UDC 625

Zabiullah Haidari
Assistant Professor

Kabul Polytechnic University
Kabul, Afghanistan

Suhrab Nikjo Qaisari
Assistant Professor

Faryab University
Faryab, Afghanistan

SEEKING POTENTIAL ROUTE FOR RAILWAY DESIGN IN PAGHMAN DISTRICT

It can be concluded that railway transportation is a relatively new phenomenon in Afghanistan, with both beneficial and harmful impacts on the surrounding environment. Compared to other modes of transportation, railway is more commonly used in industrial countries, likely due to its capability of transporting goods and people efficiently, its low budget needs, stable traffic, and high speed.

The focus of this article is on designing a railway in the Paghman district of Kabul province. The most significant parameters for designing the railway, such as slope and land cover, have been meticulously investigated.

Highways and railways are the backbone of our national economy, and extending our road and railway infrastructure to every province and village is the first step to overcome economic challenges.

Environmental issues are of great concern nowadays, and we should consider them in our project planning. Fortunately, GIS software can help us combine all the necessary conditions involved in our project.

This research ultimately used ArcGIS software to define an alignment that preserved all necessary conditions from different fields, such as environmental and economic considerations, as well as data existence and others.

Key words: *Railway, Slope, ArcMap, Design, Alignment, Paghman, project, weight.*

Introduction

Afghanistan till now hasn't experience of designing and utilization of railway, expect a railway which designed in Kabul during Shah Amanullah Khan kingdom (1919), that railway located in Kabul and started from Shah-doshamshira and extended to Daral Aman [1, p. 31]. And from that time till

periods of authority because of many reasons the railways projects were stopped [2, p. 7]. During last year just one project in north of Afghanistan initiated and currently is in progress [3, p. 12].

Railway is a new phenomenon in Afghanistan, and it has its own benefits and harms for environment. It is clear that all industrial countries transportations are depend more on railway in compare to others, the reason for that may be its capability of transporting, low budget needs, stable traffic, high speed, and etc. On the other hand, if railway system establishment don't manage in professional way it may approach to very damaging impacts on environment in long period of time. Therefore, it is very important to take all aspects of railways into account during making plans [4, p. 67].

This research belongs to Paghman district of Kabul province. In this research I mostly focused on two most significant parameters for designing railway; the slope and land cover. The slope is achieved from 30 m DEM and land cover achieved from 1 m space imagery classification. The analysis on this data's have done on ArcMap software, and by combining of slope and land cover according to their defined weights and alignment automatically defined by ArcMap.

Highways and railway are backbone of our national economy, and the first step to overcome on economic challenges is extending our roads and railways through every province and villages. But having prospective of living in a good environment is also very necessary. The railways create different kinds of pollutions like air pollution, sound pollution, water pollution, and etc. In geography which we are living is the common habitat of all spices, and every living spice is sensitive to pollutions. Therefore, the railway planers must take in care the environmental protection and stable growth [5, p. 25].

In the most projects the planers just care about the economic aspect of project, and they haven't predicted the harmfulness of environment; but it is clear the foregoing environmental issues are very serious nowadays. it should be seriously paid attention on environmental protection for having stable growth. For ecologic conservation the alignment that we chose for railway shouldn't be only function of geographic terrains; in addition, it should be function of environmental differences [6, p. 17].

The optimal lands for railway alignment should be survived from different aspects, like topographic survey, geological survey, soil survey, hydrological survey, environmental survey, social survey, economic survey, and etc. And every survey result will be studied, and the final alignment will be specified by weighting and combining of all surveys result:

- Topographic survey: All data on land terrain and artificial features or structures are collected through this survey. Slope is the outcome of topographic surveying.
- Geological survey: This survey approach collects geological data from the land, and the results of this survey are very important for making decisions about the project. For example, having information about geological breaks can help decision-makers.
- Soil survey: This survey collects data on soil in the area.
- Hydrological survey: This survey collects data on bodies of water in the region [7, p. 36], among other surveys needed for the project.

Methodology

This research was conducted in the Paghman district of Kabul province. Although Paghman is located in the capital city of Kabul, most of the people in this district are engaged in farming. Therefore, for planning the route of the railway, we should not rely solely on geodetic survey results, as was done in previous projects in our country. We should also estimate the impact of the proposed railway on the environment. In this research, I relied on two types of data: topographic data and land cover data of the Paghman district.

To achieve better results, various field data such as geological, environmental, soil, hydrological data, etc., are needed. Unfortunately, this data is either unavailable or its cost is very high in our country [8, p. 65].

Data

1. Topographic data: The first thing required to define the interested route is topographic information such as slope, surface, aspect, etc. In this research, we extracted all topographic information from the 30 m DEM, which was collected using remote sensing technologies. First, the DEM of the interested region was extracted from Afghanistan's 30m DEM. [8, p. 65].

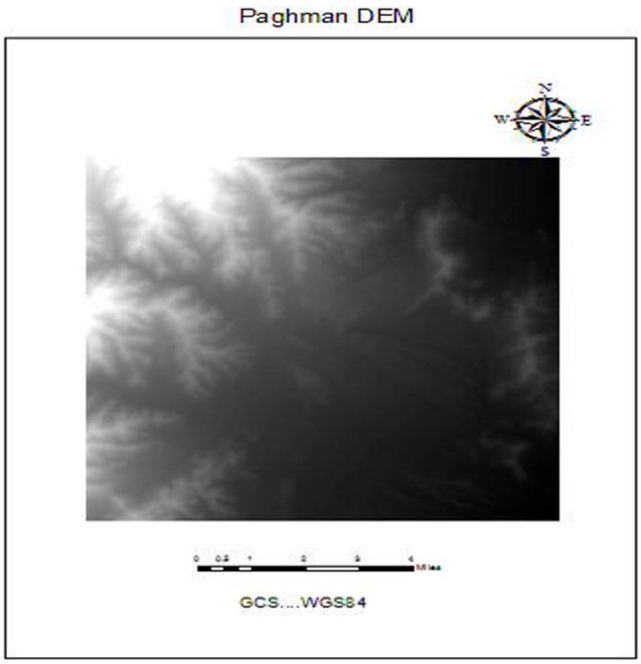

Figure 1. Paghman DEM

Slope has played a basic role in this research, and it was obtained from the DEM. The following map shows the slope data.

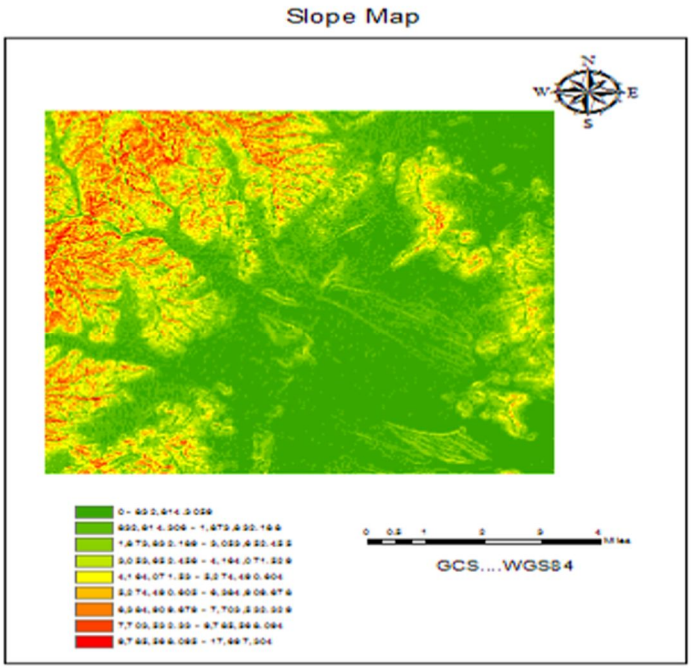

Figure 2. Slope Map

Now, we need to classify our slope into classes based on our requirements. To do this, I used the reclassify tool from the spatial analyst extension and manually classified the slope into five classes.

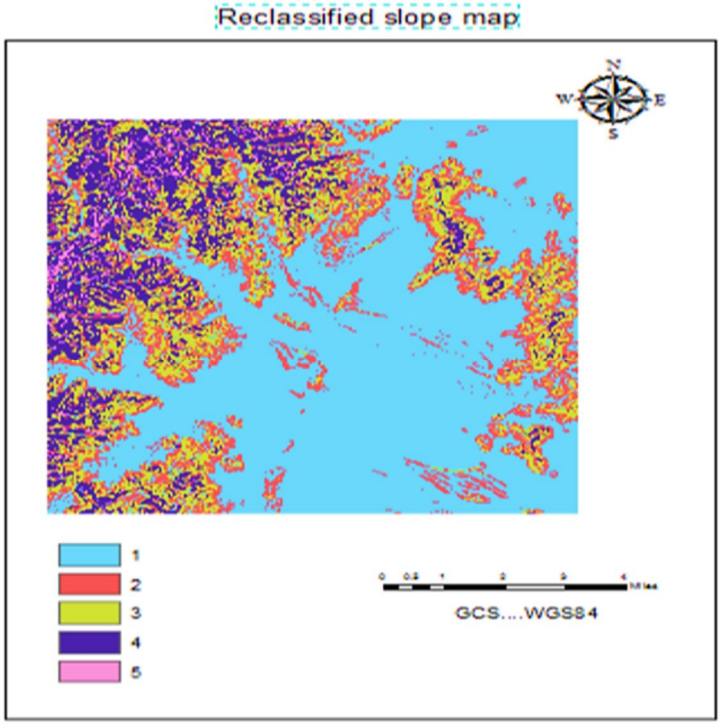

Figure 3. Reclassified slope map

In addition to topographic information, land cover data from the interested region is also necessary. For this purpose, we used the image classification capability of ArcGIS software. The image used in this research is a mosaic of 1m spatial resolution. It contains three bands: blue, green, and red, which have acceptable spatial resolution.

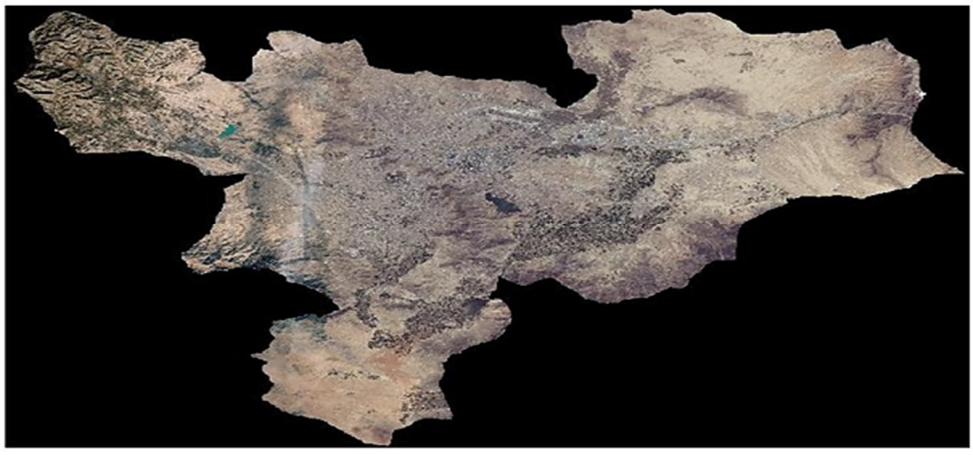

Figure 4. Satellite image of Kabul

For extracting land cover data from space imagery, the maximum likelihood classification method applied. According to image we divided the land cover into five classes:

1 – Water body.

2 – Vegetation.

3 – Weak land (land which covered with low amount of vegetation).

4 – Buildup Area.
5 – Barron lands.
The land cover map is shown in the following picture.

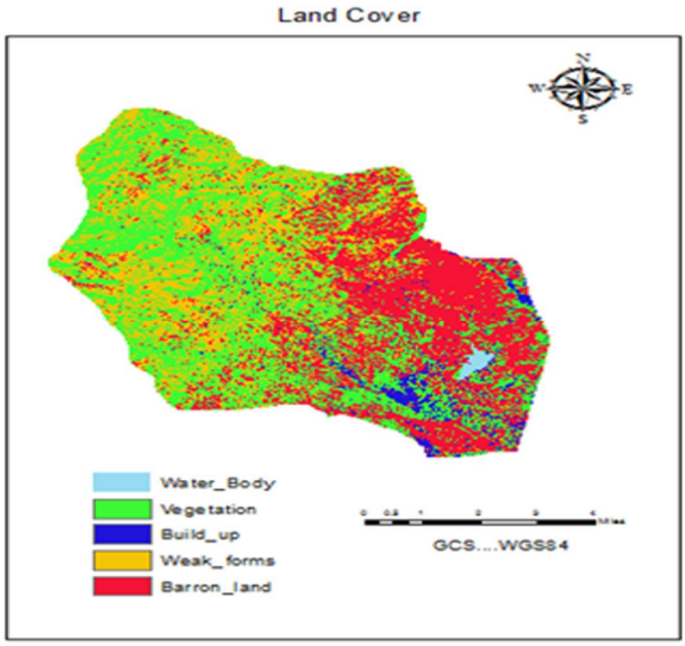

Figure 5. Land Cover

Weighting

As previously mentioned, when planning constructions, we should take into account the importance of all present phenomena in our environment.

Therefore, we should specify weights for any phenomena that is related or sensitive to the project. These weights are determined by experts and are calculated in different software. ArcGIS software has the capability of combining weights and calculating the results. Here, we weight land cover at 30 % and slope at 70 %. In addition, costs are defined for each value. All weighting and costing processes are performed using the weighted overlay tools from the spatial analyst extension.

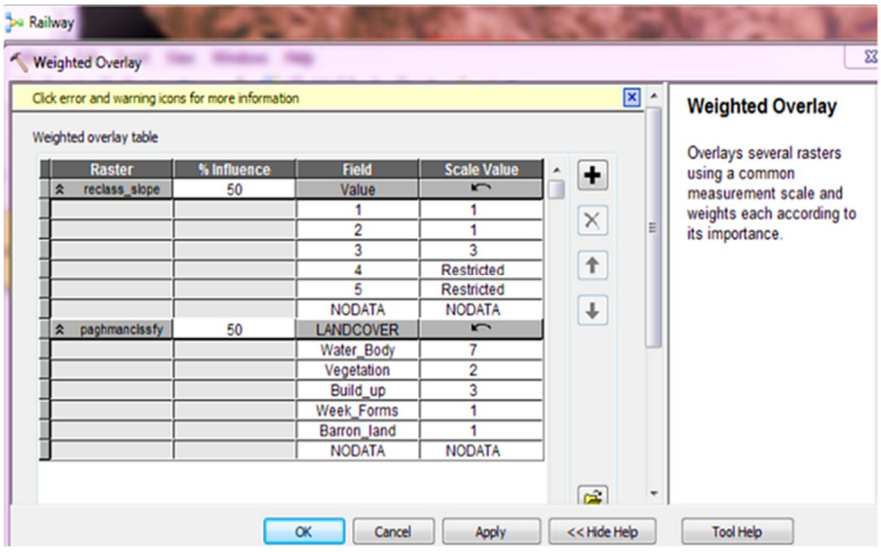

Figure 6. Weighted Overlay

Weights are chosen according to economic aspect and environmental aspects of project.

According to weights the ArcGIS software provides a cost surface which defines the cost of arriving from origin point of alignment through all other points.

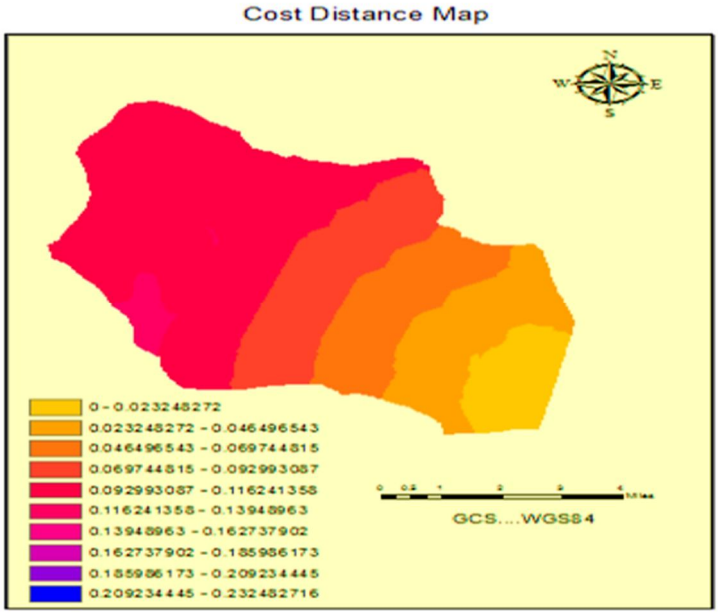

Figure 7. Cost Distance Map

Through the analysis of the cost surface, we can obtain an initial understanding of the costs of traveling through different points on the surface. The next step involves using the cost path tool to determine the best route to reach the final destination point.

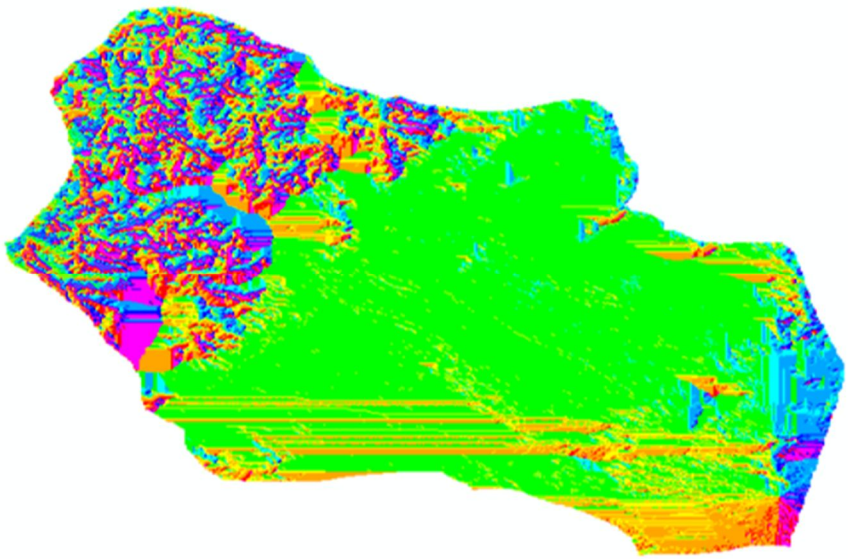

Figure 8. Cost pad tools for defining the best rout

The route defined in the cost pad map is in raster format. Therefore, we need to convert it to vector format to obtain the final route for our railway.

The final route for our railway is displayed in the following images.

Figure 9. Final route for Railway

Conclusion

Based on the research conducted in Paghman district of Kabul province, it was found that for planning the route of a railway, relying solely on geodetic survey results is not enough. The impact of the proposed railway on the environment should also be estimated.

To achieve better results, various field data such as geological, environmental, soil, and hydrological data are needed. However, this data is either unavailable or its cost is very high in the country.

In this research, the topographic data and land cover data of the Paghman district were used. The topographic information was extracted from a 30 m DEM, collected by remote sensing technologies. The land cover data was extracted from a 1m space image using the maximum likelihood classification method. The land cover was divided into five classes: water body, vegetation, weak land, buildup area, and barren lands.

To plan constructions, the importance of all present phenomena in the environment should be taken into account. Therefore, weights were specified for land cover and slope, based on economic and environmental aspects of the project. The ArcGIS software provided a cost surface which defined the cost of arriving from the origin point of alignment through all other points. By analyzing the cost surface, the cost of traveling through different points on the surface was understood.

The final route for the railway was determined using cost pad tools and displayed in vector format. The methodology used in this research can be applied to other regions, with necessary adjustments based on the unique features of the region. Overall, this research provides a useful framework for planning railway routes while taking into account the impact on the environment.

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Забиуллах Хаидари
доцент

Кабульский политехнический университет
г. Кабул, Афганистан

Сухраб Никджо Кайсари
доцент

Фарьябский университет
г. Фарьяб, Афганистан

ПОИСК ПОТЕНЦИАЛЬНОГО МАРШРУТА ДЛЯ ПРОЕКТИРОВАНИЯ ЖЕЛЕЗНОЙ ДОРОГИ В РАЙОНЕ ПАГМАН

Можно сказать, что железнодорожный транспорт является относительно новым явлением в Афганистане, оказывающим как благотворное, так и вредное воздействие на окружающую среду. По сравнению с другими видами транспорта железная дорога чаще используется в промышленно развитых странах, вероятно, из-за ее способности эффективно перевозить товары и людей, низких бюджетных потребностей, стабильного движения и высокой скорости.

Основное внимание в этой статье уделяется проектированию железной дороги в районе Пагман провинции Кабул. Наиболее важные параметры для проектирования железной дороги, такие как уклон и почвенный покров, были тщательно исследованы.

Автомобильные и железные дороги являются основой нашей национальной экономики, и распространение нашей дорожной и железнодорожной инфраструктуры на каждую провинцию и деревню является первым шагом к преодолению экономических проблем.

Экологические проблемы в настоящее время вызывают большую озабоченность, и мы должны учитывать их при планировании нашего проекта. К счастью, программное обеспечение для GIS может помочь нам объединить все необходимые условия, задействованные в нашем проекте.

В конечном счете, в этом исследовании использовалось программное обеспечение ArcGIS для определения выравнивания, которое сохраняло все необходимые условия для различных областей, таких как экологические и экономические соображения, а также наличие данных и другие.

***Ключевые слова**: железная дорога, уклон, дуговая карта, проектирование, выравнивание, Пагман, проект, вес.*