THE PROGRESS/STATUS OF ECOLOGICAL ASSESSMENT ON THE INTENSIVE LAND USE IN SELENGE AND DARKHAN-UUL PROVINCE, MONGOLIA

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ABSTRACT:

The study area, it includes Darkhan-Uul and Selenge provinces of Mongolia, is included in the most favourable natural-geographical areas, and the migration of people with livestock from the peripheral areas has led to an increase in the population, as well as a sharp increase in the number of grazing animals, resulting in the effects of natural and human activities. give an evaluation, develop the basis for the proper use of the land in the future. In Mongolia, the methods and principles of land evaluation differ depending on the general classification and purpose of land, so considering these characteristics, land evaluation is carried out by (1) the Department of Agriculture, (2) the Department of Urban Development, Industry and Mines, (3) the Department of Roads and Networks, (4) it is divided into types of land with forest reserves (Tserenbaljir, B. Naranchimeg, 2004). In the "instructions for land evaluation" issued by the United Nations Food and Agriculture Organization (FAO) in 1976, in the assessment of land quality, in addition to the main indicators of soil fertility and moisture, climate, land cover and use, chemical pollutions such as an alkaline acidity. In the ecological assessment study, data on land use, soil, vegetation, climate, natural conditions, resources, socio-economic, satellite and field studies were collected in numerical and tabular form. The Ecological assessment in intensive land use is divided into qualitative and quantitative assessment. The Qualitative assessment predicts ecological properties. The Quantitative methods use multi-species numerical methods to record ecological elements and calculate the overall percentage of ecological characteristics.

1. INTRODUCTION

The imperative of judicious land utilization emerges as paramount in facilitating national development endeavors while safeguarding ecological integrity. Integral to this endeavor is the imperative to approach land use through a scientific prism, underpinned by economic efficacy, and a steadfast commitment to land quality preservation.

Central to an elucidation of the socio-economic underpinnings of land utilization is a rigorous examination of governmental policy orientations and prospective objectives, particularly delineated in foundational policy frameworks such as Mongolia's Sustainable Development Concept-2030, Vision-2050, and New Revival Policy. This necessitates a meticulous examination of regional land resources and their utilization dynamics, indispensable for informed policy formulation and implementation.

The confluence of climate change dynamics and anthropogenic activities precipitates a discernible impact on land degradation processes. This nexus, characterized by escalating incidences of force majeure events and human-induced pressures from mining, agriculture, urban expansion, and demographic shifts, engenders adverse repercussions on land resources, notably manifested in degraded grazing lands, exacerbated soil erosion, and diminished agricultural productivity.

A holistic inquiry into land use patterns mandates an assessment predicated upon ecological carrying capacities, entailing a multifaceted appraisal of land status, quality, and socio-economic conditions. Guided by the outcomes of this assessment, comprehensive land use management strategies must be devised, integrating utilization and protective imperatives.

Considering land utilization rates and attendant adverse ramifications, the imperative to gauge per-unit area burdens, delineate judicious usage thresholds, and monitor alterations in soil and vegetation composition becomes exigent. Paramount to this endeavour is an elucidation of the manifold factors, both deleterious and beneficial, exerting influence on the ecological equilibrium of land ecosystems.

2. STURY AREA

A total of 21 sub-districts were surveyed in 4 sub-districts of Darkhan-Uul province and 17 sub-districts of Selenge province, which represent the regions with intensive land use (Figure 1).

Figure 1. Study Area

The territories of Darkhan-Uul and Selenge provinces are in the forest-steppe zone according to their natural conditions, and the extreme continental climate has a lot of hot and cold days and seasonal fluctuations. This is due to high fluctuations in daily and seasonal air temperature, different distribution of annual precipitation, high dryness of the air, and long cold winters. Spring is short and rainfall is low, while summer is relatively long. On average, the annual average temperature ranges from -2^0C to -5^0C, and the average monthly temperature reaches +9.9^0C in the warm season, i.e., April to October. As for the climate region, it is included in the ultra-continental region of the Orkhon-Selenge basin with very cold and harsh winters. In terms of precipitation, since 2005, there has been a general decline in the multi-year trend of precipitation. In Darkhan-Uul province, 352.2 mm is more than the long-term average, while in Selenge province, it is close to the long-term average - 230.3 mm in Sukhbaatar sub-district, 299.6 mm in Baruunharaa, and 229.3 mm in Zuunharaa. The average relative humidity of the province is 68.0-79.0 percent. Relative humidity reaches a minimum of 53.0 percent in spring due to dry air and strong winds. The daily course of relative humidity fluctuates quite a bit, the minimum is observed around 13-14 hours of the day, and the maximum is observed around 4-6 hours. The maximum relative humidity is 80.0-81.0 percent in January and December. The number of days with relative air humidity less than 30 percent is 52 days per year on average in the entire province, and the maximum is 10-11 days in April and May.

The study area includes the Selenge river basin, the Orkhon river basin, the Yeruu river basin, the Kharaa river basin, and the Tuul river basin. Many rivers, springs, and streams flow through the region, such as the Selenge river, Yeruu river, Kharaa river, Shariin Gol river, Khuitni river, Chuluut river, Orkhon river, Buurliin river, Rashaant river, etc. There are also many lakes such as Dangin lake, Davst lake, Ishgent lake, Tsagaan lake and Tsaram lake.

Our research area is dominated by forest-steppe and small mountains, and the soil is covered by the Orkhon-Selenge district with mountain brown and brown soil (Dorjgotov, 1976). In these areas, mountain brown soil prevails in the middle small mountains, brown soil prevails in the valleys between them, and alluvial soil is stabilized in the river valleys. The soil-forming source rock mainly consists of silty loam, light loam, and sandy sediments of eluvial, deluvian, and proluvian origin. In the river valleys, sand, sandstone, and gravel from ancient and modern rivers and lakes are widely distributed. The most common and characteristic feature of the soil of the Orkhon-Selenge basin or the central cultivation area is humus stratified medium, light loamy and sandy mechanical composition.

In terms of vegetation, in the western and eastern parts of the mountain, there are patches of larch forest, as well as birch-pine, birch-snow mixed forest, birch forest, and bramble forest. Onon, Shaamar, and Altanbulag are surrounded by pine forests, in the southern part of the forest there is a very rare piece of larch grove, and around it there is a network of birch trees. This circle is dominated by mountain steppe plants that occur in various variants. Dominant types of grasslands include sedge-grass, sedge-grass, sedge-grass, and in the east: sedge, sedge, sedge, and sedge are the main areas. In terms of vegetation, the river will consist of representatives of the subtropical forests and mountain steppes, and the Mongolian steppes at the southern end.

3. APPROACHES

The objectives of the research work are to assess the load per unit area of use, determine the appropriate limits, determine the changes in the soil and vegetation that are the main components of the land, and determine the factors affecting the ecology of the land. Therefore, when conducting regional research, research is conducted in four stages: preparatory stage, field research, material processing and presentation of research results.

In the ecological assessment study, data on land use, soil, vegetation, climate, natural conditions, resources, socio-economic, satellite and field studies were collected in numerical and tabular form.

When studying the stages and processes of land ecology assessment, it was determined that raw data, evaluation factors, and data sources should be integrated during data collection and research. Therefore, the basic parameters necessary and affecting the ecological assessment of the land are defined and shown in detail in Table 1 (Figure 3).

Table 1. Indicators of ecological assessment

Indicators	*Notes*
Boundaries	National, aimag /sub-province/, soum, bagh boundaries an urban/settlements center
Land Use	National, aimag /sub-province/, soum, bagh boundaries an urban/settlements center[1]
Geomorphologyp	Landforms, DEM, aspects, slope
Climate and Meteorology data	Average temperature, precipitations, land surface temperature etc
Ground and Sruface Water	Rivers, lakes, springs, wells, glaciers, hydrology
Vegetation /Flora/	Flora ecosystems, species, family of vegetations degradation, 1 hectare crop, and plant species
Soil Map	Soil rocks, soil types, soil mechanical components, soil fertility, pH, humus
Socio-Economy /Statistics/	Demography, livestock, cropland etc

In the integrated ecological assessment manual, some forms of ecological assessment (EA) are necessary, especially for quantitative spatial data at the landscape and regional level (1) remote sensing data (spatial images, orthoimages, aerial images), (These include 2) integrated climate data, (3) digital elevation models, (4) topographic maps, and (5) thematic images of environmental variables such as land use, landforms, soils, geology, and vegetation (Franklin, 2001).

Land ecological assessment is divided into qualitative and quantitative assessment. Qualitative assessment predicts ecological properties. Quantitative methods use multi-species numerology methods to record ecological elements and calculate the overall percentage of ecological characteristics. The land use and ecological assessment studies will be carried out as shown in Figure 2.

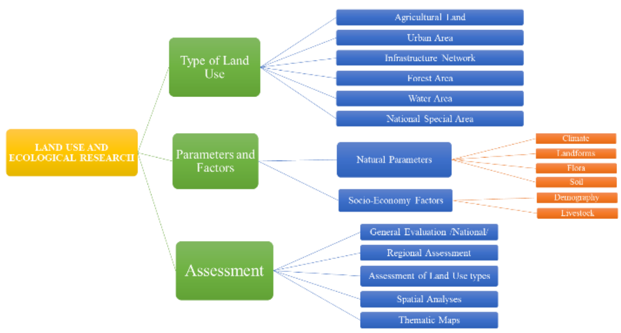

Figure 2. Methodological scheme of satellite data processing

Therefore, this study was conducted in four stages: preparatory stage, field research, material processing and presentation of research results. A geodatabase was created for the monitoring survey of agricultural land, and a map and route for the field survey was prepared before starting the field survey. The database structure is shown in Figure 2. The database includes 21 sub-district boundaries, team boundaries and agricultural monitoring points, cadastral data of cultivated and agricultural land, agricultural soil data, satellite data and topography data.

[1] Law of the Land (updated version), 2002

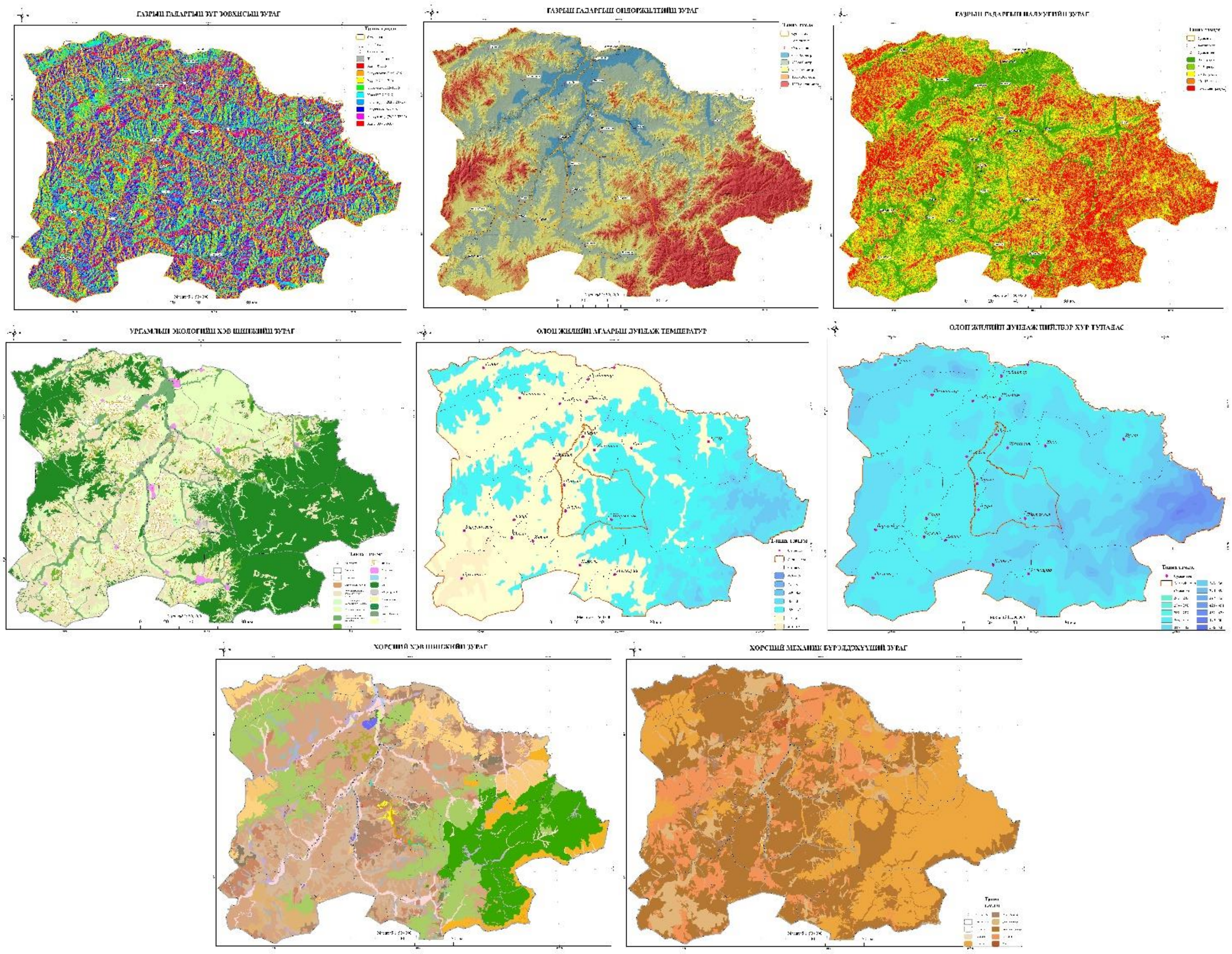

Figure 3. Thematic maps of the study area (DEM, climate, soil and vegetation)

According to the Figure 2, the ecological assessment will be modeled, and the ecological factors will be grouped together in the context of land use and socio-economic, and the order of assessment will be determined. The main processing of the assessment will be carried out using the "Multi-criteria decision-making weight method" (Figure 4). Before that, it is necessary to compile a database of each influencing factor and determine the ranking of each indicator.

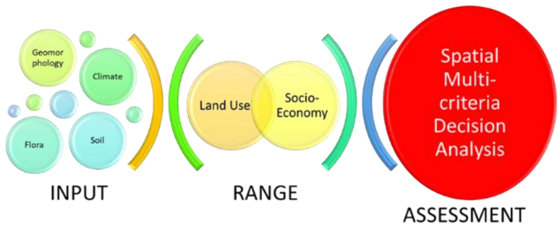

Figure 4. Ecological Assessment Model

4. RESULTS

The Mongolian Land Use is allocated to special-purpose funds taking into account the nature and ecological characteristics and features, their role, importance and requirements in society and economy. In doing so, they have been classified according to their purpose, taking into account the characteristics of the basic appearance and state of nature, and how they can meet the requirements of the intended use of the area. Using the land fund according to its purpose is important because it makes it possible to regulate land relations such as land use and protection, taking into account their roles and characteristics.
A land cover map for the study area was developed based on satellite data (Sentinel 2) for cloudless or low cloud days between August 1 and September 30, 2022 (Figure 5). In the contrast, via the website www.sentinel-hub.com, the primary processing and corrections of the satellites were carried out through cloud-based processing, and they were processed into a thematic image using the ArcGIS program of the geographic information system.
Data of the integrated land fund of Darkhan-Uul and Selenge provinces of 2018 and 2019 were collected and analyzed according to the GT-1 form issued by the Department of Land Management and Geodetic Cartography (Table 2).

Table 2. The area differences of the main type of the land use of Darkhan-Uul and Selenge provinces in 2018 and 2019, thousands of hectares

№	Types of Land Use	Darkhan-Uul			Selenge		
		2018	2019	Difference	2018	2019	Difference
1	Argicultural Land	221.9	221.5	-0.4	2057.9	2057.6	-0.3
2	Urban and settlement areas	19.3	19.7	0.4	63.8	64.1	0.3

3	Road and infrastructure	6.2	6.2	0	22.2	22.2	0.03
4	Forest area	72.0	72.0	0	1533.7	1533.7	0
5	Water area	6.7	6.7	0	19.4	19.4	0
6	National special areas	1.4	1.4	0	418.2	418.2	0
	Total	327.5	327.5	0	4115.3	4115.3	

According to the main types of land use of Darkhan-Uul province, in 2019, the agricultural land will occupy the largest area of the total area, 221.5 thousand areas, and it was removed from the area of 2018 and transferred to the area of urban and settlement areas, and it became 19.7 hectares. The smallest area of the total land will be 1.4 thousand hectares of land for special protected areas, 6.2 thousand hectares of road and infrastructure, 72 thousand hectares of forest area, and 6.7 thousand hectares of water area.

According to the main types of land use of of Selenge Province, in 2019, agricultural land will occupy the largest area of the total land, 2057.6 thousand square meters, and it was excluded from the 2018 square meter and transferred to the area of urban and settlement areas, and it became 64.1 hectares. The smallest area of the total land area is 19.4 thousand hectares of land with water area, 2.2 thousand hectares of road and network land, 418.2 thousand hectares of land for special protected areas, and 1533.7 thousand hectares of forest area. not yet transitioned.

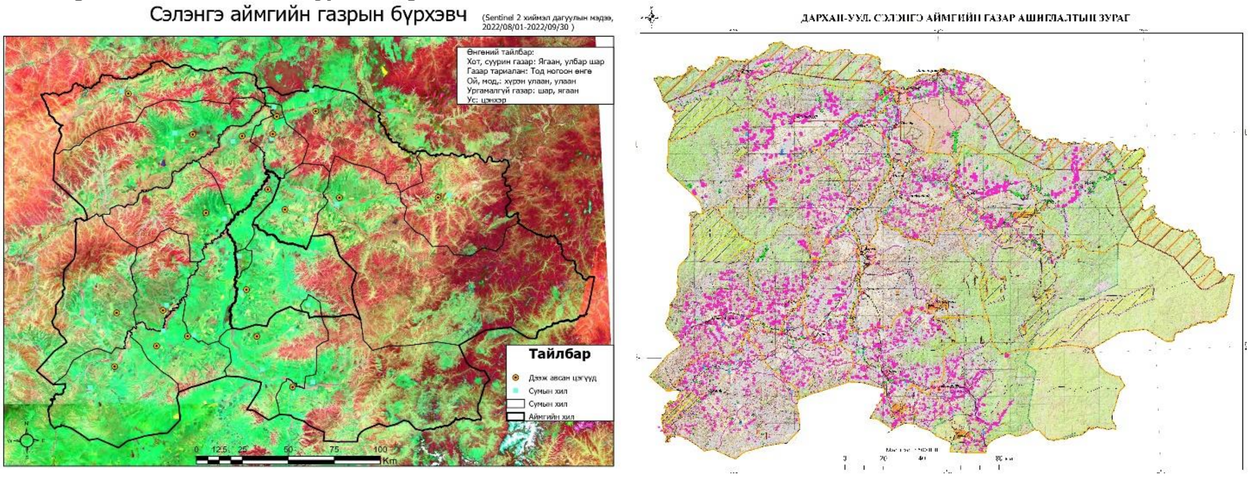

Figure 5. Land cover and land use map of 2022

According to Figure 6, the population of Darkhan-Uul Province has increased every year since 2000 until 2021. The population of Selenge Province decreased in 2000-2008, increased in 2009, decreased in 2013, and then increased again. According to this, the population of Selenge province is increasing and decreasing.

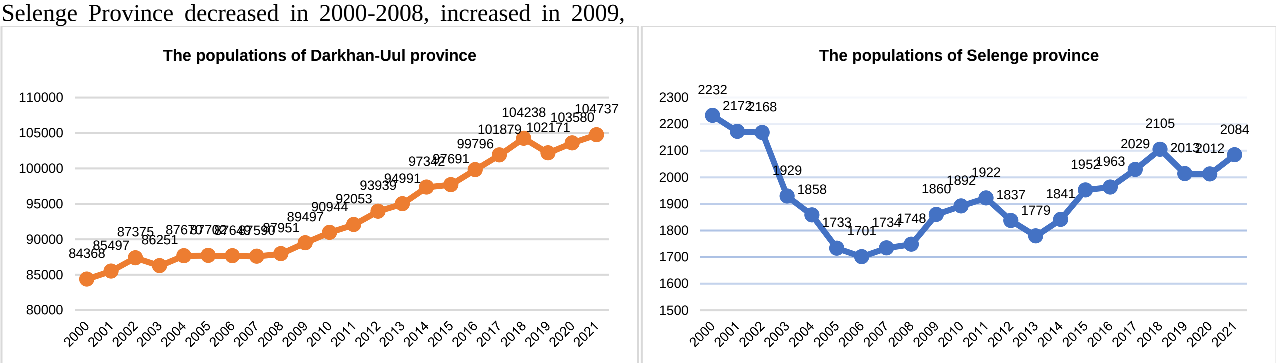

Figure 6. Demography of the study area, 2000-2021

According to Figure 7, the largest number of people migrated to Selenge province in 2004, 2005, 2013, 20014, and 2015, while the number of people who migrated in 2010 and 2012 was high. During the migration of Darkhan-Uul province, the largest number of people migrated between 2000-2002 and 2010, while between 2003-2019, the number of people who migrated is more than the number of people who arrived.

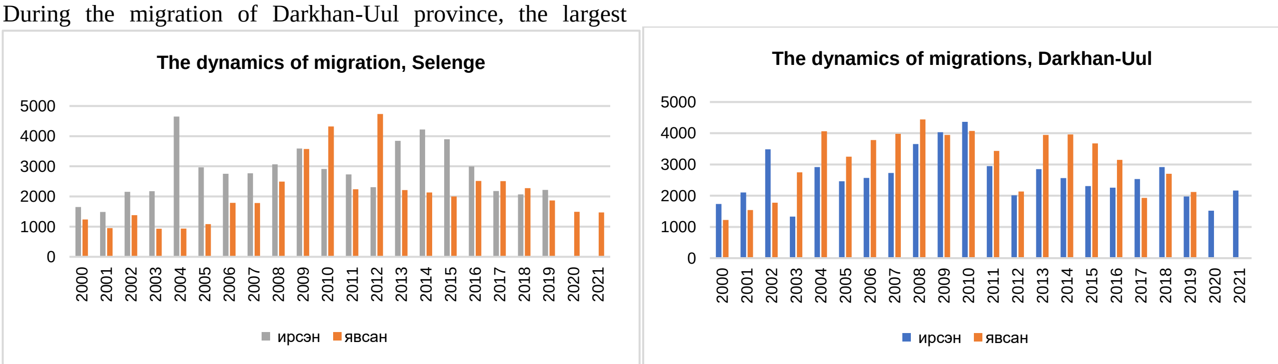

Figure 7. Population migration, 2000-2021

5. CONCLUSIONS AND DISCUSSIONS

Multi-criteria decision-making weighting methods can be used to make this assessment. The criteria weights are generated by ranking the ecological factors identified above. Given that the weight of the criteria can significantly affect the outcome of the decision-making process, it is important to pay special attention to the validity factor of the criteria (ODU, 2019). The ecological assessment factors were identified based on the ecological assessment matrix developed in 2018 for use in New Zealand. In the matrix, ecological factors are classified as very high, high, reasonable, low, very low, and the level of impact is classified as very high, high, suitable, low, very low, and basic. With this, soil, vegetation, climate, and surface parameters will be classified according to their impact on the ecology of regions with intensive land use.

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Table 3. Ecological assessment indicators and impact degree ratio (Roper-Lindsay, 2018)

Level of effect		Ecological and/or conservation value				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
Magnitude	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

In this way, research will be conducted to develop a scientifically based, field-tested and practical method for land ecological assessment. Also, to evaluate the above matrix, multi-criteria decision-making methods can be used to determine ecological capabilities and resources with geographical connections using geographic information systems.

There are a wide variety of multi-criteria decision-making methods for land ecological assessment. These include goal programming, analytical hierarchy process, weighted scoring method, VIKOR, TOPSIS, etc. (ODU, 2019). The methods are detailed in Table 4.

Table 4. Types of weighting methods for multi-criteria decision making

Subjective weighting methods	Objective weighting methods	Integrated weighting methods
• Distribution of points • Direct assessment • Ranking method • Analytic hierarchy process (AHP) • Relational method • Swing method • Delphi method • Nominal group technique • Simple multi-attribute ranking Technique (SMART)	• Entropy • Criteria Importance Through Inter-criteria Correlation (CRITIC) • Mean weight • Standard deviation • Statistical variance procedure • Ideal point method	• Multiplicative synthesis • Additive synthesis • Weight based on sum of squares • Calculate weights based on final ratio coefficients

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