ENGINEERING GEOMORPHOLOGY ASSESSMENT OF LADIZ RIVER

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ABSTRACT
Ladiz River located in the South East and Iran's and Sistan and Baluchistan province. The aim of this study was to determine changes in direction, longitudinal and transverse profiles and determine the stable and unstable parts of the river. In this research, library studies, field visits and samples from the bend of the river, explore the aerial photographs of the area, the river was divided into two intervals and morphological characteristics such as length and radius of curvature of each interval, the general trend of movement and erosion width of the channel was calculated in GIS. The results showed that the pattern of rivers, Gravely the arterial bed. The study of geometrical parameters, 38% and 62% bend folds are stable and unstable. The minimum and maximum width of the river respectively, 13 and 253 meters. Classify the morphological component is Shybza rivers. Rusgen classification, G3 and G4 are placed in the river. Comparing the 1971 and 2014 aerial photographs, river diversions have 3 bends.

Keywords: Ladiz River, Geomorphology, Engineering, Rusgen Classification, Geology, GIS

INTRODUCTION
Rivers, in the past, the focus of attention of mankind and civilization, large and small, throughout history, along with the natural phenomena of life, and continued to rise. In many cases, flood, inundation and erosion of the river bed sides hurt many farms, homes, put people marginalized in natural waterways. It is therefore important to understand the factors contributing to the erosion of the river tried to change the normal process (Refahi, 2003).

Figure 1: Geographic location map of the study area

Rivers and streams, the system is entirely dynamic. Position, shape, and other morphological features which are continuously changing over time (Rangzan et al., 2006; Khanlary et al., 2013; Roostae et al., 2013). River as natural resource contexts has elements that are in dynamic equilibrium with each other and a change in any component will cause changes in other components (Shirdeli et al., 2006; Talebi and Bayazid, 2008). Rivers, under influence of erosion and sedimentation, are subject to various changes. Including a change of direction, the longitudinal and transverse displacements, taking shortcuts, change of river bed elevation change, modify or alter aggregation path pointed geometric features (Hey, 1986).
Research Article

Ladiz River in the South East and Iran's Sistan-Baluchistan province Tuesday busted a major watercourse of Saeed Abad, Mesopotamia and the Black Forest there. In this study Jghrafayy'00 river Ladiz the opportunity to '20° 61° 61' east longitude and '85° 28 to '00° 29' north latitude (the cascade downstream) has been studied. Road access to the area, via Zahedan- Mirjaveh- Ladiz asphalt road (Figure 1). The aim of this study was to determine changes in direction, involvement in agriculture, river erosion mechanisms and reaction channels is investigated in terms of longitudinal and transverse pattern ultimately determine the stable and unstable parts of the river is.

In this study, using aerial photographs and satellite images for the years 1971 to investigate the stability and change Ladiz River downstream from Niagara Ladiz discussed.

Classification of River of Age

In this classification, the successor bed erosion is the erosion process. Cross rivers carry sediment by branches of the slope is more to it. Ladiz River with gravelly bed of a river is young.

Classification of the River

In general, both the Cascade Range to the branching points downstream, the arterial pattern. Based on the average slope of 2.0 to 6.0 per thousand and the average annual rate of 4/69 cubic meters per second, according to the criteria (Lane, 1957; Leopold and Wolman, 1960) placed in the artery.

Classification of River Morphology

Given the longitudinal profile (Figure 3), the morphology of the slant river placed. Also by Category I (Schumm, 1963), is an irregular pattern of vasodilatation.

![Figure 3: Longitudinal profiles of Ladiz River (downstream from the waterfall)](image)

Classification of River Classification System Rusgen

Rusgen classification, characteristics such as the shape of the plan, the slope, and the average particle size of the substrate, the W/D ratio, En, and sinusitis than calculated and listed in Table 2. The average width of 41 m river width to depth ratio is less than 12 degrees.

<table>
<thead>
<tr>
<th>Plan</th>
<th>Grain Size</th>
<th>Dip Av.</th>
<th>W/D</th>
<th>En</th>
<th>Si Max</th>
<th>Av.</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braded</td>
<td>Gravel</td>
<td>0.02-0.39</td>
<td>12&gt;</td>
<td>1.4 &gt;</td>
<td>2.05</td>
<td>1.46</td>
<td>1.25</td>
</tr>
</tbody>
</table>
According to the specifications listed in Table 2 and Figure 4, the river in groups G3 and G4 (classified according to the Rusgen level II) the arterial form is placed.

**River Engineering Polymorphic Method**

The best way to identify these parameters from Morphology studies and their use in the regularization scheme. Estimate Morphological Rivers, River Bank Stability of Three hydraulically, experiential and qualitative done.

**Table 3: Characteristics of the studied bending Ladiz River (above the waterfall)**

<table>
<thead>
<tr>
<th>No.</th>
<th>$\lambda$</th>
<th>L</th>
<th>AM</th>
<th>Si</th>
<th>$R/B$</th>
<th>B</th>
<th>R</th>
<th>D (Degree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>920</td>
<td>562</td>
<td>97</td>
<td>1.3</td>
<td>2.9</td>
<td>32</td>
<td>95</td>
<td>339</td>
</tr>
<tr>
<td>2</td>
<td>1083</td>
<td>930</td>
<td>86</td>
<td>1.2</td>
<td>12.16</td>
<td>13</td>
<td>156</td>
<td>341</td>
</tr>
<tr>
<td>3</td>
<td>1139</td>
<td>1014</td>
<td>84</td>
<td>1.3</td>
<td>12.14</td>
<td>14</td>
<td>170</td>
<td>342</td>
</tr>
<tr>
<td>4</td>
<td>1395</td>
<td>973</td>
<td>135</td>
<td>1.2</td>
<td>8.04</td>
<td>24</td>
<td>193</td>
<td>289</td>
</tr>
<tr>
<td>5</td>
<td>1853</td>
<td>1746</td>
<td>127</td>
<td>1.6</td>
<td>2.8</td>
<td>110</td>
<td>309</td>
<td>323</td>
</tr>
<tr>
<td>6</td>
<td>1489</td>
<td>767</td>
<td>136</td>
<td>1.3</td>
<td>1.45</td>
<td>151</td>
<td>220</td>
<td>199</td>
</tr>
<tr>
<td>7</td>
<td>754</td>
<td>519</td>
<td>107</td>
<td>1.4</td>
<td>1.2</td>
<td>102</td>
<td>122</td>
<td>243</td>
</tr>
<tr>
<td>8</td>
<td>590</td>
<td>562</td>
<td>77</td>
<td>1.4</td>
<td>1.34</td>
<td>78</td>
<td>105</td>
<td>306</td>
</tr>
<tr>
<td>9</td>
<td>412</td>
<td>391</td>
<td>196</td>
<td>1.8</td>
<td>3.48</td>
<td>39</td>
<td>136</td>
<td>164</td>
</tr>
<tr>
<td>10</td>
<td>337</td>
<td>478</td>
<td>156</td>
<td>2.05</td>
<td>2</td>
<td>55</td>
<td>110</td>
<td>249</td>
</tr>
<tr>
<td>11</td>
<td>390</td>
<td>547</td>
<td>242</td>
<td>1.9</td>
<td>0.95</td>
<td>192</td>
<td>182</td>
<td>172</td>
</tr>
<tr>
<td>12</td>
<td>1184</td>
<td>1377</td>
<td>239</td>
<td>1.44</td>
<td>0.94</td>
<td>253</td>
<td>238</td>
<td>331</td>
</tr>
<tr>
<td>13</td>
<td>1207</td>
<td>864</td>
<td>334</td>
<td>1.15</td>
<td>1.14</td>
<td>227</td>
<td>259</td>
<td>191</td>
</tr>
</tbody>
</table>

According to the results of Table 3, five of bending (5, 9, 10, 11 and 12) is unstable with respect to the degree of Sinuosity greater than 4.1 and low sediment transport capacity of the river. Figure 4-6 shows a diagram Sinuosity frequency coefficients, according to the chart, 38 percent and 62 percent of bends, bends are stable and unstable.
Table 4-4 Characteristics of curvature of the bend in the river Ladiz coefficient expressed in percentage terms. According to the results of Table 4-3 can be seen that the average curvature of the arc of the river coefficient is 1.46.

Table 4: Characteristics of the coefficient of curvature bend in the river

<table>
<thead>
<tr>
<th>Av. Si</th>
<th>Max Si</th>
<th>Min Si</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.46</td>
<td>2.05</td>
<td>1.15</td>
</tr>
</tbody>
</table>

The central angle of the arc of the river and out of the Kornis model (Kornis, 1980), a central angle of 6 arc in the range (more than 296), 5 River Bend in the range (296-185) and the second arc in the range (185-85) are given. Most central angle of approximately 46.15% of those placed over 296 degrees, which corresponds to a twisted pattern is developed (Fig. 6).

Figure 5: Diagram of the frequency Sinuosity Ladiz River (above the waterfall)

Figure 6: Graphs the distribution of the central angle of the bend of the river Ladiz

Figure 7 graphs the frequency range spanning the river bends to show. The ratio of the radius of curvature of less than 1.5 on the river, which is about 35% cut by shooting mode shows in some of the bends, lateral spreading is observed. The field survey results have been implemented.
Results Table 6 shows that both the average interval streams according to the parameters obtained from the unsteady state.

Table 6: To determine the range of stable and unstable streams based on the geometric parameters in each interval

<table>
<thead>
<tr>
<th>Av. Si</th>
<th>Av. R/W</th>
<th>Av. D</th>
<th>Si type</th>
<th>R/W type</th>
<th>D type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.46</td>
<td>3.88</td>
<td>268</td>
<td>Unstable</td>
<td>Unstable</td>
<td>Horseshoe shaped</td>
</tr>
</tbody>
</table>

The mean coefficient of 1.5 indicates high curvature of the maze that is the boundary between the straight and the river meanders. Also Kvrnays model, 56.5% of the central angle of the bend of the river among the twisted horseshoe is to be developed. Coefficients obtained from these models, the need for stabilization through management practices, biological and engineering structures requires.

Changes in Cross River

Transverse sections of the river due to erosion and sedimentation in the outer arc of the inner arc straight over intervals have experienced localized increases. Farmers also play a role in reducing the width of the river is the river. In Table 7, changes in minimum, medium and Maximum River is presented.
Table 7: The minimum, average and maximum width of the river

<table>
<thead>
<tr>
<th>Min Width</th>
<th>Av. Width</th>
<th>Max Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>99</td>
<td>253</td>
</tr>
</tbody>
</table>

Changes in River Morphology over Time

River morphology is such that erosion and twisted phenomenon is, when the annual flooding occurs frequently in its path. Meanders-moving rivers and the longitudinal and lateral movements caused by changes in river plan. River plain of low slope and low-speed stream, river occupied by villagers and bank erosion, major morphological changes over time has experienced. Figure 9 Plan of the river in the period 1971 to the present show. As it becomes clear picture of the seven bends of the river, have been rerouted.

CONCLUSION

Classifying the shape of the arterial pattern of the river. According to the geometric parameters of the 13 bends, polymorphic methods show that 5 from bending due to Sinuosity greater than 4.1 are unstable and low sediment transport capacity of the river. A total of 38 percent and 62 percent, bends, folds unstable stable. Considering the Kornis model, No. 6 Bent over 296, No. 5 and No. 2 for bending bending between 296-185 185-85 and Rudy twisted pattern has developed. Maximum and minimum width of the river respectively 13 and 253 meters. Classify the morphological component is slope rivers. Rusgen classification, G3 and G4 are placed in the river. According to the 1971 and 2014 aerial photographs, river diversions have been studied in 3-Bend.

REFERENCES

Alai Taleghani M (2005). Geomorphology of Iran (Ghomes publication).
Bodaqpur S and Ebrahimi M (2010). The morphology of rivers and swamps Gorgan River, the fourth had a scholarly conference and Exhibition on Environmental Engineering, Tehran University.
Research Article


Talebi L and Bayazidi Sh (2008). Evaluation of morphological changes using classified rivers Rosgen (The Case of the Green River Mountains), *the Seventh Conference of Iranian Hydraulic, Power and Water University of Technology (Martyr Technology), 21 to 23 November.*