    | <b>4</b>  |
|                                                                       | 5-2. Implementing asset management for road infrastructure                                                              | 17         | 18        | 18        | 13          | 17        |
|                                                                       | <b>5-3. Establishing a decision-making system to manage the aging road infrastructure</b>                               | <b>6</b>   | <b>3</b>  | <b>12</b> | <b>5</b>    | <b>6</b>  |
|                                                                       | <b>5-4. Ensuring sustainable funding for deteriorating infrastructure</b>                                               | <b>1</b>   | <b>1</b>  | <b>2</b>  | <b>16</b>   | <b>2</b>  |

| Road policy objectives                                              | Policy direction                                                                       | Importance | Urgency  | Impact   | Feasibility | Priority |
|---------------------------------------------------------------------|----------------------------------------------------------------------------------------|------------|----------|----------|-------------|----------|
| 6. Diversifying road funding sources to ensure sustainable services | <b>6-1. Securing alternative funding sources for road investment beyond fuel taxes</b> | <b>4</b>   | <b>9</b> | <b>1</b> | <b>19</b>   | <b>8</b> |
|                                                                     | 6-2. Using private capital in road construction and maintenance                        | 16         | 16       | 11       | 7           | 13       |
| 7. Enhancing disaster and calamities response systems               | <b>7-1. Updating legal and regulatory frameworks to improve road safety</b>            | <b>7</b>   | <b>5</b> | <b>5</b> | <b>3</b>    | <b>5</b> |
|                                                                     | <b>7-2. Creating a disaster and emergency response management system</b>               | <b>2</b>   | <b>2</b> | <b>3</b> | <b>6</b>    | <b>1</b> |

**Note** The top 10 out of the 19 road policy directions are highlighted in bold

**Source** Park et al. (2024)

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\* This article is an overview of “Road Policies in Response to Megatrends(I).” by Park, J., Kim, J., Bae, Y., Kim, S., Kim, M., and Yeon, B. 2024. Sejong: Korea Research Institute for Human Settlement

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- Statistics Korea. <https://kostat.go.kr/statDesc.es?mid=a10501010000> (accessed June 10, 2024)

Yunkyung Bae

## 1. Policy Trends of Road Investment Evaluation Systems

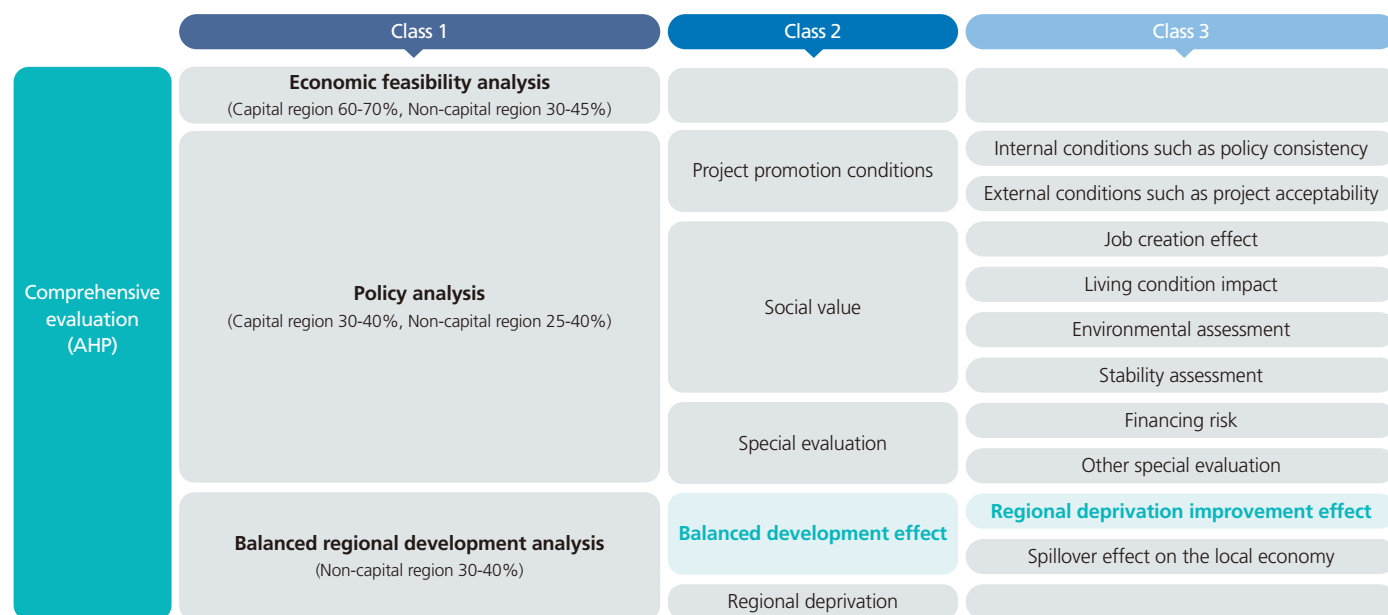
### ■ Evolution of the preliminary feasibility system in response to the changing values of the times

The preliminary feasibility study system, originally introduced to promote efficient and rational investment in road projects, has continuously evolved in response to the changing values of the times. It has been updated to reflect various effects beyond just the economic feasibility of projects, the improved quality of life of residents, and the relaxation of regional imbalances. In 2003, the analytical hierarchy process (AHP) was introduced to synthesize the results of economic feasibility and policy analyses of projects. To derive opinions, the weight given to economic feasibility evaluations has been gradually reduced, and policy

evaluations have been internalized. In particular, economic feasibility-oriented project evaluations have resulted in investments focused on regions with high development levels and concentrated populations, worsening regional imbalances. In response to such an issue, balanced regional development analysis was introduced by assigning greater weight to underdeveloped areas.

The recent reorganization of the system has required discovering various benefits, reflecting the specificity of the project, and establishing new evaluation items for improving regional deprivation to reinforce the evaluation. Additionally, the evaluation criteria have been strengthened, a strict system has been implemented, and the speed and flexibility of the evaluation process have been improved. [Figure 1](#)

**Figure 1.** Changes in the structure of the comprehensive evaluation after the reorganization of the preliminary feasibility study system (2022)



**Source** Figure on p. 8 of the materials from the first preliminary feasibility study kick-off meeting in 2023 (Korea Development Institute) as cited in Bae et al. (2023)

### ■ Problems and limitations of the recent system reorganization with strengthened balanced regional development assessment

The impact of balanced regional development analysis items on investment decision-making has been strengthened, in line with the hierarchical adjustment of balanced regional development analysis within the AHP system and the continuous increase in weight. However, challenges and limitations still remain. First, there is a reliability issue in the calculation of balanced development indices used to derive regional deprivation indices. Since there are inappropriate indicator items that are applied to the evaluation of road projects, there are limitations in applying them to the road investment evaluation system. Furthermore, as the balanced development indices consist of indicators mainly related to living social overhead capital (SOC), it is inappropriate to utilize them for road network project evaluation due to the scale of such projects. Second, as the current balanced development indices are composed of indicators evaluating the current regional development status, they are insufficient for identifying the improvement effect of road project implementation. Finally, in the current hierarchy of the comprehensive evaluation for the preliminary feasibility study, the pre-weighting range in the first class is limited, and the variations in the weights of the regional deprivation improvement effect item are small due to fixed weights among the items in the second class, resulting in a limited impact on project implementation.

## 2. Development of Regional Deprivation Improvement Effect Indices for Balanced Regional Development

### ■ Indicator development plan based on a review of domestic and overseas cases related to balanced regional development

In other countries, indices related to regional deprivation for balanced regional development are reflected in various manners in the evaluation process, and factors such as better accessibility, higher connectivity, and consideration of vulnerable groups have been emphasized. Considering such features, it is necessary to make a plan to improve regional deprivation so that it reflects the aforementioned features. The United Kingdom has utilized the Index of Multiple Deprivation to select and fund deprived areas. Germany has incorporated regional deprivation into its spatial planning and urban development effectiveness evaluation process. Australia has considered regional deprivation by utilizing the Index of Social Exclusion. This study reviewed domestic policy cases such as the Index for the Growth Promotion Area Selection<sup>01</sup>, the Index for the Regional Revitalization Area Selection<sup>02</sup>, and the Index of the Regional Development<sup>03</sup>. It excluded redundant items, utilized indicators that can drive improvement effects, and attempted to develop indicators that can strengthen the lacking linkages. [Table 1](#)

**Table 1.** Cases reflecting the effects of balanced regional development in the evaluation of overseas SOC projects

| Country        | Reflection phase                                                                                                 | Main indicators                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------|------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| United Kingdom | Strategic project plan, commercialization plan, and consideration in the main project evaluation                 | <ul style="list-style-type: none"> <li>• Social and redistribution effects, regional regeneration, and regional inequality</li> <li>• Redistribution per class and underdevelopment improvement effects</li> <li>• Accessibility, quality of passage/transportation, and resolution of regional imbalances</li> <li>• Impact on vulnerable groups and facilities and compatibility with national balanced development goals</li> </ul> |
| Germany        | Separate implementation in the spatial planning assessment and urban development effectiveness assessment phases | <ul style="list-style-type: none"> <li>• Improvements in traffic connectivity and a lack of accessibility</li> <li>• Improvement of connectivity between centers and identification of connectivity quality</li> <li>• Improvement of land use and accessibility and urban regeneration effects</li> </ul>                                                                                                                             |
| Australia      | Consideration of the Index of Social Exclusion                                                                   | <ul style="list-style-type: none"> <li>• Access to land use and transportation options</li> </ul>                                                                                                                                                                                                                                                                                                                                      |

**Source** Transport Analysis Guidance (2014, DfT), The 2030 Federal Transport Infrastructure Plan (2016, BMDV), Principle and Guidelines for Economic Appraisal of Transport Investment and Initiatives (2016, Transport for NSW) as cited in Bae et al. (2023)

01. Selection of underdeveloped areas under the Special Act on Balanced National Development

02. Differential support for underdeveloped areas under the Regional Development Assistance Act

03. Index for diagnosing regional development levels, developed by the Korea Rural Economic Institute

■ **Indices for regional deprivation improvement effects derived through the selection and supplementation of existing indices and the development of new indices**

Indices were selected from the existing balanced development indices, excluding redundant items and ensuring they could effectively estimate the improvement effects of road projects. Several indices were selected as they can contribute to improving the quality of residents' lives by supplementing the calculation methods and concepts of the indices. Additionally, new indices were developed to estimate road connectivity and the impacts on local communities, which are regarded as insufficient in the Republic of Korea compared to overseas cases, as well as to assess regional development through road projects.

To identify changes in regional road connectivity, this study

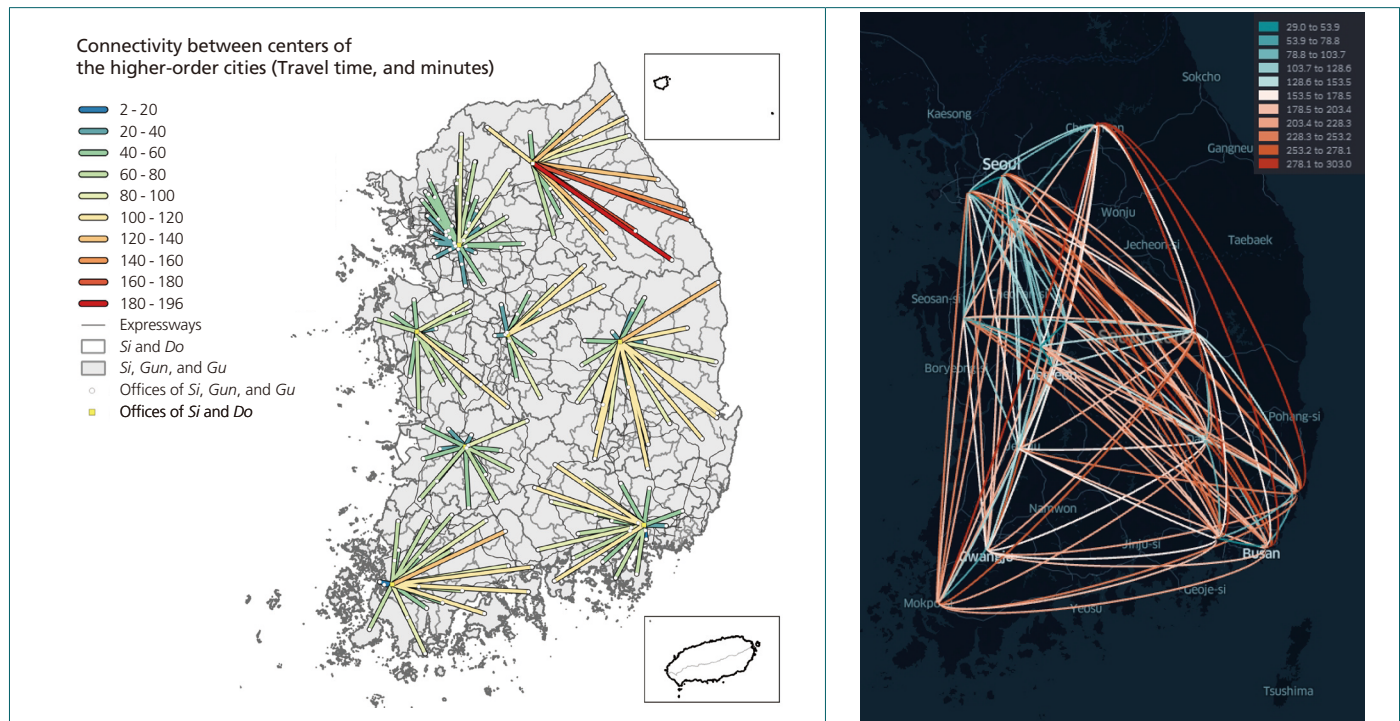
developed indices with ① the inter-city connectivity analysis to calculate the number of cities that can be reached within the reference time, ② the intra-city mobility analysis to calculate the range of the cities that can be reached within the reference time, ③ the inter-regional connectivity analysis to identify accessibility to other regions, and ④ the connectivity analysis with the higher-order cities to estimate the accessibility from neighboring cities to the metropolitan center areas. Furthermore, for the analysis of population changes within the sphere of influence to determine the actual impact on the local community, this study developed indices for change quantification in the population within the service area affected by a new project, as well as indices for the change ratios compared to the existing beneficiary population. [Table 2, Figure 2](#)

**Table 2.** Composition of the evaluation indices for regional deprivation improvement effects

| Category                                                                             | Items                                        | Description                                                                                                                                             |                                                                                                                                                                         |
|--------------------------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Balanced development indices                                                         | Transportation                               | Expressway IC accessibility                                                                                                                             | • Road travel distance to the nearest expressway IC                                                                                                                     |
|                                                                                      |                                              | Accessibility to high-speed railroads                                                                                                                   | • Road travel distance to the nearest high-speed railroad                                                                                                               |
|                                                                                      | Safety                                       | Fire station accessibility                                                                                                                              | • Road travel distance to the nearest fire station                                                                                                                      |
|                                                                                      |                                              | Police station accessibility                                                                                                                            | • Road travel distance to the nearest police station                                                                                                                    |
|                                                                                      | Culture and Leisure                          | Percentage of the population within the service area of performing culture facilities                                                                   | • Number of dwellers in a grid within the service area of a performing culture facility/total registered population ×100                                                |
|                                                                                      | Health and Welfare                           | Percentage of older adult population within the service area of leisure welfare facilities for older adults                                             | • Number of dwellers in a grid within the service area of a leisure welfare facility for older adults /total registered population ×100                                 |
| Percentage of the population within the service area of emergency medical facilities |                                              | • Number of dwellers in a grid within the service area of an emergency medical facility/total registered population ×100                                |                                                                                                                                                                         |
| Newly proposed indices                                                               | Transportation                               | Road ratio                                                                                                                                              | • Ratio of road areas to the total area of the administrative district                                                                                                  |
|                                                                                      | Road Connectivity                            | Inter-city connectivity analysis                                                                                                                        | • Calculation of the number of cities that can be reached by road from each regional center within the same reference time                                              |
|                                                                                      |                                              | Intra-city mobility analysis                                                                                                                            | • Analysis of the distance or maximum access distance from each regional center to the centers of neighboring cities that can be reached within the same reference time |
|                                                                                      |                                              | Inter-regional connectivity                                                                                                                             | • Comparative analysis of the restriction level, such as travel distance and required travel time, from each regional center to all other regions                       |
|                                                                                      |                                              | Analysis of connectivity with the higher-order cities                                                                                                   | • Analysis of travel distance and required travel time from the metropolitan center areas to neighboring cities                                                         |
|                                                                                      | Population change in the sphere of influence | Analysis of change quantification in the beneficiary population per project                                                                             | • Analysis of change quantification in the population size within the service area affected by a new project                                                            |
| Analysis of change ratios in the beneficiary population per project                  |                                              | • Analysis of the ratio of dwellers in the new beneficiary area compared to the population within the service area affected by the existing new project |                                                                                                                                                                         |

**Source** Establishment of an investment evaluation system for road projects reflecting shifts in future conditions: Focusing on improving regional balanced development analysis.p.114. 2023, Korea Research Institute for Human Settlements

**Figure 2.** Average access time to centers of the higher-order cities per region (left) and connectivity between regions (access time between centers of the higher-order cities) (right)



**Source** Establishment of an investment evaluation system for road projects reflecting shifts in future conditions: Focusing on improving regional balanced development analysis. p.180-181. 2023, Korea Research Institute for Human Settlements

### 3. Empirical Analysis of Regional Deprivation

#### ■ Overview of empirical analysis

Seven indices derived from the existing balanced development indices and seven new indices were used to analyze the effect of improving regional deprivation. Empirical analysis was performed to verify the applicability and feasibility of the

indices. The significance of the indices and the effectiveness of the proposed reorganization plan of the comprehensive evaluation system and the proposed alternatives were empirically analyzed by targeting four road projects for which a preliminary feasibility study was conducted in 2022. **Table 3**

**Table 3.** Cases of road projects subject to empirical analysis of the effectiveness of improving regional deprivation

| Project titles                                                                  | Project details                            | Length (km) | Project cost (KRW hundred million) | Cost-benefit ratio | Overall grade |
|---------------------------------------------------------------------------------|--------------------------------------------|-------------|------------------------------------|--------------------|---------------|
| Daesan-Dangjin Expressway Construction Project                                  | Construction of a new four-lane expressway | 25.4        | 9,073                              | 0.95               | 0.575         |
| Jecheon-Yeongwol Expressway Construction Project                                | Construction of a new four-lane expressway | 29.0        | 11,955                             | 0.46               | 0.559         |
| East Gwangju-Gwangsan Expressway Expansion Project                              | Expansion of an expressway (4 → 6 lanes)   | 11.2        | 6,952                              | 0.79               | 0.527         |
| Construction of the connecting road between Bugang Station and North Daejeon IC | New road construction                      | 12.73       | 3,863                              | 1.77               | 0.674         |

**Source:** Preliminary feasibility study report of each project, provided by the Korea Development Institute's Public and Private Infrastructure Investment Management Center, as cited in Bae et al. (2023)

### ■ Empirical analysis of the indices of regional deprivation improvement through balanced development indices

The implementation of road projects has improved access to services by shortening the travel time and distance through the expressway IC and high-speed railroads. This has enabled a wider scope of enjoying services provided by older adult leisure welfare facilities, emergency medical facilities, and performing culture facilities.

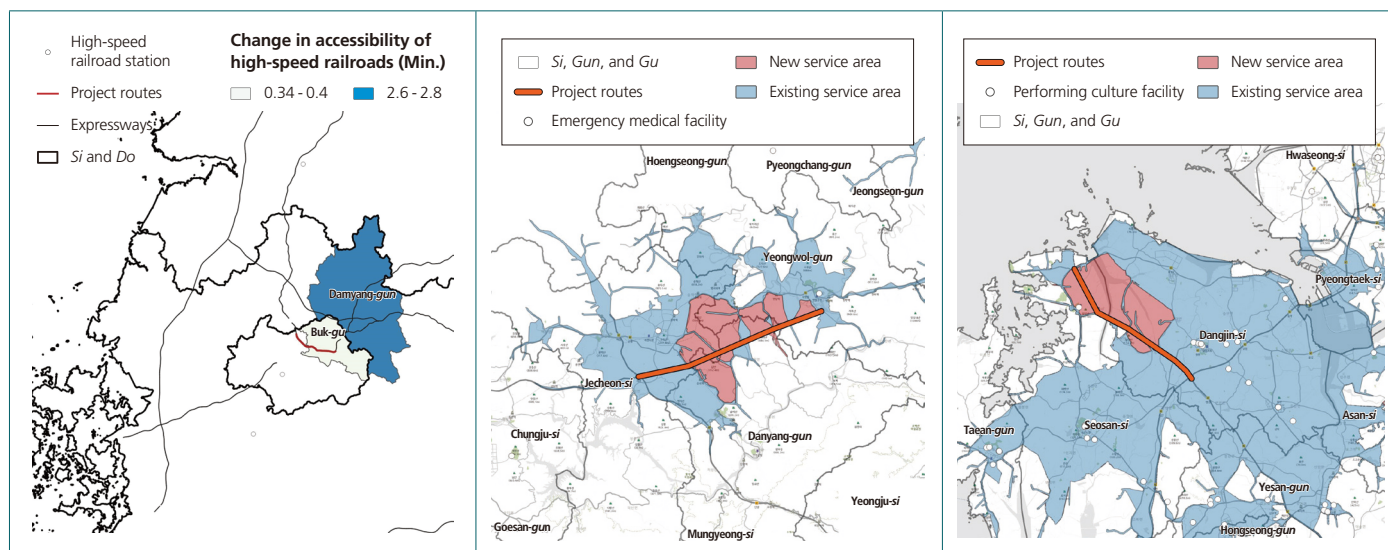
The implementation of the Jecheon-Yeongwol Expressway Construction Project shortened the access time to the Expressway IC in Yeongwol-eup, Yeongwol-gun, by 39 minutes and the access time to Jecheon station from Yeongwol-eup, Yeongwol-gun, by 20 minutes. The implementation of the Daesan-Dangjin Expressway Construction Project reduced the access time to fire and police stations from Daehoji-myeon in Dangjin-si by 6 minutes, and the East Gwangju-Gwangsan Expressway Expansion Project reduced the access time to fire and police stations in Damyang-gun, Jeollanam-do, by 1 minute. The Daesan-Dangjin Expressway Construction Project enabled 5% of the total population within the sphere of influence to be included in the expanded service area of performing culture facilities. It also enabled 12% of the total older adult population in the sphere of influence to be additionally included in the service area of older adult leisure welfare facilities. **Figure 3**

### ■ Empirical analysis of the new regional deprivation improvement effectiveness indices

The new indices can be used to assess regional deprivation improvement effects by evaluating the road connectivity and network efficiency of regions before project implementation, as well as by analyzing changes resulting from the improvements in inter-regional traffic and traffic to or around the metropolitan areas due to the project's implementation and the reduction of transportation vulnerability. The analysis revealed that inter-regional connectivity was generally low in coastal and island areas of the Republic of Korea due to long travel times and that inter-regional connectivity varied depending on differences in access to expressways.

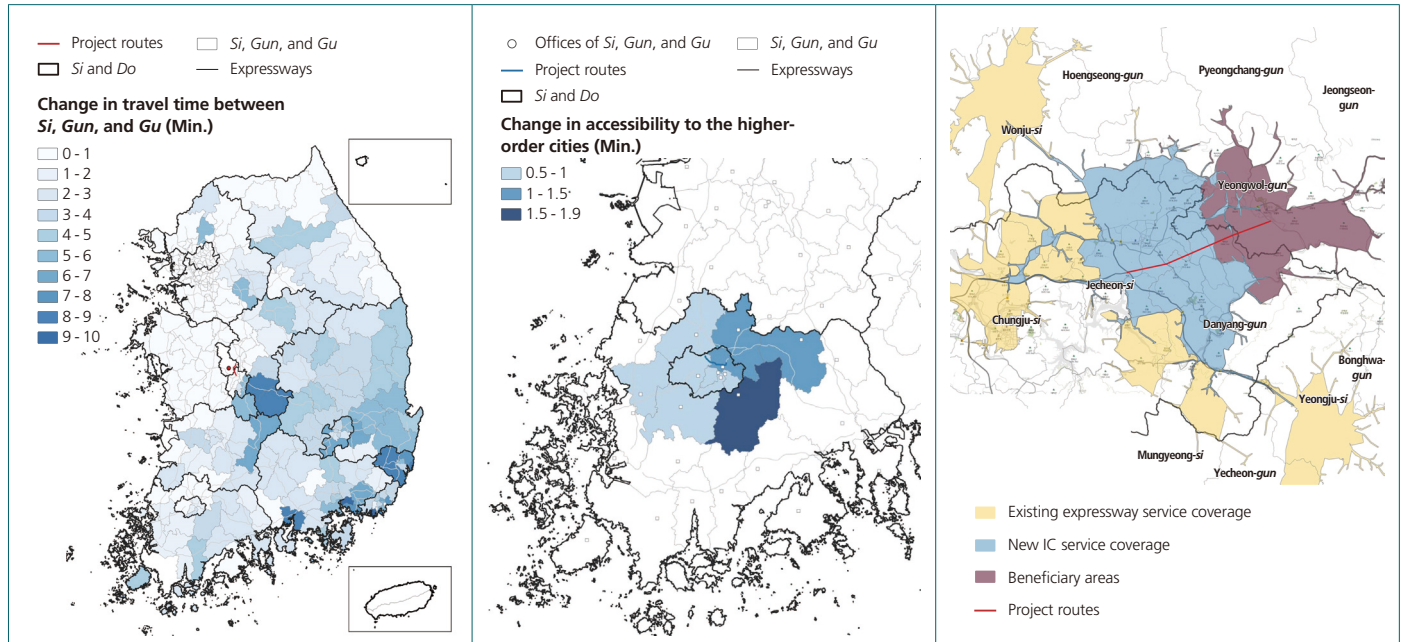
Regarding the effects of road projects such as the addition of service supply facilities or expansion projects other than new road construction projects, the existing indices were supplemented by assessing the impact on users after reflecting the actual qualitative level change in the road network. **Figure 4**

**Figure 3.** Improved access to high-speed railroads via the East Gwangju-Gwangsan Expressway Expansion Project (left), expanded service area for emergency medical facilities via the Jecheon-Yeongwol Expressway Construction Project (center), and expanded service area for performing culture facilities via the Daesan-Dangjin Expressway Construction Project (right)



**Source** Establishment of an investment evaluation system for road projects reflecting shifts in future conditions: Focusing on improving regional balanced development analysis. p.129, 152, 141. 2023, Korea Research Institute for Human Settlements

**Figure 4.** Improved inter-regional connectivity in Sejong Special Self-Governing City via the construction project of the connecting road between Bugang Station and North Daejeon IC (left), improved connectivity between centers of the higher-order cities in each region via the East Gwangju–Gwangsan Expressway Expansion Project (center), and expanded expressway service area via the Jecheon–Yeongwol Expressway Construction Project (right)



**Source** Establishment of an investment evaluation system for road projects reflecting shifts in future conditions: Focusing on improving regional balanced development analysis. p182,176,187. 2023, Korea Research Institute for Human Settlements

#### 4. Policy Application of the Regional Deprivation Improvement Effect Index

##### ■ Short-term institutional change response and policy application in the planning processes

First, the indices proposed in the study are applicable in the short term for calculating regional deprivation indices for balanced regional development analysis and regional deprivation improvement effects. By utilizing existing and new indices, it is possible to effectively capture not only access to living SOC but also road connectivity and the actual changes experienced by the beneficiary population. Second, these indices can be utilized to confirm the performance of road investment projects in official plans, such as the National Road Network Plan or Construction Plan, and to measure the expected effects of the plan. Finally, these indices can be included in the balanced development indices within the transportation sector, enhancing their practical use in policy through continuous data collection and management and being utilized as a foundational resource for balanced development policies.

##### ■ Policy application for selecting underdeveloped areas and constructing a monitoring system in the medium to long term

First, the indices proposed in this study can be applied to select underdeveloped areas with relatively poor conditions and in need of economic and social growth (stimulus). They can be included in the investment process of road projects to support regional development. Second, it is possible to facilitate the analysis and feedback of balanced regional development effects from the implementation of financial investment through the continuous collection, analysis, and management of the proposed index data via a platform. Finally, in the comprehensive evaluation of the preliminary feasibility system, hierarchical adjustments to the evaluation items for the effects of improving regional deprivation can address the existing issue of limited reflection of balanced regional development effects from road investment.

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\* This article is an overview of “Establishment of an investment evaluation system for road projects reflecting shift in future conditions: Focusing on improving regional balanced development analysis.” by Bae, Y., Kim, J., Jeong, S., Kong, J., and Lee, J. 2023. Sejong: Korea Research Institute for Human Settlement

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# Korea's High-Speed Rail: Driving Balanced Territorial Development

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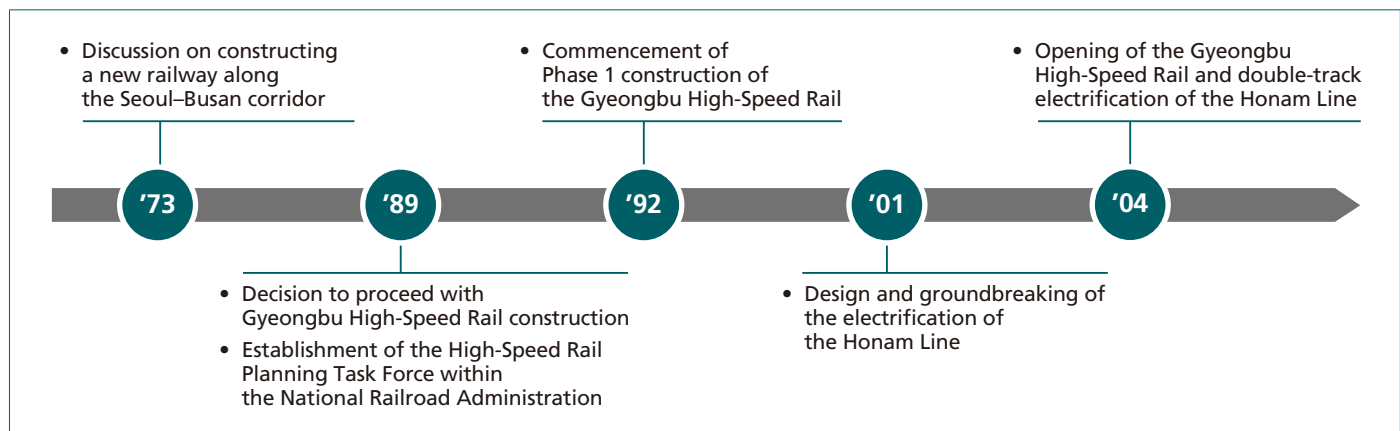
## 1. Background of South Korea's High-Speed Rail Construction

South Korea experienced rapid economic growth during the 1970s, leading to an explosive increase in demand for freight and passenger transportation that the existing infrastructure could not accommodate. In 1973, the World Bank commissioned France and Japan to study Korea's transportation situation in connection with a potential railway loan. Following their survey, both countries recommended the construction of a new railway along the Gyeongbu corridor. Subsequently, in 1978, the Korea Advanced Institute of Science and Technology conducted a study proposing the introduction of a High-Speed Rail on the Gyeongbu Line. In 1983–1984, the Korea Research Institute for Human Settlements conducted a feasibility study on the Gyeongbu High-Speed Railway. This study was executed in collaboration with Hyundai Engineering, Louis Berger, CDM Smith of the United States, and Danish partners. The project comprised two phases: Phase 1, the *Study on the Necessity of Long-term Transportation Investment along the Seoul–Busan Corridor and a Feasibility Study for a Seoul–Daejeon High-Speed*

*Rail*, and Phase 2, the *Feasibility Study for the Construction of a Seoul–Busan High-Speed Rail* (KRIHS 2008:143–144).

By the late 1980s, the existing Seoul–Gyeongbu Line had reached its capacity, and the economic feasibility of constructing a High-Speed Rail system was acknowledged. In May 1989, the government decided to proceed with the construction of the Gyeongbu High-Speed Rail. In December of the same year, a High-Speed Rail Construction Planning Group was established within the National Railroad Administration. By June 1990, a *Basic Plan for High-Speed Rail Construction* had been formulated, laying the foundation for South Korea's High-Speed Rail blueprint. Initially, completion of the Seoul–Daejeon section was scheduled for 2000 and completion of the Daejeon–Busan section by 2002. However, multiple revisions to construction plans, route modifications, soaring construction costs, and the 1998 Asian financial crisis significantly delayed the project. Ultimately, construction of Phase 1 of the Gyeongbu High-Speed Rail began in 1992, and 12 years later, in 2004, Phase 1 of the Gyeongbu Line and the Honam Line double-tracking project opened (KRIHS 2008:146). [Figure 1](#)

**Figure 1** Construction timeline of the High-Speed Rail in South Korea



**Source** Adapted from Korea Research Institute for Human Settlements, 2008:146 as cited in You et al. (2023)

## 2. High-Speed Rail Operations in South Korea

Since Phase 1 of the Gyeongbu High-Speed Rail between Seoul and Daegu opened in 2004, South Korea's High-Speed Rail network has continued to expand. As of 2021, with the addition of the newly constructed Bubal–Chungju High-Speed Line, the total length of the country's High-Speed Rail network was approximately 900 km. The entire Seoul–Busan section of the Gyeongbu High-Speed Rail was completed and opened in 2015. The Honam High-Speed Rail's first phase, Osong–Gwangju Songjeong, was also completed in 2015, and the second phase, Gwangju Songjeong–Mokpo, is currently under construction. In addition, a semi-high-speed line between Wonju and Gangneung was opened in 2017 in time for the Pyeongchang Winter Olympics, followed by the new Bubal (Icheon)–Chungju section of the Jungang Line in 2021. Currently, 10 High-Speed Rail lines are in operation, including the Gyeongbu High-Speed Line, Honam High-Speed Line,

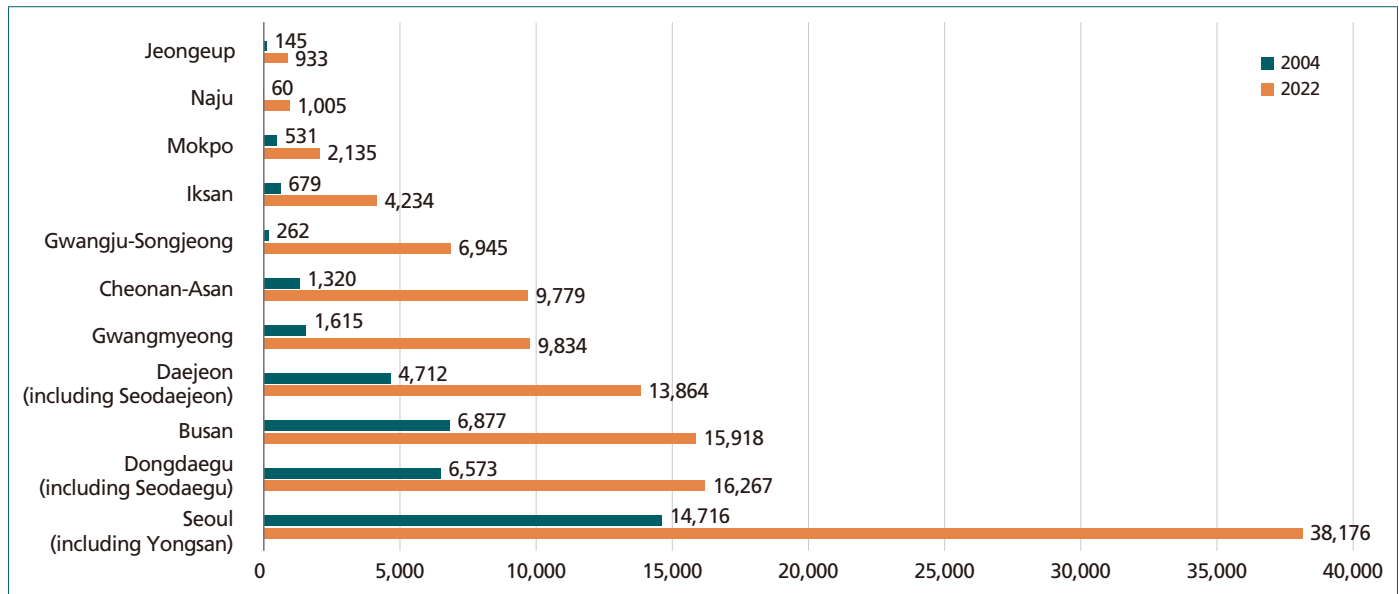
Gangneung Line, and the Super Rapid Train (SRT). A total of 69 High-Speed Rail stations are currently operational throughout the country (see <Table 1>). In 2004, approximately 20 million passengers used High-Speed Rail through approximately 20 stations. By 2022, approximately 95 million passengers had traveled nationwide through 69 stations, contributing to the establishment of a half-day living zone throughout South Korea. [Table 1](#)

From the 2004 opening to 2022, major stations, such as Gwangmyeong, Cheonan-Asan, Iksan, Jeongeup, and Naju, saw a significant increase in passenger volume. In particular, Gwangju-Songjeong Station recorded a remarkable 20-fold increase in ridership, Naju Station saw a 13-fold increase, and Gwangmyeong and Cheonan-Asan Stations recorded an approximately 4–5-fold growth. Outside capital region, Dongdaegu Station recorded the highest number of passengers, with around 11 million passengers in 2022, at an average of 30,000 passengers per day. [Figure 2](#)

**Table 1** High-Speed Rail lines and major stations

| Line                                     | Departure–Arrival      | Stations                                                                                                                                       |
|------------------------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Gyeongbu High-Speed Line                 | Seoul–Busan            | Haengsin–Seoul–Gwangmyeong–Cheonan–Asan–Osong–Daejeon–Gimcheon–Gumi–Dongdaegu–Sinyeongju–Ulsan–Busan                                           |
| Gyeongbu Line (Transit)                  | Seoul–Busan            | Haengsin–Seoul–Yeongdeungpo–Suwon–Daejeon–Gimcheon–Gumi–Seodaegu–Dongdaegu–Gyeongsan–Miryang–Gupo–Busan                                        |
| Honam High-Speed Line                    | Yongsan–Mokpo          | Haengsin–Seoul–Yongsan–Gwangmyeong–Cheonan–Asan–Osong–Gongju–Iksan–Jeongeup–Gwangju Songjeong–Naju–Mokpo                                       |
| Honam Line (Transit)                     | Yongsan–Mokpo          | Haengsin–Seoul–Yongsan–Gwangmyeong–Cheonan–Asan–Osong–Seodaegu–Gyeryong–Nonsan–Iksan–Gimje–Jeongeup–Jangseong–Gwangju Songjeong–Naju–Mokpo     |
| Suseo–Pyeongtaek High-Speed Railway Line | Suseo–Pyeongtaek Jije  | Suseo–Dongtan–Pyeongtaek Jije                                                                                                                  |
| Gyeongjeon Line                          | Seoul–Jinju            | Haengsin–Seoul–Gwangmyeong–Cheonan–Asan–Osong–Daejeon–Gimcheon–Gumi–Dongdaegu–Gyeongsan–Miryang–Jinyeong–Changwon Central–Changwon–Masan–Jinju |
| Jeolla Line                              | Yongsan–Yeosu Expo     | Haengsin–Seoul–Yongsan–Gwangmyeong–Cheonan–Asan–Osong–Gongju–Iksan–Jeonju–Namwon–Gokseong–Gurye-gu–Suncheon–Yeocheon–Yeosu Expo                |
| Gangneung Line                           | Seoul–Gangneung        | Haengsin–Seoul–Cheongnyangni–Sangbong–Yangpyeong–Seowonju–Manjong–Hoengseong–Dunnae–Pyeongchang–Jinbu–Gangneung                                |
|                                          | Seoul–Donghae          | Haengsin–Seoul–Cheongnyangni–Sangbong–Yangpyeong–Seowonju–Manjong–Hoengseong–Dunnae–Pyeongchang–Jinbu–Jeongdongjin–Mukho–Donghae               |
| Jungang Line                             | Cheongnyangni–Andong   | Cheongnyangni–Yangpyeong–Seowonju–Wonju–Jechon–Danyang–Punggi–Yeongju–Andong                                                                   |
| Jungbu Inland Line                       | Bubal (Icheon)–Chungju | Bubal–Ganam–Gamgok Janghowon–Angseong Oncheon–Chungju                                                                                          |

**Source** Korea Railroad Corporation, Station Information (retrieved June 3, 2023) <https://www.letskorail.com/ebizprd/stationKtxList.do> as cited in You et al. (2023)

**Figure 2** Changes in High-Speed Rail passenger numbers at major stations since 2004 (total of boarding and alighting)

**Source** Ministry of Land, Infrastructure, and Transport; Korea Railroad Corporation (2023), 2022 Railway Statistical Yearbook (I) pp. 70–85; Korea Railroad Corporation and Korea Rail Network Authority (2005), 2004 Railway Statistical Yearbook pp. 68–100; as cited in You et al. (2023)

### 3. Role of High-Speed Rail in Promoting Balanced National Development

#### ■ (1) 1990s–2000s

To create a decentralized national spatial structure and establish a rational traffic distribution system, the introduction and operation of High-Speed Rail in South Korea was positioned as major transportation projects aimed at creating a nationwide half-day living zone.

The *Third Comprehensive National Territorial Plan (1992–2001)*<sup>01</sup> focused on shaping a decentralized national framework. It sought to improve the productivity of resources, such as land, raw materials, energy, and time, by strengthening national infrastructure systems. Key objectives included revitalizing regional functions through regional development, inducing the relocation of population and industry to non-capital region, efficiently accommodating the anticipated growth in domestic and international traffic, promoting balanced regional development, and meeting citizen demand for faster and higher-

quality transportation. Additionally, the plan aimed to maximize the effectiveness of High-Speed Rail construction by linking it with initiatives in other sectors, such as the development of new industrial zones, national leisure areas, and new towns.

*The Fourth Comprehensive National Territorial Plan (2001–2020)*<sup>02</sup> further emphasized balanced territorial development, envisioning an integrated national framework in which all regions could grow and prosper according to their unique characteristics and potential. To achieve this, the plan proposed the development of 10 major metropolitan regions to function as regional hubs, the establishment of extensive road and rail transportation networks, and the provision of metropolitan-scale services, such as water supply systems. For railways specifically, the plan aimed to ensure all regions could access the major transportation network within 30 minutes. It advocated continued construction of the High-Speed Rail network as planned, completion of Phase 1 of the Gyeongbu High-Speed Rail, and the utilization of upgraded and double-track conventional lines as High-Speed Rail branch lines.

01. Government of the Republic of Korea. 1992. *Third Comprehensive National Territorial Plan (1992–2001)*

02. Government of the Republic of Korea. 2001. *Fourth Comprehensive National Territorial Plan (2001–2011)*

## ■ (2) 2000s–2010s

During this period, greater emphasis was placed on strengthening regional connectivity and ensuring that the benefits of High-Speed Rail construction were spread throughout the country. The *Revised Fourth Comprehensive National Territorial Plan (2006–2020)*<sup>03</sup> identified six major strategies, including the development of metropolitan areas, innovation cities, enterprise cities, and High-Speed Rail station zones.<sup>04</sup> The development of High-Speed Rail station areas was especially emphasized to spread the benefits of High-Speed Rail nationwide and strengthen interregional connectivity. The *Revised Fourth Comprehensive Plan (2011–2020)*<sup>05</sup> focused on enhancing infrastructure to connect wide-area economic zones and mega-regions, promoting strategies compatible with the era of high-speed and eco-friendly transportation. This included milestones such as the opening of Phase 2 of the Gyeongbu High-Speed Rail and the commencement of construction of the Honam High-Speed Rail.

In line with these developments, the First National Rail Network Plan (2006–2015)<sup>06</sup> aimed to markedly enhance rail competitiveness through network expansion and improved transportation services, and the Second National Rail Network Plan (2011–2020)<sup>07</sup> emphasized balanced development by considerably improving accessibility, thereby expanding the range of areas benefiting from High-Speed Rail services. Additionally, the expansion and upgrade of semi-high-speed railways were pursued alongside high-speed lines, securing rail service capacity and promoting smooth interregional exchanges to support regional growth.

## ■ (3) 2020 and Beyond

The realization of inclusive growth has been increasingly emphasized through the expansion of High-Speed Rail service areas and upgrading of underdeveloped conventional railway lines. Recent philosophies on High-Speed Rail operations and

balanced national development have stressed the importance of achieving inclusive growth by planning new railway networks to build interregional connectivity, expanding High-Speed Rail service coverage, and upgrading conventional railways in underserved areas. The Fifth Comprehensive National Territorial Plan (2020–2040)<sup>08</sup> presented the vision of achieving a balanced national territory where all areas are habitable. It proposed regional development strategies, such as regional specialization and super-regional connectivity, to promote regional growth and competitiveness. In this context, the Fourth National Rail Network Plan (2021–2030)<sup>09</sup> suggested expanding High-Speed Rail services by upgrading existing tracks and introducing new High-Speed Rail services, while also aiming to markedly reduce travel time between regional hubs. In particular, the criteria for selecting new projects in non-capital region were revised to include the consideration of regional balanced development effects, thereby enhancing the effectiveness of policies designed to achieve balanced national development goals.

In summary, the Comprehensive National Territorial Plans and National Rail Network Plans have consistently emphasized the role of High-Speed Rail in two aspects of balanced national development. First, the role of High-Speed Rail was highlighted as a measure to foster regional growth in response to capital region concentration by contributing to the formation of a decentralized national framework through initiatives such as the development of regional metropolitan areas. Second, efforts were made to expand the range of areas benefiting from High-Speed Rail services to spread the ripple effects of High-Speed Rail beyond major cities into broader regional areas.

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03. Government of the Republic of Korea. 2006. *Revised Fourth Comprehensive National Territorial Plan (2006–2020)*

04. In fact, Gimcheon (Gumi) Station is a high-speed rail station located within the Gimcheon Innovation City development zone in North Gyeongsang Province. It was established to facilitate the construction of the innovation city, attract population inflow, and improve access to the Gimcheon and Gumi industrial complexes. The station's design process began in 2006, and construction commenced in August 2008, with the station officially opening on November 1, 2010

05. Government of the Republic of Korea. 2011. *Revised Fourth Comprehensive National Territorial Plan (2011–2020)*

06. Ministry of Construction and Transportation. 2006. *First National Rail Network Plan (2006–2015)*

07. Ministry of Land, Transport and Maritime Affairs. 2011. *Second National Rail Network Plan (2011–2020)*

08. Government of the Republic of Korea. 2020. *Fifth Comprehensive National Territorial Plan (2020–2040)*

09. Ministry of Land, Infrastructure, and Transport. 2021. *Fourth National Rail Network Plan (2021–2030)*

\* This article is an overview of “20 Years of High-Speed Rail in Korea: Effect of Balanced National Development and Future Task.” by You, H., Nam, K., Hong, S., Jeong, D., Kim, H., Lee, Y., and Choi, J. 2023. Sejong: Korea Research Institute for Human Settlement

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KRIHS (Korea Research Institute for Human Settlements) was established in 1978 in order to contribute to the balanced development of national territory and the improvement of the quality of life of people by conducting comprehensive policy-oriented research in the efficient use, development, and conservation of territorial resources.