Classifying Alluvial Fans shapes by Triangular/Fan-shaped Coefficient: Applied morphometric study to Alluvial Fans of Aqaba Gulf and Suez Gulf, in Sinai.

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Extended Abstract:

1. Introduction

When we study the morphometric characteristics of the Valleys or Alluvial Fans, it is necessary that we extracted the morphometric analysis of these valleys basins and his alluvial fans basins, that we can de through study of each of the following elements: 1- Characteristics of the dimensions (lengths - widths) of valleys basins and alluvial fans basins. 2- Characteristics of sizes and slopes of the valleys basins and alluvial fans basins. 3- Characteristics the forms (shapes) of valleys basins and forms of alluvial fans basins. In this paper, we discuss only the third element (study of the properties of Alluvial Fans forms). Because the study of forms of any natural phenomenon contribute to give an indication of the morphological stage of these phenomena.

Usually, the form of natural phenomenon is studied by linking them with a geometric shape, which we can measure the shape of this phenomena, so that gives us the possibility to comparing (geometrically) the form of this phenomena with other forms of the same phenomena.

The study of alluvial fans forms was handled through several previous studies, by linking and analogy the alluvial fans shapes with some fixed geometric shapes. Such as Circle, Cone, Oval, Arrow …etc. And some previous studies using the same transactions to measure the valleys basins forms, they used to measure the shapes of alluvial fans. These transactions such as the coefficient of Elongation Ratio, Circulation Ratio, Form Factor, Compactness Coefficient, Length/Width Ratio, …etc.

But in fact, there is a difference between the pattern formation of valleys basins forms, and between the pattern formation of alluvial fans basins forms. The valleys forms take some formats such as pattern: Circular, Elliptic, Pyriform, and many irregular forms. This forms cannot be applied to the traditional forms of alluvial fans, which is taken the normally form of radial separated, be similar to shape of the (fan) or shape of (triangle). Especially, in case growth the fan with normally stages.

But in case the fan grow abnormally by structural factors (Figure 1), or be affected by the element of neighboring the fans with each other (Bajada) (Figure 2), therefore the natural shape of fan will be difference of the triangular shape or fan shape, and this would be in the most stages of growth of fan.

Figure 1. Influence structural factors on shape of alluvial fans.

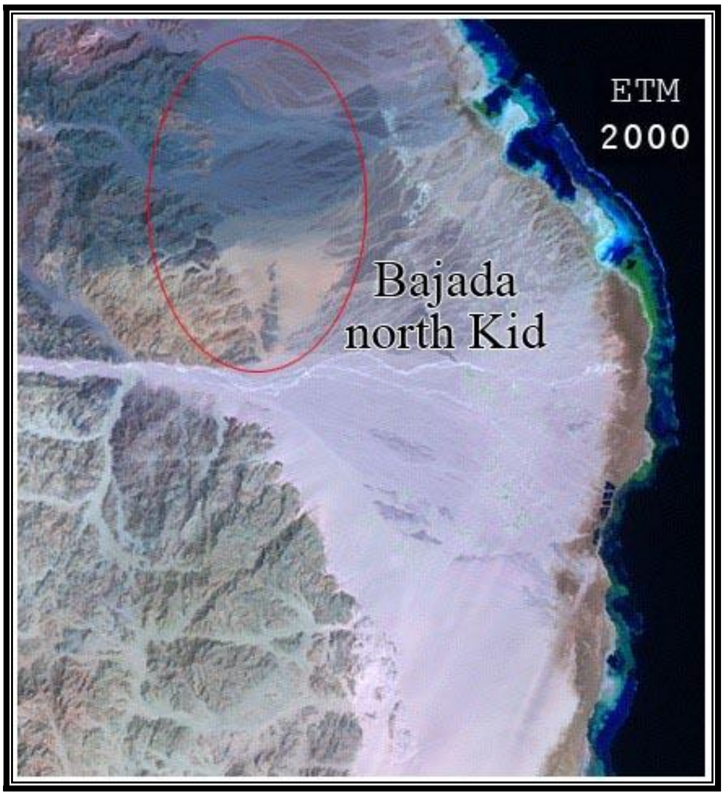

Figure 2. Influence fans neighboring on shape of alluvial fans (Bajada).

Addition to, the fans shapes is unstable, because of repeated flooding and deposition with any flow of valleys water, Therefore, can be described the fans as a dynamic phenomenon, his shape and area is changing repeatedly. Therefore, an attempt to measure its natural form by linking it with a geometric shape his dimensions not flexible, would not give us results can be conform to natural reality of fan form.

Therefore, in this paper we will try to find a geometrically form, his dimensions is variable in the shape and the area, depending on the natural change that occurs on the area and shape of the fan. Hereupon, we can match property the characteristics of this flexible geometry shape with the shape and area of the real fan. And in the future, we can successively change this geometry to simultaneously with the stages of natural growth of the fan. So that, we can considered this variable geometry shape is a perfect shape, or typically fan shape proportionate with each stage of growth the fan, until reach the fan to stage of maturity.

Now, we call this geometry shape the (triangular/fan shape), and we match it with the actual shape of the natural alluvial fan. Afterwards, we comparison the dimensions of a geometry shape with the shape and area of fan, that through applying a simple arithmetic coefficient, we call it (triangular/fan-shaped coefficient). It is a digital coefficient, his work method similar correlation coefficient. Eventually, by this Digital Coefficient we classify the all alluvial fans in the study area according to his shaped to the four class: (triangular shape, typical-fan shape, semi-fan shape, atypical-fan shape).

2. Area of study

In this study we classify all Alluvial Fans (eighty-four fans) located in South Sinai, Egypt (Figure 3). This fans found along the Coasts of the Gulfs of Aqaba, Suez, and small part of the Red Sea. All area it is between longitudes 32°–34° east and latitudes 27°–29° north.

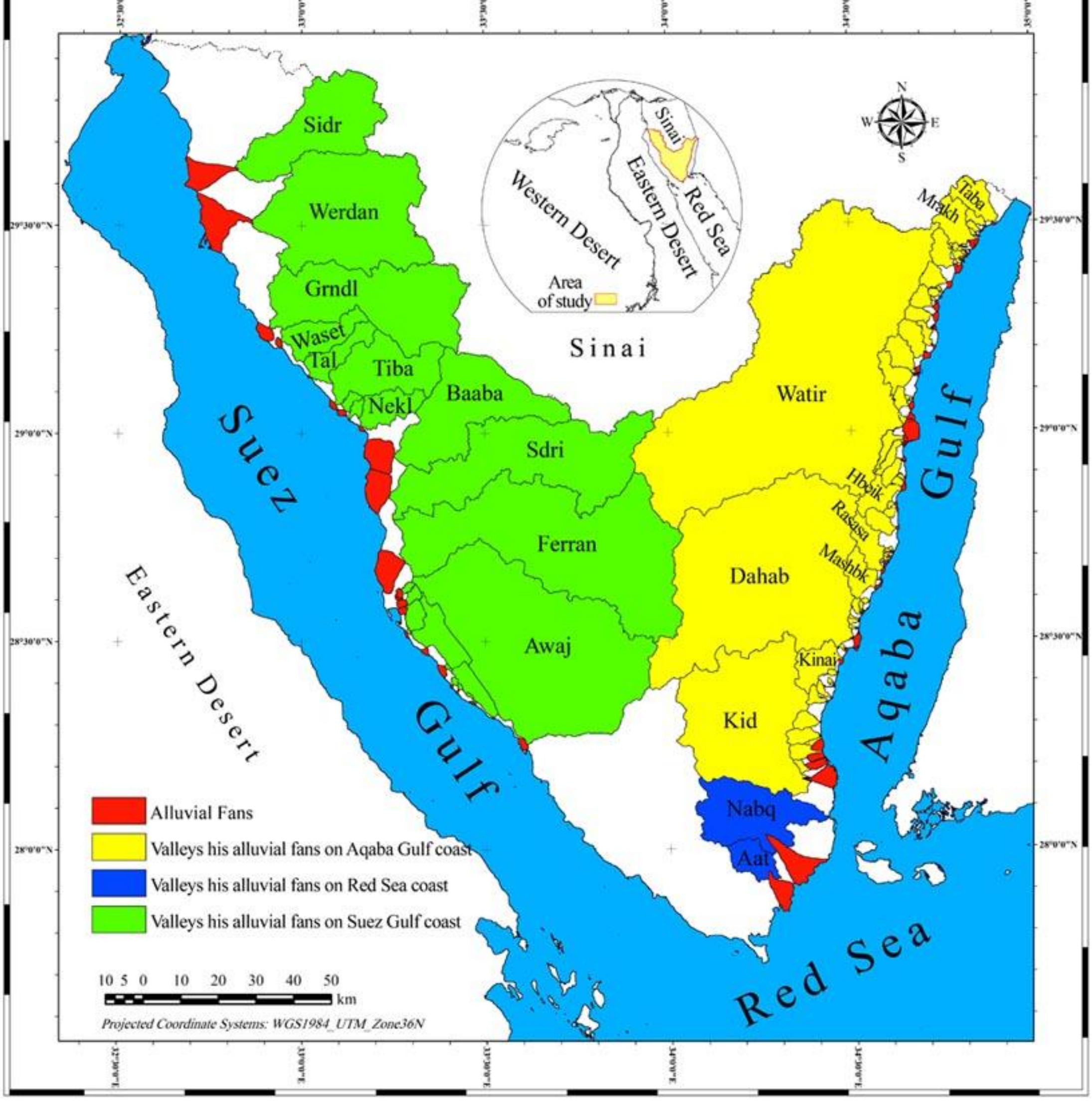

Figure 3. Distribution of alluvial fans in the study area.

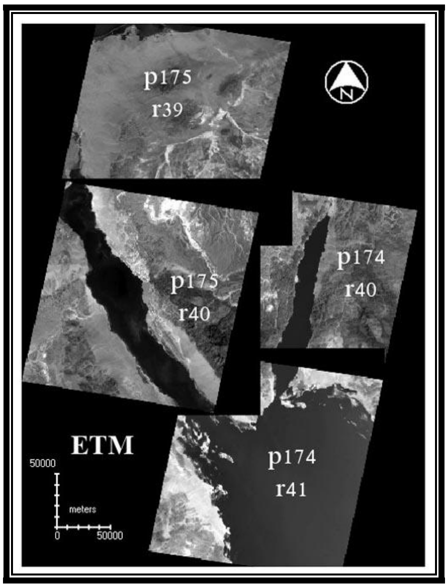

Figure 4. Landsat Satellite Images (ETM+, 2000) for the study area.

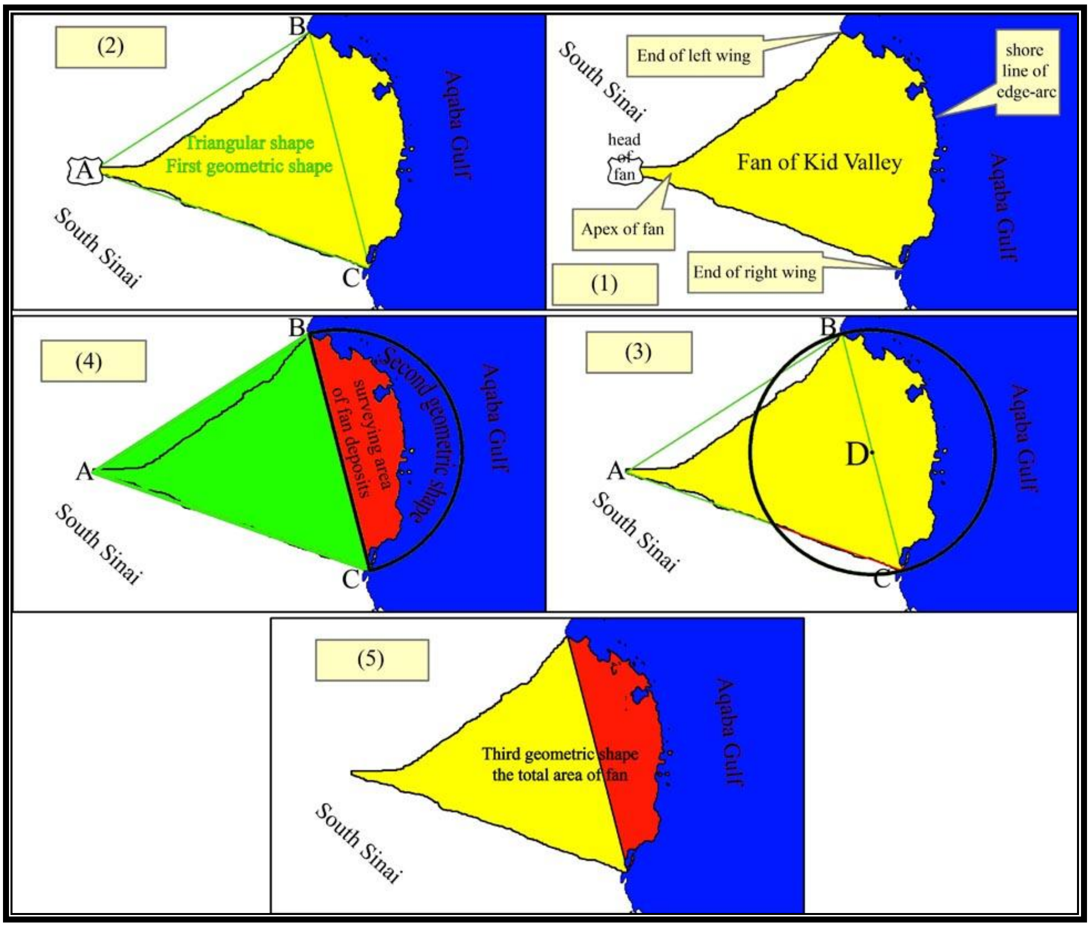

Figure 5. Stages of created the triangular/fan shape.

3. Methodology of study

We can arrangement the stages of classification according to the work on the following two stages:

3.1. First stage: Method of created triangular/fan shape:

3.1.1. From the available data of Landsat Satellite Images (Figure 4), can be extracted the forms of real fans, and then have been identified the: apex of fan - end of right wing - end of left wing – shore line of edge-arc (Figure 5).

3.1.2. Identify three points A B C on every fan in the study area, each of them alone.

3.1.3. Created three ribs between the three points A B C, will appear geometric triangular shape, called a (first geometric shape), it is shaded (green color) (Figure 5).

3.1.4. Define point D in the middle of the triangle rib at the side of edge-arc of the fan.

3.1.5. Create a circle in the center of point D, and his radius starts from point B or C.

3.1.6. Remove overlapping area between the two forms the triangle and circle, and keep on the semicircle part of the fan (Figure 5), called it a (second geometric shape).

3.1.7. Make a union area between the first geometric shape and the second geometric shape, be generated only one union shape, (Figure 5), called it a (third geometric shape).

3.2. Definitions of terminology the first stage:

3.2.1. **Point A**: It is the point at which begins sedimentation deposition in the fan apex.

3.2.2. **Points B and C**: It is representing the two wings of fan, and located at the maximum radial spacing along the sides reached sediments (located before beginning to arc circumference). This (arc circumference) represents the maximum extension of fan can deposits in the direction of downstream.

Win the sedimentary arrival to the limit of the fan arc (semicircle), which means that the energy of the valley equalized with the maximum size of the sediment fan. If the fan arrived at this situation, it can not increase the growth front or side of the fan.

But if there is a change in the current climate or is the rejuvenation of the valley, then will be an increase in the deposition fan in front, and it is commensurate with the increased deposition in the sides, timely the points B C is spacing from each other, as well as a spacing from the neck of the fan.

3.2.3. **First geometric shape**: it is mean a (triangular shape) (Figure 6) represents area of the range from the basic triangular fan (fan base), this area is restricted sites A B C points. This geometric shape indicates the approach of a fan to form a triangle, and inability of Sediments movement to front fan, or increase in the side of the fan.

3.2.4. **Second geometric shape:** it is mean a (half circle) represents the maximum free area of ranging-arc of the fan deposits (shaded in red), which are by the force flow of sediment in the middle range of the fan.

Here, we will find the perimeter of a half circle. Would represent the maximum that can be up to fan deposits in this range arc. Therefore, the area and the location of this region is directly proportional to site the points B C, and the amount of spacing between them.

3.2.5. **Third geometric shape**: it is mean a (typical-fan shape) (Figure 7) represents the total area, is supposed to reach them sediment fan, and this with the characteristics of the current climate and current characteristics of his valleys, such as (the density of drainage - type and size of grains of sediment - the power flow - ... etc.).

This third geometry shape will indicate how close to the actual shape of the fan to ideal shape (typical shape). This indicates that the growth of the fan was a natural, and it is close to the stage of completion, which is the stage where the area of true fan equal with the area of geometry form.

Figure 6. Example of fans approach to triangular shape.

Figure 7. Example of fans approach to typical-fan shape.

3.3. Rrelationships between fan areas and areas of geometric shapes:

3.3.1. Case 1: Win the value of surveying area of fan deposits (shaded in red) are closer to the value of area of second geometric shape (half circle), whenever became the real shape of fan closer to the form of (typical-fan shape). As well as, the shape of fan moved away from the geometric shape of a triangle. But if these values diverged, that would mean approaching the shape of fan to triangle geometrically shape.

3.3.2. Case 2: Win the value of total area of fan are closer to value of area of the first geometric shape (in the green color),Whenever became the real shape of fan closer to the geometric shape of a triangle (triangular shape). Therefore, the shape of fan moved away from (typical-fan shape). In addition, this result were obtained from this case will confirm the result obtained from the case 1.

3.3.3. Case 3: In the case, if the value of total area less than value of area of the first geometric shape, it means that the real shape of the fan significantly get away from the (typical-fan shape) or (triangular shape), here it becomes abnormally shape, and we can be called it (atypical-fans shape). Usually, this happens if there is outside effects, at the bottom or around the fan like the structural geology, it influenced in the growth stages, or restricted the normal radial distribution of the sediment.

3.4. Second stage: Method of calculating the triangular/fan-shaped coefficient:

The results of both coefficients supposed to be confirms the result on each other, but in case of a conflict between the two results, this indicates that the shape of alluvial fan is swinging between the (triangular shape) and the (typical-fans shape), here we arrival to (case 4), it can be called his fan form a (semi-fan shape).

Equations of two coefficients:

$$\textbf{Fan-Shaped Coefficient} = (E \div F) \times 100 \quad (1)$$

E: Is the surveying area of the region of fan (shaded in red).
F: Is the area of the second geometric shape (half circle).

Notes 1: Whenever the output closer to 100%, which mean incidence approach of the fan form to the (typical-fans shape). But the resulting value farther of 100%, this indicates that mean approach of the fan shape to the (triangular shape).

Note 2: The (fan-shaped coefficient) will be more accurate than (triangular coefficient) when we compare alluvial fan with the (typical-fan shape).

$$\textbf{Triangular Coefficient} = G \div H \quad (2)$$

G: Is the total area of the alluvial fan.
H: Is the area of the first geometric shape (green triangle).

Notes 1: When the equation output closer to (number one), that mean indicates approach of the fan form to (triangular shape). But, whenever the equation output increases more than (number one), this indicates mean approach of the fan form to the fan shapes (semi-fan shape) or (typical-fan shape). Also, when the output of the equation is lower than (number one), that mean the shape of fan move away from the natural form of alluvial fans (atypical-fan shape)..

Note 2: The (triangular coefficient) will be more accurate than the (fan-shaped coefficient) when we compare the alluvial fan with (triangular shape).

4. Biography

Name: Tamer Youssef Amron

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Notes: This (Extended Abstract) it is just included: Introduction, Area of study, Details Methodology of study, so that the condition of the maximum page length (ten pages). However, in the Faial (Complete Research) I will included all parts, like the following index of contents:

Index of contents
for the complete research