

# Quality Inspection Methods and Case Studies on Thematic Natural Resources Survey and Monitoring Results

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**Abstract**—The thematic survey and monitoring results of natural resources (TMR) provide scientific, detailed and reliable data support for government management departments to grasp the overall situation, reflect the society and people's lives. Therefore, product quality for TMR is a major concern of outcome producers and users. This paper discusses the quality evaluation model and test method of TMR, and summarizes and proposes methods to improve the quality of the results by examining the quality of different TMR.

## 1. INTRODUCTION

### 1.1 The Background of TMR

The "Overall Plan for the Construction of the Natural Resources Survey and Monitoring System" (Overall Plan) states that in order to perform the "two unifications" duties of the Ministry of Natural Resources (the unified exercise of the responsibilities of the owner of all natural resource assets and the unified exercise of the control of all land and space uses and ecological protection Restoration duties), build a natural resource investigation and monitoring system, unify the classification standards of natural resources, organize and carry out natural resource investigation, monitoring and evaluation in accordance with the law, find out the background and changes of various natural resources in my country, formulate national land and space planning for scientific purposes, and gradually realize mountains, rivers, forests, fields and lakes. The overall protection, system restoration and comprehensive management of grass, provide basic support to ensure national ecological security, and provide service guarantees for the realization of the modernization of the national governance system and governance capacity [1]. The overall plan requires that a quality management system for natural resources investigation and monitoring be established, and quality supervision duties should be

strictly performed in accordance with the law to ensure that the results of investigation and monitoring are true, accurate and reliable.

### 1.2 Thematic Geographical Monitoring Results And TMR

Thematic Geographical Monitoring Results refers to making full use of the results of the census of geographical conditions and basic geographical conditions monitoring, combined with archiving basic geographical information results, aerospace remote sensing image data, and economic and social data, etc., to refined, sampling, and rapid thematic monitoring [2].

Thematic monitoring, that is, to focus on organizing two thematic monitoring projects, the comprehensive monitoring of land space development and utilization and ecological restoration, and the monitoring of special indicators of natural resources, of which the former serves the unified exercise of the control of all land and space uses and the performance of ecological protection and restoration responsibilities; The latter serves to uniformly perform the duties of the owner of natural resource assets owned by the whole people. The two monitoring tasks promote each other and advance in concert. On the basis of the above monitoring, thematic monitoring is carried out on the key tasks of the state, the provincial party committee and the provincial government and the special indicators of natural resource management needs [3].

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Table 1 Comparison of Similarities and Differences Between Thematic Geographical Monitoring Results and TMR

Compare Content	Thematic Geographical National Conditions Monitoring Results [8]	TMR [1]
Organization and implementation subject	Former National Bureau of Surveying, Mapping and Geographic Information	Department of Investigation and Monitoring, Ministry of Natural Resources
Data source	Geographical Census Data Geographical National Conditions Monitoring Data	Third National Land Survey Data Geographical Census Data Geographical National Conditions Monitoring Data
Topic name	Special topic on monitoring of land and space development; The topic of resource conservation and utilization monitoring; Eco-environmental protection monitoring topic; Major national strategies and regional overall development monitoring topics; Special topic on urbanization development monitoring; Other monitoring topics	Basic survey and monitoring results include geographical and national conditions monitoring results, thematic geographical and national conditions monitoring results, etc.; special survey and monitoring results include survey and monitoring results of cultivated land, forests, grasslands, wetlands, water resources, mineral resources, and marine resources.
Outcome Type	(1) Monitoring data (2) Analyze and evaluate results (3) Monitoring report (4) Maps	(1) Data and database (2) Statistical data set (3) Report (4) Maps
Use data department	Used by ministries	

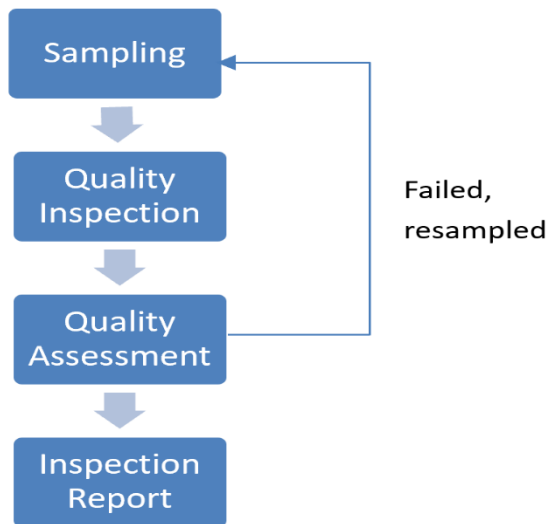
At present, there are many articles on the quality inspection of geographical and national conditions monitoring results, such as article [4-6], which describes the quality inspection technology, method and practice of geographical and national conditions monitoring results. There are also articles about the thematic geographic national conditions inspection, such as article [7], which puts forward the inspection method and quality evaluation model of thematic geographic national conditions monitoring results, and evaluates the quality of thematic geographic national conditions monitoring results objectively and scientifically. However, there are few studies on the quality inspection of TMR. It can be seen from Table 1 that although the TMR and the thematic geographic national conditions monitoring results are organized and implemented by different entities, different data sources, and different thematic names, they are the same in terms of the type of results and the use department. Therefore, it is one of the research directions whether the quality inspection model of the monitoring results of thematic geographic national conditions can be used for the quality inspection of TMR. Under the new situation, the TMR have appeared in cooperation with multiple departments, and there has been a trend of cross-industry, cross-professional and cross-standard. According to the overall plan, this paper refers to the model for the quality inspection of the thematic geographic national conditions monitoring results, refines the inspection content and methods, and selects TMR of different themes to verify. According to the requirements and characteristics of natural resources survey, monitoring and evaluation, the

focus of quality control of results is analyzed, and the focus of production and inspection of TMR is proposed. Provide reference for better serving the "two unification" responsibilities and ensuring the quality of TMR.

## 2. TMR QUALITY EVALUATION MODEL

The steps for quality inspection of TMR are as follows (Fig 1):

- Explicitly check the inspection object, including several quality elements.
- Sampling according to the sampling rules;
- Check the samples;
- Quality assessment of quality elements. If one quality element fails, it needs to be returned to the production unit for re-sampling inspection after modification.
- For the TMR that pass the quality assessment, return to the production unit to revise the problems found in the inspection. After the review and revision is completed, an inspection report is prepared.



**Figure 1** Flow chart of quality evaluation process of TMR

## 2.1 Object of Inspection

Based on data and databases, statistical datasets, reports, and graphs as quality elements, checks are carried out separately [8].

- Data and databases: including various remote sensing image data, various survey, monitoring, analysis and evaluation data, as well as databases, shared service systems, etc.
- Statistical data sets: including various surveys, monitoring series data sets, special statistical data sets, and various analysis and evaluation data sets formed by classification, classification, sub-region and sub-element statistics.
- Reports: including work reports, statistical reports, analysis and evaluation reports, as well as special reports, bulletins, etc.
- Maps: including atlas, atlas, thematic maps, wall charts, statistical charts, etc.

## 2.2 Sampling Method

Due to the large number of data results involved, the TMR can be combined with a combination of overall inspection and sub-outcome type inspection. The report adopts the overall inspection. The inspection of data and database, statistical data set, and map can be based on administrative divisions, regions, feature sets, and map sheets according to the situation. the complexity of the ground objects (such as urban areas, villages, etc.) factors are stratified and randomly selected with a proportion of no less than 10% of the data for inspection.

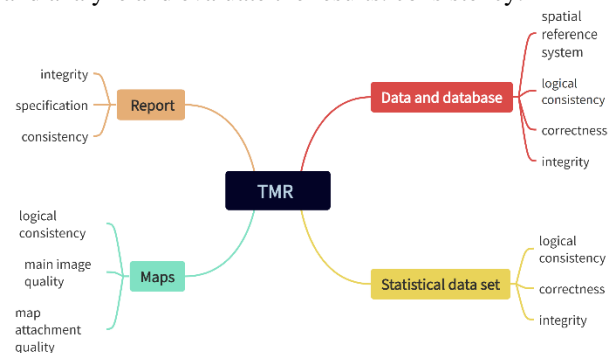
## 2.3 Inspection Content

According to the test content of TMR in Figure 2, it can be seen:

- The data and database are mainly checked through internal inspection to check whether the spatial reference

system and logical consistency satisfy the design requirements, and to check the integrity of the data.

- The statistical data set mainly checks whether the logical consistency meets the design requirements, checks the integrity of the data, and checks the correctness of the calculation of the statistical results and the consistency with the monitoring data by means of reference data comparison and internal inspection.
- The report mainly checks the completeness of the report content, the standardization of the report content, the statistical values, illustrations, tables and monitoring data, analysis and evaluation results, and graphic results in the report through reference data comparison and internal inspection. consistency.
- Maps are mainly checked by means of reference data comparison and internal inspection to check whether the logical consistency meets the design requirements, check whether the quality of the main drawing and the quality of the accessories meet the design requirements, check the statistical values and monitoring data in the maps, and analyze and evaluate the results. consistency.



**Figure 2** The content of the inspection of TMR

## 2.4 Quality Element Quality Assessment

The quality assessment of TMR implements the weighting method of GB/T 24356-2009 Specification for quality inspection and acceptance of surveying and mapping products [9]. That is to say, each quality element is evaluated by error and leakage rate evaluation to carry out each type of evaluation, which is divided into four grades of ABCD. The evaluation content of grades is determined according to different themes.

- Category A indicates errors or omissions of extremely important inspection items, or extremely serious errors and omissions of inspection items; 42 points will be deducted for a Category A error.
- Category B: errors or omissions of important inspection items, or serious errors and omissions of inspection items; 12 points will be deducted for a Category B error.
- Category C: Errors or omissions of more important inspection items, or serious errors and omissions of inspection items; 4 points will be deducted for a Category C error.
- Category D: Minor errors or omissions of general inspection items. 1 point will be deducted for a Class D error.

## 2.5 Quality Assessment Of TMR

- The data and databases, statistical data sets, reports, and graphs in the TMR are evaluated separately as four quality elements, and their respective scores are calculated;
  - According to the characteristics and requirements of the project, give different weights to each form of achievement;
  - The total score obtained by multiplying the four scores by different weights is the final score of the TMR.

## 3. RESEARCH ON QUALITY EVALUATION OF TMR

### 3.1 Main Quality Problems

In this paper, five types of TMR are selected as the research objects to carry out inspection and evaluation, involving water resources survey and monitoring results, land and space planning implementation monitoring results, marine resources survey and monitoring results, and urban land and space survey results. Through inspection, it is found that the main quality problems of the four quality elements are as follows:

#### 1) *Main quality problems of data and database*

Topological relationship errors; thematic feature attribute values are incorrect; data set results are incomplete, etc.

#### 2) *The main quality problems of statistical data sets*

Table calculation error; individual tables are missing from statistics.

#### 3) *Main quality problems of maps*

Errors and omissions in the subject content; inconsistency between the values in the map and monitoring data; irregular finishing of the results of the map; incomplete content of the base map; inconsistency in the organization structure, data format, and file naming of the map with the requirements of the design document.

#### 4) *Report major quality problems*

Statistical data of individual indicators are missing from the report content; statistical values are inconsistent with monitoring data; nouns are wrong; word descriptions are inconsistent with tables; illustrations and table units are wrong, etc.

Take the inspection of thematic water resources results as an example. The results ranged from a section of watershed involving 70 counties in 4 provinces. The results examined include data and databases, statistical datasets, maps and reports. Data and databases are stored in shp format, pictures are stored in jpg format, statistical data sets are stored in the form of datasets, reports, thematic maps, etc., and reports are stored in file format. Among them, the data and database quality problems are that the elements have errors in individual topological relationships; the attribute values of individual thematic elements are incorrect. Statistical dataset quality issues are individual table calculation errors. The quality of the map is that thematic elements are missing, the content is wrong, and the values in individual maps are inconsistent with the monitoring data. The quality problem of the report is that

the content of the report lacks statistics of individual indicators, etc. After quality assessment, the achievement meets the requirements of technical design, and the quality of the achievement is qualified.

### 3.2 Discussion

By arranging and analyzing the experimental data of TMR, it is possible to understand the current quality of TMR, find the general rules, and facilitate the quality management department to formulate targeted measures to improve the quality of the results. The main reasons that affect the quality of TMR are as follows.

- The data source is complex. TMR use a variety of data sources, including geographic and national conditions census data, geographic and national conditions monitoring data, data from the third national land survey, and professional statistical data from various industries. In order to integrate different data into a database that meets the requirements of the project, errors and omissions of individual data may be caused during data processing and conversion.

- TMR involve cross-professional industry knowledge. If the project leader does not have the corresponding professional knowledge reserve, the produced products cannot well meet the requirements of the user department.

- From the perspective of quality elements, data and databases are the foundation, and data quality will have an impact on other quality elements. There is no unified format and form for the maps and reports, resulting in a lack of basis for quality evaluation. Statistical datasets are an important type of outcome that directly serve ministries and provide them with decision-making use. It can be seen from the scores that everyone is aware of the importance of the achievement, and pays special attention to the control of the result in production.

### 3.3 Suggestions On Improving The Quality Of TMR

Based on the above analysis and research, it is recommended that the management departments, production units and quality inspection units responsible for TMR should pay attention to the following points:

- It is suggested that when the production and inspection of TMR are carried out in the future, a process inspection mechanism should be introduced, and the data and database results should be inspected first, so that quality problems can be found and solved early in the production process. Promote the improvement of the quality of thematic results.

- Carry out pre-job training to improve production staff's understanding of reports and drawings. Refine the production requirements for reports and drawings when compiling technical designs. Among them, maps should focus on the expressiveness and applicability of graphs. The bearing capacity of the drawing is limited, and the selection of important elements and one-pass elements is what needs to be paid attention to in the inspection.

Including the choice of base map, important data cannot be covered, etc.

- Pay attention to the production of the first product. The first product is to select a small area for verification, to ensure the participation of production personnel and quality inspection personnel in the whole process, to ensure that the technical process is feasible, and the quality of the results is reliable, and then large-scale production is carried out. This ensures that the quality of the entire project is controllable.

## 4. CONCLUSIONS

TMR were originally derived from the results of the geographical census. Under the new mission and requirements of the country, the application scope and objects of the TMR have changed. In order to better carry out quality control and management of new data results, this paper discusses the applicability of inspection content, inspection methods, sampling methods, and quality evaluation system in the thematic monitoring of quality results in natural resource survey and monitoring. Combining a number of thematic achievement cases, starting from the user's point of view for the first time, it is of great significance to analyze and evaluate the key contents of the TMR and the key points of quality inspection, and expand the inspection objects and types for the future TMR. As more and more TMR are produced in the overall plan, more production and quality inspectors from other fields and departments will participate in the inspection of TMR in the future. This article provides them with reference.

In addition, the overall plan proposes to "promote the construction of a 3D reality database and provide a unified spatial base reality 3D database for the construction of digital China. It can be seen that the thematic monitoring results will include the types of real 3D results. Therefore, in the future, the real 3D results will be more research on quality inspections.

## ACKNOWLEDGEMENT

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