Research on the application of GIS technology in the preparation of village planning --Take Feng Sheng Village as an example

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Abstract. Hubei Province is gradually carrying out the preparation of five levels and three types of territorial spatial planning, to scientifically layout construction space, agricultural space and ecological space, and strengthen the guiding and constraining role of territorial spatial planning for all planning. At the same time, in order to promote the construction of beautiful countryside and rural revitalization, the preparation of village planning in Hubei Province is also in progress; according to the five levels and three categories of territorial spatial planning, village planning belongs to the township-level detailed planning category, and the conventional village planning can no longer meet the requirements of territorial spatial planning, so the ecological space, agricultural space and construction space in village planning should be adjusted and whitened with the help of GIS technology. Therefore, the GIS technology should be used for landuse adjustment, white space delineation, spatial control and comprehensive improvement of the national land space.

1. Introduction
Based on the requirements of the "Basic Technical Guidelines for the Preparation of Village Planning in Hubei Province" (for trial implementation), village planning is the legal planning that integrates the original village planning, village construction planning, village land use planning, land improvement planning and other rural planning to realize the "unification of multiple regulations" such as land use planning and urban and rural planning, and is the detailed planning of rural areas in the spatial planning system of the national land. It is the detailed planning of the rural areas in the national spatial planning system, and is the legal basis for implementing the spatial use control of the national land and issuing rural construction planning permits. As a result, the village planning requires precise land indexes in the village area, and the statistics of land indexes cannot be completed by conventional CAD. Therefore, it is necessary to use GIS technology to complete the sorting out of the status quo of land space utilization in the village, the positioning of permanent basic agricultural land indicators, the statistics and adjustment of conflicting patch indicators, and the delineation of the three lines of village space.

In April this year, the author completed the village planning of Feng Sheng Village, Xiaochang County, and in the process of preparation, the most important contents of the planning results, such as the basic farmland adjustment planning, the white land planning and the comprehensive improvement of the national land space, were all completed by applying GIS technology.
2. Overview of Territorial Spatial Planning

On May 9, 2019, the Central Committee of the Communist Party of China (CPC) and the State Council officially issued the Opinions on Establishing a Territorial Spatial Planning System and Supervising its Implementation, which integrates the main functional area planning, land use planning, urban and rural planning and other spatial planning into a unified territorial spatial planning, realizes the integration of multiple regulations, and strengthens the guiding and constraining effect of territorial spatial planning on each special planning.

From the viewpoint of planning level and content type, we can divide the spatial planning of land into "five levels and three types". The "five levels" are vertical, corresponding to China's administrative management system, which is divided into five levels, namely, national, provincial, municipal, county and township levels. The "three types" refer to the types of planning, which are divided into master plan, detailed plan and related special plan. The master plan emphasizes the comprehensive nature of the plan, which is a global arrangement for the protection, development, utilization and restoration of land and space in a certain area, such as the whole area of the administrative district. Detailed planning emphasizes implementation, and is generally organized below the city and county level, and is an implementation arrangement for specific land use and development intensity. Detailed planning is the legal basis for carrying out land space development and protection activities, including the implementation of land space use control, issuance of planning permits for urban and rural construction projects, and various construction. It can be clarified that village planning belongs to one of the detailed planning categories at the township level, and it is further regulated by including village planning as a detailed planning category outside the development boundary of towns. [1]

This is a major innovation in planning technology and a historical transformation and upgrade. In terms of technical means, the only preferred compilation and research platform that can handle such a complicated work is GIS. [2]

3. Spatial planning of village land

After the completion of the village land space status combing work, mainly focus on the optimization of the village land layout, improve the rural development conditions, combined with zoning guidance control, under the premise of meeting the requirements of the higher planning, the overall arrangement of village construction land, agricultural land and ecological land, clear land planning, scope and land layout, supporting the improvement of various public facilities and infrastructure, according to local conditions to implement ecological restoration, comprehensive land improvement, village environmental improvement and other work. [3]

At the same time, according to the requirements of the superior planning, the red line of permanent basic farmland protection and the red line of ecological protection are precisely implemented, the ecological space, agricultural space and construction space in the village area are reasonably divided, the development pattern of the village area is clearly defined, and control measures are formulated.

The following is an example of the village planning results of Feng sheng Village, Xiaochang County, Hubei Province, which is discussed in five aspects, including overall planning of land space, basic farmland adjustment planning, white space planning, land space zoning and control measures, and comprehensive improvement of land space, to specifically illustrate the application of GIS technology in the preparation of village planning.

3.1. Territorial space master plan

After carefully studying the current situation of the land space, superior planning and villagers' development wishes, etc., the planning results are prepared as follows: the total land area of the village domain is 405.44 hectares, with 41.73 hectares of planned urban and rural construction land, 363.71 hectares of agricultural land and no ecological space. Among them, 26.66 hectares of rural residential land and 213.09 hectares of arable land.
(1) Urban and rural construction land: Field survey is conducted on the basis of the data of three surveys, and the scale of the current village land is obtained after collation and analysis; construction land is predicted according to the development of village population; to cope with the unpredictability of village development, a certain amount of development land is reserved. The final construction land is 41.73 hectares, including 1.98 hectares of reserved land, accounting for 5% of the total current construction land.

(2) Agricultural land: the total amount of 192.29 hectares of basic farmland is determined in the above planning as a guiding basis, and the actual occupation is transferred out and 0.43 hectares are planned to be transferred in through comprehensive land improvement, which meets the control requirements of basic farmland in Feng sheng Village after planning. [4]

(3) Ecological space: There is no ecological space in Feng sheng Village in this planning.

3.2. Basic farmland adjustment planning
The total amount of basic farmland required in Fengsheng Village is 192.29 hectares, the current situation is about 20.33 hectares occupied, and this planning transfers out the part occupied by rural residential bases, highway land, town and village roads, square land, administrative office land, etc., about 1.85 hectares. The current status is occupied by garden land, forest land, grassland, pond and water surface, agricultural land for facilities, special land, etc., about 18.47 hectares are reclaimed and restored to basic agricultural land. The adjustment data are shown in Table 1.

| Adjustment                        | Area (ha) |
|-----------------------------------|-----------|
| Before Adjustment                 | 192.29    |
| Transfer out                      | 1.85      |
| Reclamation and restoration       | 18.47     |
| Transfer in                       | 2.28      |
| After adjustment                  | 192.72    |

The general arable land is planned to be transferred to the basic farmland in order to achieve the total balance. A total of three spots are transferred, and the status quo is dry land and paddy field, as shown in Figure 1: spot 1 has an area of 11,306.81m² (paddy field); spot 2 has an area of 7004.72m² (dry land); spot 3 has an area of 4,471.50m² (dry land), with a total area of about 2.28 hectares. Therefore, the total amount of basic agricultural land after planning is 192.72 hectares, an increase of 0.43 hectares.

3.3. White space planning
According to the relevant requirements of territorial spatial planning, in order to meet the needs of the industrial development of the village and to cope with the unpredictability of the long-term development, a certain degree of flexibility should be retained in the control of construction land, so part of the strategic white land is planned. Therefore, 1.98 hectares of land, with a total of 4 plots, is planned for the development of rural tourism.

The current site is composed of facility agricultural land and dry land, including 0.58 hectares of facility agricultural land and 1.40 hectares of dry land.

3.4. Territorial space zoning and control measures
(1) Agricultural production space: including permanent basic farmland protection area, general agricultural area and forestry land, etc., with a total planning area of 363.71 hectares.

(2) Construction space: mainly arranges urban and rural construction land and other construction land, etc. The total area of planned construction land is 41.73 hectares.
(3) Ecological space: mainly refers to woodland (ecological forest), water area, etc. This village does not involve such land.

| Type of spatial control | Area (ha) | Ratio (%) |
|------------------------|-----------|-----------|
| Ecological space       | 0         | 0         |
| Agricultural production space | 363.71   | 89.70     |
| Construction Space     | 41.73     | 10.30     |
| **Total**              | **405.44**| **100**   |

3.4.1. **Spatial control measures for agricultural production**

The area of arable land in the village is 213.09 hectares, garden land is 11.57 hectares, forest land is 9.16 hectares, grassland is 1.08 hectares, and other agricultural land is 18.35 hectares. The planned permanent basic farmland protection area is 192.72 hectares; specific control measures are as follows.

1. **Basic farmland**
   ① The arable land within the scope of the basic farmland shall not be changed without approval, shall not be abandoned, can be rotated to fallow, and encourage other land to be converted into permanent basic farmland or land for permanent basic farmland services.
   ② Prohibit the occupation of permanent basic farmland for the construction of towns, villages, development zones and industrial zones, as well as the construction of houses, graves or unauthorized excavation of sand and soil, each other waste and dumping of polluting harmful substances.

2. **General agricultural land**
   ① Any unit and individual cannot arbitrarily occupy arable land; indeed occupy, should be confirmed by the villagers’ group, the village committee review and agree to issue a written opinion, the town government in accordance with the procedures for the relevant approval procedures.
   ② Strictly control the transformation of arable land in the village use. All kinds of construction is strictly prohibited to occupy arable land, such as infrastructure, key projects need to occupy, in accordance with the relevant provisions of the revised land use planning, and the strict implementation of the national policy of arable land balance, to ensure that the quantity of arable land is not reduced, the quality is not reduced.
   ③ Without approval, no non-agricultural construction activities shall be carried out on garden land, commercial forest and other agricultural land. For existing non-agricultural construction land and other sporadic agricultural land in the village, priority shall be given to collation, reclamation or adjustment to arable land or garden land, and where collation, reclamation or adjustment is really not possible during the planning period, the current use may be retained, but the area shall not be expanded.

3.4.2. **Construction space control measures**

The area of urban and rural construction land in the village is 41.73 hectares, the area of rural construction land is 39.63 hectares, and the area of regional infrastructure land is 2.1 hectares; specific control measures are as follows.

1. **Urban and rural construction land**
   ① The construction of towns in villages should give priority to the use of existing inefficient construction land, idle land and abandoned land.
   ② All types of urban and rural construction projects should adhere to the principle of saving and intensive land use, in strict accordance with the relevant national standards, to reasonably determine the land use standards and scale.
(2) industrial development space
   ① Commercial service facilities land building density needs to be controlled at 35% or less, building height does not exceed 15 meters, volume ratio does not exceed 1.5, the green space rate is greater than 30%.
   ② Industrial projects with environmental pollution shall not be introduced into the village, and industrial land shall be coordinated with the relationship between the surrounding land.
   ③ Commercial service facilities land, industrial and storage land adjustment should be confirmed by the villagers' group, reviewed and agreed by the village committee, and reported to the original approval authority of village planning at each level. [5]

(3) Rural residential bases
   ① 26.66 hectares of residential bases are designated in the village, which stipulates that for new applications, the construction base area of each household is controlled within 180 square meters and should be within the scope of construction of residential bases designated, and priority is given to using vacant land, idle residential bases and unused land in the village.
   ② The number of layers of villagers building houses should not exceed 3, the building height should not be greater than 12 meters, should reflect the characteristics of the residential houses in northern Hubei, with reference to the "Jingchu School" village and town style planning and residential architectural design guidelines" for the selection of new buildings, unified architectural style, in line with the overall landscape control requirements of the village.

(4) Infrastructure and public service facilities
   ① shall not occupy the traffic land to build houses, in the village on both sides of the main road to build houses back not less than 3 meters.
   ② Land for infrastructure such as garbage collection points, public toilets, sewage treatment facilities and land for public service facilities such as integrated service stations, grass-roots comprehensive cultural service canters, health rooms, etc. shall not be occupied by villagers at will.

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3.5. Comprehensive improvement of land space
The content of comprehensive improvement of national land space mainly involves habitat environment management, style and appearance improvement, ecological environment restoration, rural landscape construction requirements, etc. The program of agricultural land consolidation, rural
construction land consolidation, land reclamation, unused land development, land ecological improvement, etc. is formulated according to local conditions, and the comprehensive national land space improvement program of Feng Sheng Village is shown in Table 3.

| Serial number | Remediation content             | Current Status                  | Planning                                      | Remarks                                      |
|---------------|---------------------------------|--------------------------------|-----------------------------------------------|----------------------------------------------|
| 1             | Rural home base base remediation | Home base                      | Land for public service facilities and greenery | 3.88 hectares                                |
| 2             | Pond remediation                 | Pond and water surface          | Pond water surface                             | 1 in each village bay, dredging and slope protection, landscape enhancement |
| 3             | Basic farmland reclamation       | General agricultural land       | Paddy field (Basic farmland)                  | 18.47ha                                      |
| 4             | General farmland improvement to basic farmland | Arable land (non-basic farmland) | Arable land (Basic farmland)                  | 2.28ha                                      |
| 5             | Village main and secondary roads widening | Lower than 4 meters            | 4-5m                                          | 810m                                         |
| 6             | New construction of main roads    | General agricultural land       | Town and village road land                     | 750m                                         |

4. Conclusion
According to the requirements of the general guidance of the five levels and three categories of territorial spatial planning, the latest village planning results of the preparation of the content of spatial data and non-spatial data have put forward higher requirements, and the author in the preparation of the village planning results of Feng Sheng village, through the actual application of GIS platform, found that the GIS platform data and technical means can be very perfect to meet the above two requirements, and GIS data management is very strict. The data management of GIS is very strict, and the mapping must comply with the pre-defined data model, so the data redundancy is very small and the data quality is very high. Finally, through the GIS platform, a total of drawings such as overall territorial spatial planning, basic farmland adjustment planning, and white land planning have been prepared, which can be directly stored for the construction management of village planning at a later stage. The author hopes to share the experience of how to apply GIS technology for the preparation of village planning results through this paper, so as to provide some reference and help for future research and exploration of village territorial spatial planning work.

References
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