APLLYING ARCGIS TO ESTABLISING SLOPE MAP IN QUANG BINH PROVINCE WITH 1/50.000 SCALE

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ABSTRACT

Slope map is one of the important tools in support of deciding and planning reasonable territory using policy.

Before, slope map is mainly established by handmade method taking much time and low accuracy. Nowadays, with the great development of computer technology, Geographic Information System (GIS) has created many specialized software with integrated information and space analysis probability supporting of establishing slope map fast and exactly.

In framework of this article, we bring out the content elements, calculating methods and process of establishing slope map in Quang Binh province with scale 1/50.000 by ArcGIS 10.0 software.

1. PREFACE

Slope map is one of the important map in recent stage. On the one hand, it is the basis for establishing thematic maps, such as: Soil map, geomorphology map, landscap map... In the other hand, slope map helps us to calculate the area of the plots exactly according to slope levels, from there, we has direction in using available territory plan.

Before, slope map is mainly established by handmade relying on topography map so it takes much time, efforts but at low accurate and it is difficult to apply in large scale. Nowadays, with the great development of information technology, Geographic Information System - GIS has brought many specialized software which has integrated information and space analysis ability, exactly interpolation algorithm, supporting of establishing slope map fast and exactly.

Quang Binh is a province which has diversified and original topography, including: mountainoust area, midland, plain and coastal sand - dune, in there Phong Nha - Ke Bang limestone mountainous area is full of obstacles occupying most of the West of territory. Therefore, applying ArcGIS in establishing slope map on behalf of handmade method is huge reality significance.

2. THE ELEMENTS OF MAP CONTENT

2.1. Thematic basic of map

Thematic basic of map is displayed in map projection, scale and lay-out. Basing on background database of topography map in 1/50.000 scale, Quang Binh slope map is established according to VN-2000 projection (Vietnam Projection)

2.2. The content of map

- The general geography basic: It includes:

+ Hydrograph: Displaying the main rivers and streams of the terrain.

+ Traffic: Displaying the distribution of the main traffic included road and rail transport.

+ Administrative boundary: Displaying the administrative border of territory, included: district boundary and commune boundary.

+ Geographic name: Displaying geographic name of commune, mountain...

- Thematic element: Displaying thematic element about slope included 6 levels according to the regulation of Agriculture and Rural Development Ministry: level I: $< 3^0$; level II: $3 - 8^0$; level III: $8 - 15^0$; level IV: $15 - 20^0$; level V: $20 - 25^0$; level VI: $> 25^0$.

Apart from geographic basic and thematic element, there are secondary elements. Those are the map signs system used enclose with necessary explanation.

3. CALCULATING METHOD AND THE PROCESS OF ESTABLISHING SLOPE MAP BY ARCGIS

3.1. Calculating method

In supporting of Argos software, from the elevation dataset we carry out interpolating and calculating DEM. Basing on that result, we analyze and calculate slope value in research area.

Elevation dataset → **Digital Elevation Model - DEM** → **Slope value**

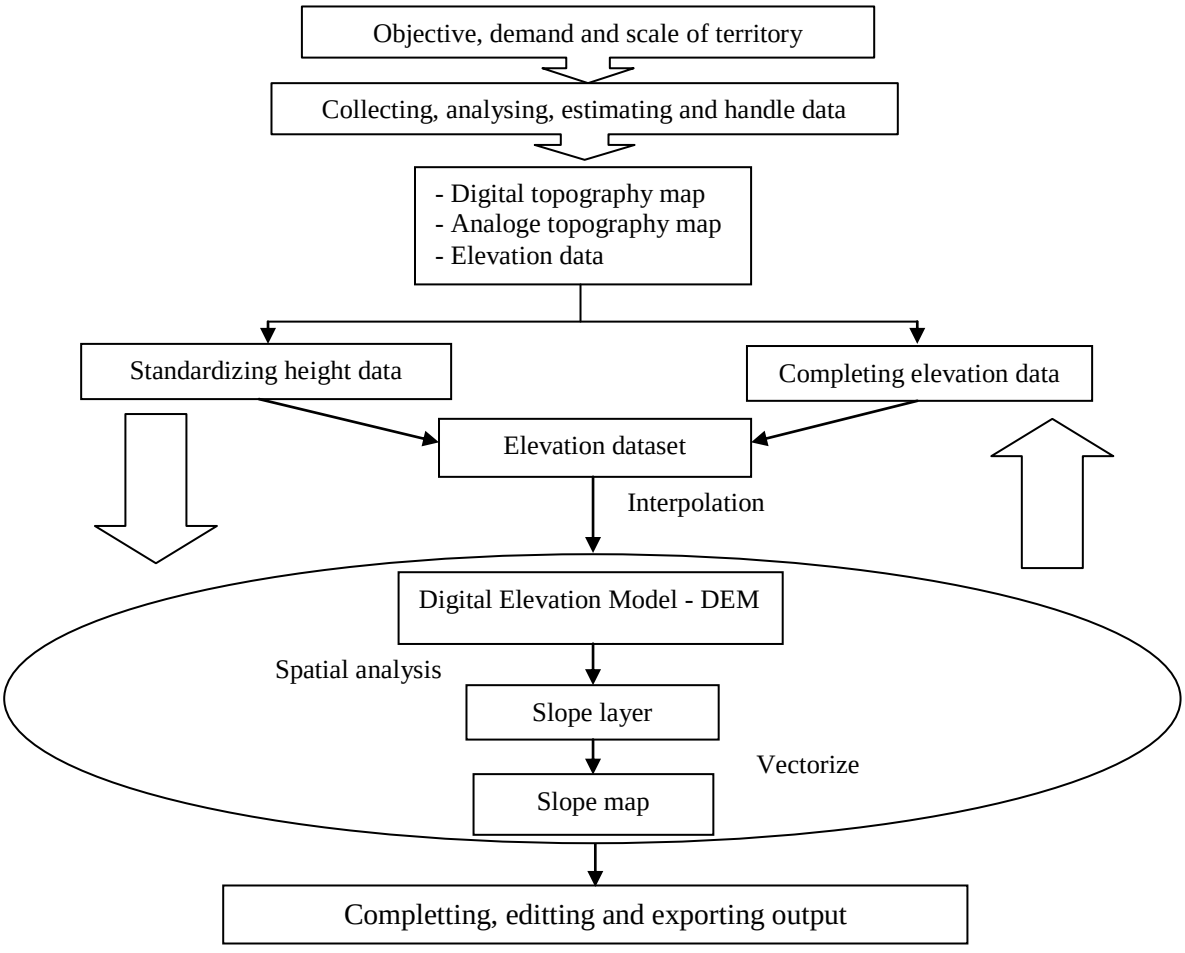
Slope is the rate of maximum change in z-value. Slope identified the steepest downhill slope for a location on a surface. Slope is calculated for each triangle in TINs and for each triangle. For a TIN, this is the maximum rate of change elevation acroses each triangle. For rasters, it is the maximum rate of change in elevation over each cell and its eight neighbors [2,5].

Using a 3x3 window to caculate the derivative of elevation curve line. This window will move in turn throughout the map.

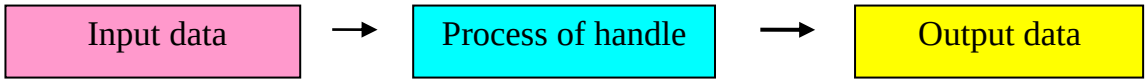
The slope value is calculated by formula: $tgG = \sqrt{(\delta Z / \delta X)^2 + (\delta Z / \delta Y)^2}$

Every cell in the output raster has a slope value. The lower the slope value, the flatter the terrain; the higher the slope value, the steeper the terrain. The output slope raster can be calculated as percent of slope or degree of slope. The flat terrain has slope value at 0 [5].

3.2. The process of establishing slope map



With the process of establishing slope map above, after we have full database handled by MapInfo software, we establish slope layer by Argos. This step is included 3 main works: converting polylines to points, interpolating DEM and interpolating slope value [2,5]. It can be illustrated as follows:



- Elevation dataset.
- Height line system

- Handling elevation dataset
- Interpolating DEM.
- Interpolating slope value

- Slope layer

a) Converting polylines to points

Using extention Xtool pro 4.0 runs in ArcGIS environment. We should'n set too numerous points affecting to calculating and interpolating DEM process. The space between 2 points is selected 100 m [7, 8].

b) Interpolating DEM (DEM)

There are many interpolated methods, such as: Spline, IDW, Kriging… In this case, we chosse Kringing method helped us to calculate correctly the lost elevation value and its advantage is high accurate. Besides, Kriging has more advantage than other method, that is it can detemine the total mistakes in result with the resolution 10 m [5].

c) Interpolating slope value

Basing on DEM established, we carry out interpolating slope value. The resolution of DEM decide the accuracy and detail of slope map. Using raster surface analysis to interpolate slope map. In this problem, the slope unit choice is degree [3,4,2].

Using caculate area method to caculate the area for each individual slope region. The caculating result show that Quang Binh territory is divided into 6 slope level with specific area as follows:

Level	Area (ha)	Rate (%)
I (< 3^0)	182.491,90	32,98
II (3 - 8^0)	30.869,10	5,58
III (8 - 15^0)	36.525,10	6,60
IV (15 - 20^0)	74.183,89	13,40
V (20 - 25^0)	189.600,12	34,26
VI (> 25^0)	39.788,10	7,19
Total	**553.458,21**	**100,00**

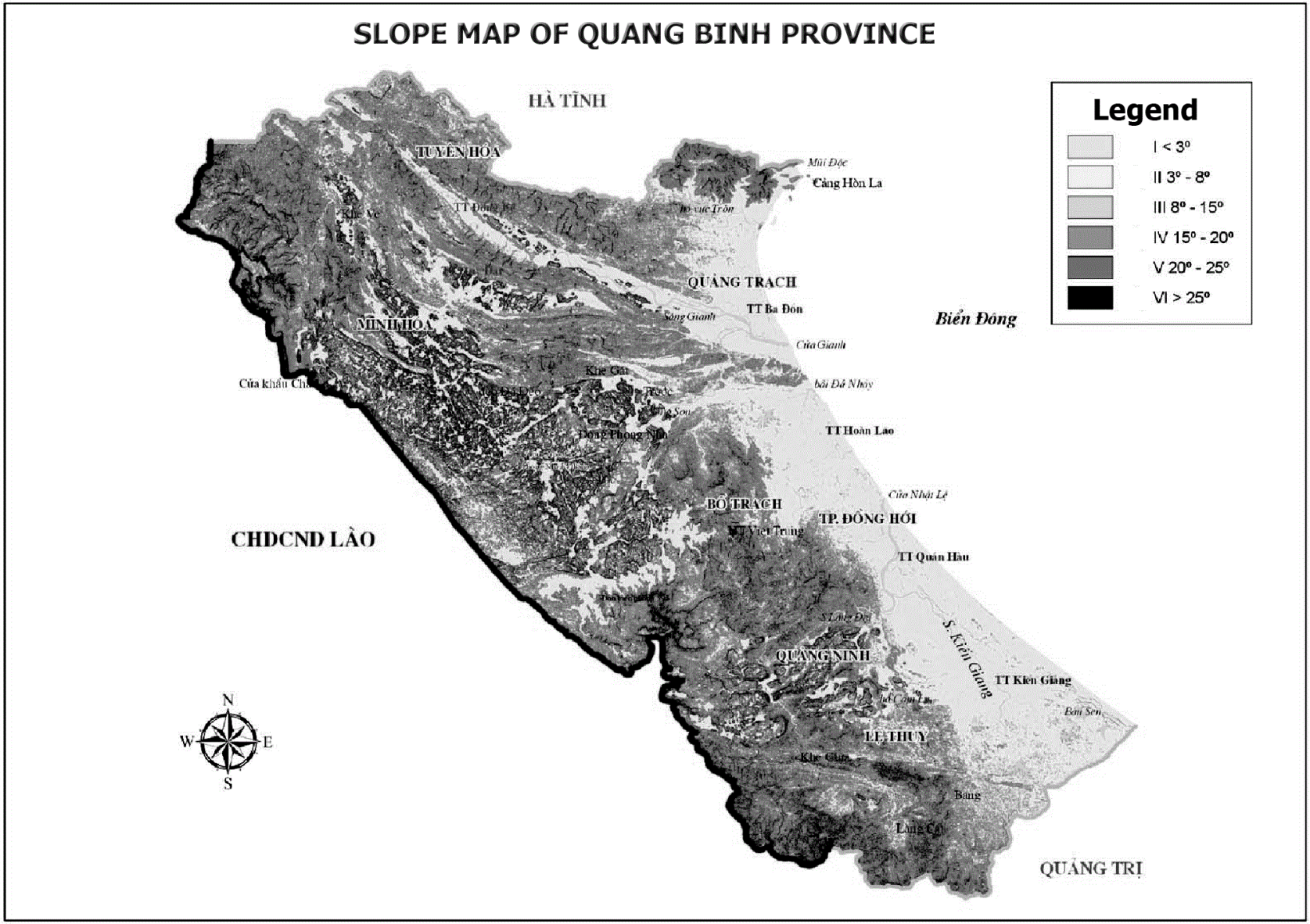
4. CONCLUSIONS

- Establishing slope map in support of GIS technology will save time and high accuracy. Especially with the complicated topography territory, establishing slope map by modern method will take more effect than by traditional method.

- ArcGIS is one of the software having strong and effective surface analysis ability, especially with numerous interpolation methods helping us in choosing the reasonable method for establishing slope map. Kringing method is the most topographic surface interpolation method effect and brings out the relative accuracy DEM.

- Apart from surface analysis ability, ArcGIS software is still a use full tool for territory management and updating, calculating data when the rate of slope topography changes.

- Basing on established slope map, we see that Quang Binh territory is divided into 6 slope levels, in there level I make up for 32,98% and level V make up 34,26% area of territoire.



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REFERENCE

1. Dang Van Duc., 2001. *Geography Information System*. Hanoi publishers of scientific and technical.
2. Pham Vong Thanh., 2004. *DEM for resources and environment research*. Hanoi publishers of scientific and technical.
3. Quang Binh People's committee., 2002. *Quang Binh landuse planing on period 2001 - 2010*. Summary report.
4. Paul V. Bolstad., 2002. *GIS Fundamentals: A First Textbook on Geographic Information Systems*. Eider Press; 2nd edition (July 30, 2005)
5. ESRI., 2008. *Getting to Know ArcGIS Desktop: Basics of ArcView, ArcEditor, and ArcInfo*. ESRI Press; 2nd Edition (Update) edition (December 1, 2008)
6. ESRI., 2005. *ESRI Guide to GIS Analysis*, Volume 2: Spatial Measurements and Statistics. ESRI Press; 1 edition (July 1, 2005)