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Estimation of *Suaeda aegyptiaca* Plant distribution regions at Iraq using RS & GIS Applications

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Abstract

For ecosystem functions factors monitored the natural changing of environmental systems, and the managing ability expectation or prediction the plantation regions, (e.g. desert decreasing, air pollution reducing and weather wet stabilization). How, depends on the ability to understand how a particular ecosystem functions and the automation that control the elements distribution, such as (*Suaeda aegyptiaca*) plant in this study. Which recognized plants Iraq native, and, that are widely found in some regions of Iraq finding randomly. Amplitude plantations regions and automation wealth can be observed diffusion and growth this plantation, as well as estimated the far-reaching and unknown locations to form control and improve environmental and ecosystem relief.

We will be used Botany mapping techniques, this map is identified many indicators about the spatial variability distribution areas, and the maps can be a clear indication display significant spatial points of environmental. This process Required different techniques such as spatial description locations.

For purpose, this study applied RS, GIS techniques and Kernel density estimation (KDE) achievement this study.

In this study are finding distribution regions of *Suaeda aegyptiaca* determination often in middle and a lot of in western south of Iraq, for this, Kernel density estimation is an effective tool to identify species of Suaeda aegyptiaca plant areas within point patterns of plantations by producing a smooth and continuous surface. Also, kernel density estimation represents a powerful way to find hot spot analysis and dimensions visualize over large areas easily.

Keywords: Suaeda aegyptiaca plant, Point Pattern Analysis (PPA), Kernel Density Estimation (KDE), GIS techniques.

تخمين مناطق توزيع نبات السويدا في العراق باستخدام تطبيقات التحسس النائي ونظم المعلومات الجغرافية

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الخلاصة

لمراقبة التغيرات الطبيعية والعوامل المؤثرة للنظام البيئي، والمقدرة على ادارة وتوقع وتنبأ مناطق المستعمرات النباتية مثل (انخفاض التصحر، التقليل من التلوث، وحفظ توازن الرطوبة في الجو)، و يتم بالاعتماد على المقدرة في كيفية تحويل ميكانيكيا للوظائف البيئية والسيطرة على توزيع عناصرها مثل نبات (*Suaeda aegyptiaca*) في دراستنا هذه. الذي تميز العراق بهذا النبات واصبح هوية له والذي وجد في مناطق شاسعة ومبعثرة. واهميتها تاتي من تحويل اوتوماتيكيا المناطق المستعرات النباتية الغزيرة ومراقبة توزيع ونمو هذا النبات، وتخمين المواقع الغير معروفة والتي لا يمكن الوصول اليها والسيطرة عليها وتحسين بيئة حياة النظام البيئي.

سوف نستخدم تقنية الخرائط النباتية، هذه الخرائط محددة بعدد من المؤشرات تعبر عن مساحات توزيع المتغيرات الحيزية، وهذه الخرائط من الاهمية باستطاعتها عرض مؤشرات واضحة للنقاط الحيزية البيئية، وهذه العملية تتطلب تقنيات مختلفة مثل وصف المواقع الحيزية.

ولهذا الغرض، في هذه الدراسة طبقت تقنيات التحسس النائي ونظم المعلومت الجغرافية وتخمين كثافة كيرنل لاتمام هذه الدراسة. وفي هذه الدراسة وجد توزيع نبات السويدا محصورة في وسط وجنوب غرب العراق،لذلك تخمين كثافة كيرنل اداة مؤثرة لتحديد مساحة انواع نبات السويدا في النماذج النقطية الحيزية للمستعمرات النباتية بواسطة انتاج سطوح متواصلة (قطعة واحدة لمساحات كبيرة جدا مثل مساحة العراق) و رخيمة. كذلك تمثل تخمين كثافة كيرنل وسيلة قوية لايجاد تحليل المناطق الكثيفة وتصور سهل للابعاد ولكل المساحات الكبيرة.

Introduction

Remote sensing (RS) techniques when have data availability capture huge regions studies un complicated without reached it, and Geographic information systems (GIS) have ability to manipulate and analyze raw data of environmental resources as plants (Botany). And help to expect or predict species of Suaeda aegyptiaca plant shifts in distribution and stability under an altered climate, and enable more refined hypotheses about the functioning of these, [1].

In order to evaluate plant distributions and the environmental effect of the plantations, the objective of this study was to determine and understand factors that control the distribution and abundance of *Suaeda aegyptiaca* plants in Iraq. Improved knowledge plantation diffusion and finding suitable climate it, also preservation on peaceful environmental and producer.

Natural of species diversity and distribution have considerable ecological significantly change environmental conditions. The spatial characteristics of these influence regeneration dynamics, [2]. The imagery of airborne impact simplicity can be analyzed to produce a plantation cover maps for a range of types of species plantations. These maps patterns were used to delineate species in these areas, also the techniques of GIS can used to derive range of measures to describe the spatial characteristics of this species, in order to infer the relative ecological status of different types of *Suaeda aegyptiaca* plants.

Such as the caps characteristics of species or spaces between plantations, with be smaller or larger gaps. When the large caps is appeared obviously notice the natures barrier and finding widely differential in climate, opposite, the short gaps carried the same characteristics of climate and adjacent areas appeared.

Identical, the satellite imagery can be depicted accurately, and the large or small caps demonstrated eyewitness at scale 1:10000 beyond, moreover, inexpensiveness and amplitude the satellite imagery.

Determining the region smooth interested and the finding connected smallest gaps areas by using kernel density estimation (KDE).

1- Study Area

Iraq lies between latitudes 29° and 38° N, and longitudes 39° and 49° E (the top-bottom photomap geo-coordinates are 37o22’17’’ N, 38o48’33’’E, and right at 29o06’10’’N, 48o36’15’’E). Spanning 438,317 km2, it is the 58th largest country in the world, show Figure- 1.

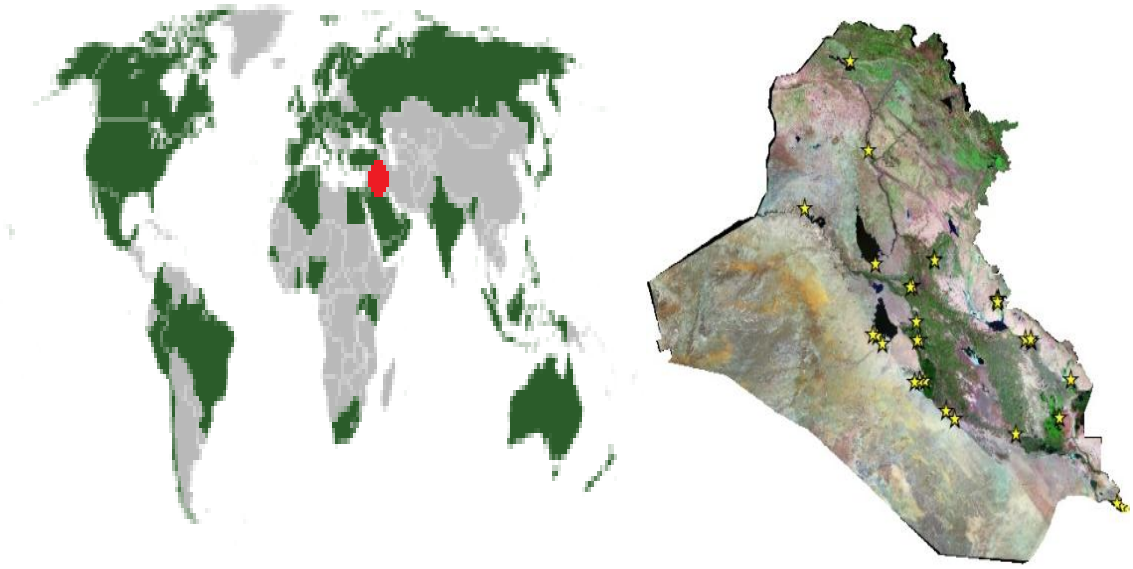


Figure 1-The Study Area of Iraq, shown Suaeda *aegyptiaca* plants regions.

Iraq has a generic hot and dry climate; it is characterized by long hot and dry summers about eight month, and short cool winters about three month. The Iraq's location climates are influenced by between the subtropical barren of the Arabian Desert areas and the subtropical damp of the Arabian Gulf. December mid and January month is the coldest, with temperatures from 4°C minimum to 12°C maximum, and August month is the hottest with temperatures reached to 50°C maximum, show Figure- 2.

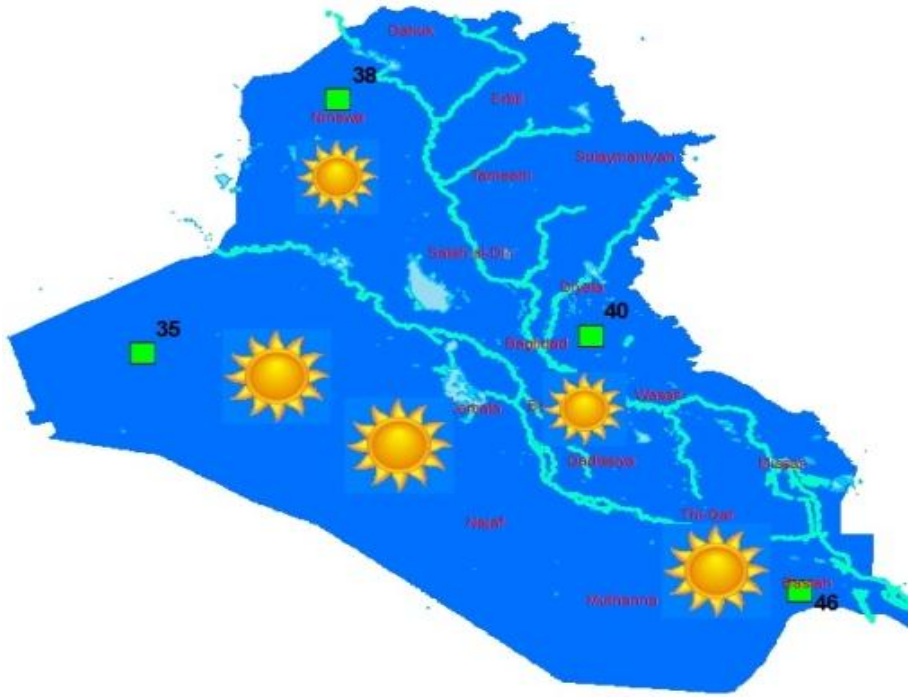


Figure 2- the climate state of Iraq is illustrating the temperature degree and weather pictorial.

In general, the Iraq areas summers are hot with mostly sunshine, it is day longest night, but in Iraq southern is humidity, because effects under the southern coastal areas of the Arabian Gulf. the area cover enveloped Temperatures very hot; In days temperatures can reach 45°C or more, especially in

the Iraqi desert areas. In nights less about 5 for 10 degree, The area sometime expose violent sandstorms caused hot and dry desert wind.

Iraq divided in three type climate zones classifications. The Western and southwestern areas can be classified as BWh Climate, the desert climate temperatures average above 18°C. The locations are between the Arabian Gulf and the Turkish Border in the northeast of Iraq can be classified as BSh climate zone, the average temperatures are between 20°C to 10°C, and Climate enveloped hot and dry.

The Iraq North Mountains are classified as Dsa Climate zones, The Temperature average is between 10°C to -2°C in day and night. See Figures -3 showed differential temperatures degree at all zones of Iraq area.

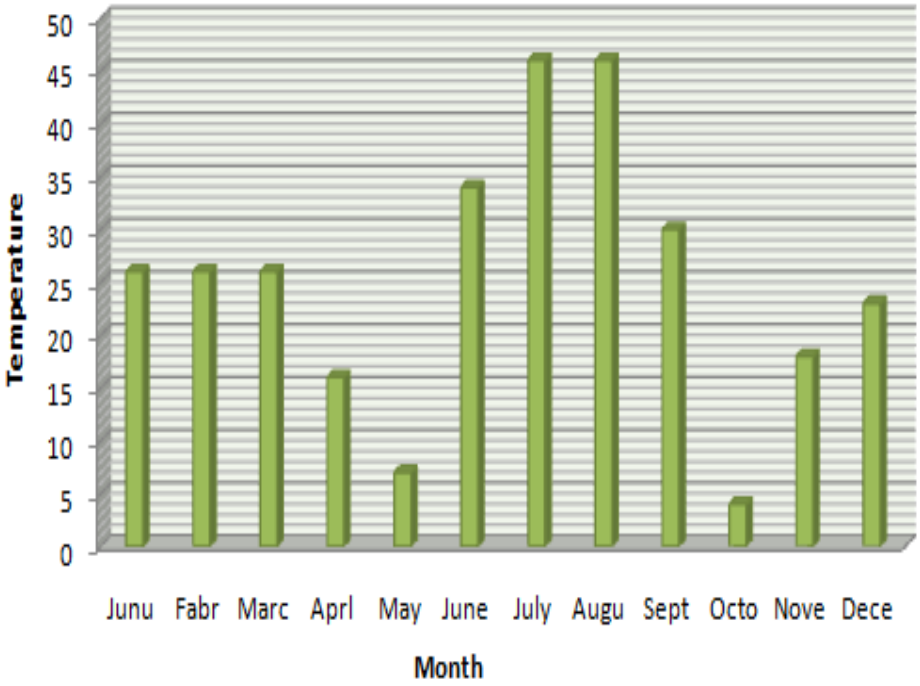


Figure 3- temperature level of Iraq, periodically is 25 years.

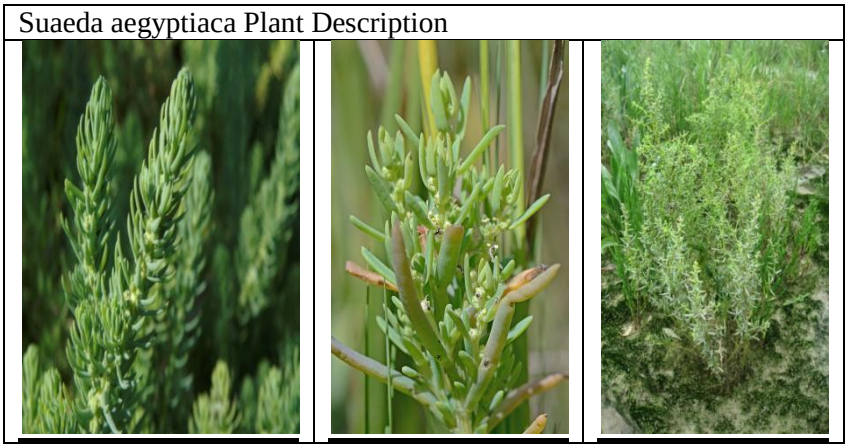


Figure 4- Representation, sampling of s*uaeda aegyptiaca.*

2- Methodology

2-1 Environmental Data

The methodology for this study was directed toward producing a map of spectrally distinct topography according to Landsat Thematic Mapper (TM) data (Imagery) are being used for soil, water and vegetation mapping in the majority of state land cover only use mapping project for Iraq. The

Thematic Mapper records reflected energy in three spectral bands BRG (Blue, Green, and Red), with a spatial resolution of 28 m. TM data of the study area produced for March 2002. The satellite data were georeferenced to The World Geodetic System (GCS-WGS-1984) is a standard for use in cartography, coordinate system to match it with topographic maps of the region.

Through, we can notice the vegetation regions extremely at Iraq involved all species kind; process the Landsat Satellite imagery and utilization reflected spectrum of any species of plant can distinguish the kinds. The sample dispersed on the mapping creation dropping on the green regions of Landsat satellite imagery. Creation layers features are Property Rivers, lakes, and watery plane according to satellite Landsat imagery map; these are bases work the search.

In addition, using aerial photo topography reflected to paper map for determining the pin point of sampling at a scale of 1:100,000.

Furthermore, transformation that information of species of *Suaeda aegyptiaca* presents in grass laboratory computerized by tabulate in Microsoft applications (Excel 2007) involved coordinate (Longitude, Latitude) for each points and address, and imported into GIS environment in order to analysis the spatial dispersion selection (species of *Suaeda* aegyptiaca), see Table- 1.

Table 1- illustration, the example of location Long.-Lat (x-y axis) coordinates system and address for each spatial point.

Plant Location Number	Plant Location Name	Long. (λ) Degree, x-axis (pixels)	Lat. (φ) Degree, y-axis (pixels)
1	UMQaser1	48.559799	29.9149
2	UMQaser2	48.447399	29.9447
3	UMQaser3	48.363098	29.9907
4	UMara	47.184898	31.305799
5	ALSHeeb	47.416599	31.889
6	KUT-UMara road	46.618698	32.476501
7	KUT-ALGHraf1	46.494301	32.519501
……	……	……	……..
29	KArkuk HEmreen	43.306801	35.393902
30	RAHaliea	45.0658	31.2957
31	DIHook SUllaf	42.929699	36.768299
32	RAwa SHbani	42.0106	34.516499

Storage Data above and management to manipulation transformation to perform a layer (feature) mapping and determining pin point which represent species of *Suaeda aegyptiaca*, show Figure -5.

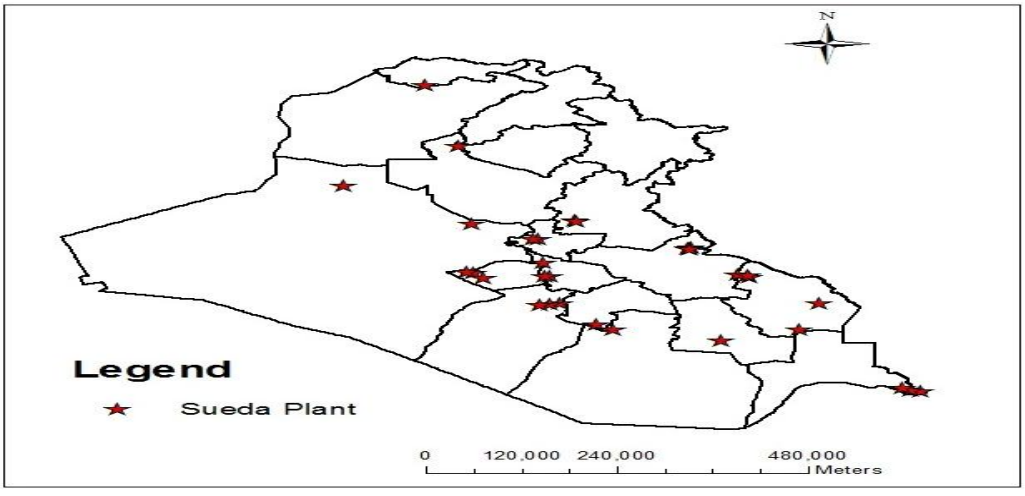


Figure 5- illustration create feature layer in GIS applications and pin point of samples.

2-2- Suaeda *aegyptiaca* habitat characterization

In general annual by agreement, the shape description, erect, ascending or decumbent, glabrous living. Stem is richly wit repeatedly branched, in young condition periodic is pale green throughout, later turning white to cream colored and terete or delicately striate.

The branches erect or ascending are the lower often spreading and flexuous. Leaves are succulent and semi-terete or terete, the under linear or oblong, the upper narrow obove to clavate, obtuse, at base attenuate into a short petiole. The lower straight, the upper arcuate, ascending to spreading with C4 anatomy and internal of tissue aqueous.

Bracts subclavate to clavate, arcuate, spreading, the lower much longer, the upper as long as or even shorter than floral and fruit clusters. Bracteoles narrow ovate, trullate or triangular, acute or acuminate, the margins lacerate to toothed. Glomerules (1)5-30-flowered, inserted on very short axillary branches, sometimes fused for a very short distance with the petiole of the subtending bract. Perfect flowers weakly protandrous, fig-shaped, tepals very succulent, fused for 1/2-2/3, forming a compact cone, higher up widened into a bowl-like structure, the tepal-lobes very succulent, incurved, green with hyaline margins, somewhat cucullate. Stamens 5, the thread-like filaments inserted on an epitepalous rim, Ovary semiinferior, in its lower, ovule bearing part is fused with the perianth, which is upper part forming a column or slender cone shape. Stigmas with long papillae is inserted in the centre of the collar like ovary apex. Fruiting perianth widespread enlarged, fig-shaped is common partly or completely spongy.

Seeds vertical shape, a little of flattened, at beak short and testa black, shiningand smooth to delicately sculptured.Flowering Period in September or October, [3].

The species favored habitats, which are temporarily wet regions, usually saline and subject to moderate to strong nature of soil, sea level to 100-130 Distribution. From UMQaser region in south of Iraq, middle north regions, and little in north separate scarce.

The morphology of the species is distinguishing extremely variable shape, particularly with relevance to growth style, branching themes system, size, shape of spikes, shape and succulence extraction of leaves and bracts.

2-3 Point Pattern Analysis (PPA)

Point pattern analysis (PPA) advanced tools for spatial analysis, these techniques are a group of quantitative methods, which describe the pattern involve point locations and defined if point locations are concentrated (or clustered) within a boundary region of study. Recently, Statistical field according for PPA has largely emerged from work in the plantations ecology research.

Point patterns (PPA) counting disperse by consist a series of spatial distribution points, [4].

A point pattern (PPA) include of a set of point must be criteria highlighted below;

- The patterns should be showed on a plane aiding by Pictorial, The topographic include of the plants cover a three-dimensional ground surface. The boundaries of the study area of Iraq were delineated based comprise of data as neighbor of points.
- The plants must be derived a climate indicated of the study area.
- Plants locations must be compatible and unusual effective.

Then, the advent of Geographical Information Systems (GIS), Point patterns have been used with increasing frequency in a field of applications involve identification of flora especially plantation patterns and tracking of epidemiology outbreaks, [5].

Kernel density functions more sophisticated to use density based method, by summing with series circular formed regions by given position in the study area of Iraq, as well as, PPA involves measure the distances between points that pointer a distance function, and PPA compute spatial accompany that vary locally from the larger global a cover a region of study as Iraqi plantations, [6].

2-3-1 Kernel Density Functions

Kernel Density mapping is one of the most common methods for defining hotspots region, because it details a continuous area and smooth surface map involve plantation in the study area, The Kernel Density compute the density of species of plant around each point, measured by the distance from the point to each species of *Suaeda aegyptiaca* , by calculate the density around each point. Different bandwidth (sigma) using estimated suitable density, [7]. The key argument to pass to the density method for point pattern objects is sigma, which determines the bandwidth of the kernel; we use this to cumulate density values for different values of sigma.

Kernel density functions include efficient tools of density based techniques for evaluating point patterns. In the spatial analysis, kernel densities are to stimulate three-dimensional according to weight events within a domain of influence based on their distance to a point, where density is being estimated, [8]. The equation of kernel estimation is:

$$\lambda(x,y) = \frac{1}{nh^2} \sum_{i=1}^{n} \kappa \frac{(x_i,y_i)}{h} \quad \ldots\ldots (1)$$

Where **λ(x, y)** is the density of the spatial point pattern measured at position (x_i, y_i) is the observed *ith* points, ***k*** is the kernel weighting function, ***h*** is the bandwidth or (sigma), and ***n*** is number of samples. The simplest of the kernel density functions is the simple function, which quantity the point pattern intensity λ(x, y) on a circle centered at the position where a point density is to be estimated, [9]. Mathematically, this is expressed as:

$$\lambda(x,y) = \frac{no.[S \in C(\boldsymbol{P},r)]}{\pi r^2} \text{ s} \quad \ldots\ldots (2)$$

The numerator is the quantity of points of pattern ***S*** within C (***p***, *r*), a circle of radius ***r*** centered at the position of interest ***P***, see Figure-6.

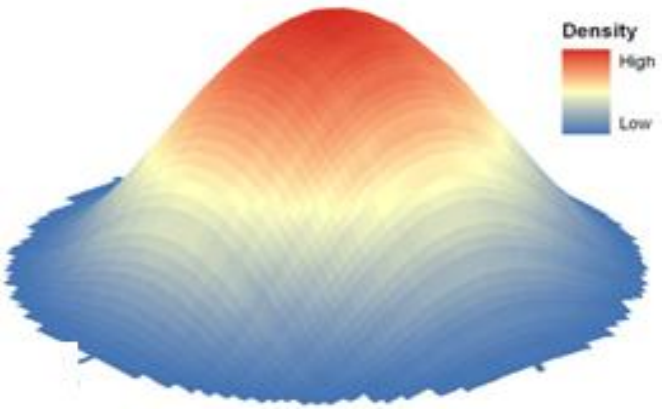


Figure 6- illustration, three dimensions of Kernel Density Estimation (KDE), [10].

The quantity of denominator in this equation (πr^2) represented the circle area. A continuous area surface cover a study area of Iraq, these values can be using in comparisons with other continuous area data fields (e.g. ground continuous surface elevation). The surfaces can also be used to regulate or normalize density functions to valuable for local variety in sample density.

2-3-2 Density Estimation

Density estimation is a probability density function. This Technique is performing density estimation comprise fine quality of good tests distributions and quantity (nonparametric) technique, and clustering methods are role this nonparametric (e.g., k-means estimation, mixture models, and kernel methods), [11]. In wide area very high dimensional space is necessary to reduce the dimensionality of the space at time, in order to reduce quantity and avoid abundant record data elements. Primary, to perform spatial density estimation use location of a plant, and current approaches only the same location. By creating a density function in the two coordinate dimensions of x-axis and y-axis. In this paper, we prove and explain a method for extracting environmental conditions such as plantation using geographic information systems, see Figure- 7.

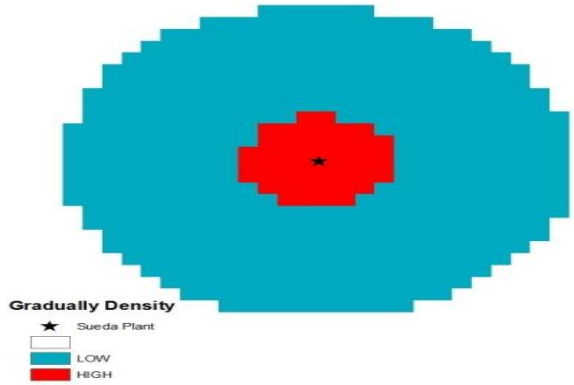


Figure 7-Demonstration, Density Estimation for plant location in 2D, which represented density function, and reduce dimensionality spaces.

2-3-3 Bandwidth Kernel Density Estimation

The kernel density estimation, which used a bandwidth based (e.g., sigma) on a geographic distance; how, to condition bandwidth method uses fixed data to calculate a kernel density with varying size for each individual case, as well as a species of *Suaeda aegyptiaca* . The influence of a single case has a small spatial extent acknowledge, finding where the plantations densities are high as the bandwidth is small [12]. Contrarily, in plantation areas where densities are lower, the kernel is location larger and the influence of a single case is greater, see Figure- 8.

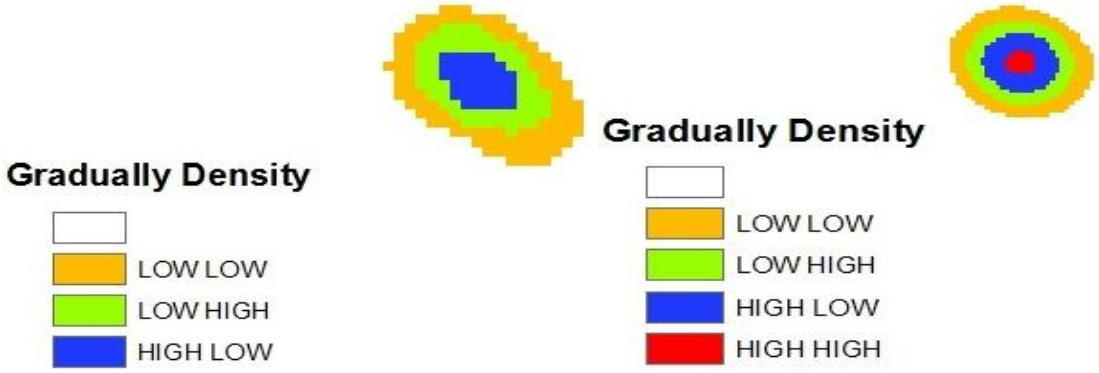


Figure 8- illustration, two cases of density surface represented differ bandwidth for radii (sigma= 2.5, 5 km^2) consecutively.

The adaptive method is calculated as follows;

$$f(x,y) = \sum_{i=1}^{n} K\left(\frac{d_i}{p(u,v)}\right) \quad \text{..... (3)}$$

$p(u,v) = nh^2$ which represent bandwidth (sigma);

In this equation, the bandwidth (sigma) is explained by $P(u,v)$, which is a function centered at a location with (u,v) and based on the location as plantation. Additionally, the denominator $p(u,v)$ is disregard since the output value is disconcerted by the situation area of the kernel (nh^2). The involve bandwidth method have basing the influence of a case on the underlying plantation sustenance, choices by various the function K; that not significantly affect the outcome. In this study will using a simple form;

$$\begin{cases} K\left(\frac{d}{h}\right) = \left(1 - \frac{d^2}{h^2}\right) if\ d < h \\ K\left(\frac{d}{h}\right) = 0\ otherwise \end{cases} \quad \text{..... (4)}$$

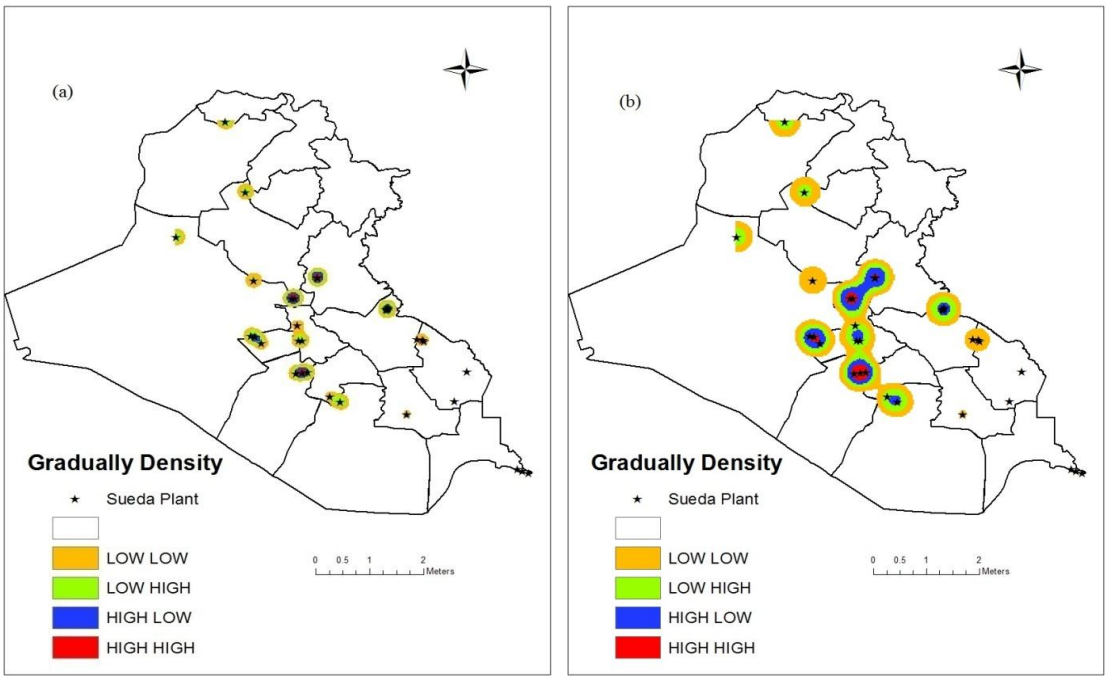
Generally, the influence of one case will compatible that of another. In this term, the bandwidth (sigma) and kernel density estimation calculations are implemented separately for each case, and the results are an account. for optimal results Obtained for bandwidth, that can apply this equation;

$$h_{opt} = \left[\frac{2}{3n}\right]^{\frac{1}{4}} \sigma \quad \text{..... (5)}$$

Where, $\boldsymbol{h_{opt}}$ optimal bandwidth, $\boldsymbol{n}$ number of samples and $\boldsymbol{\sigma}$ standard deviation [13].

3- Results and discussion

In this study, spatial patterns variations for species of *Suaeda aegyptiaca* overlap the study region apply ordinary kernel densities by sampling density by compute bandwidth per area basis.
Then, suppose here building different radii various value (bandwidth) of 0.25 , 0.5 , 0.75 and 1km^2, in order to created kernel mapping continuous surfaces of density or probability of the underlying variable, depending on bandwidth, see Figure -9.



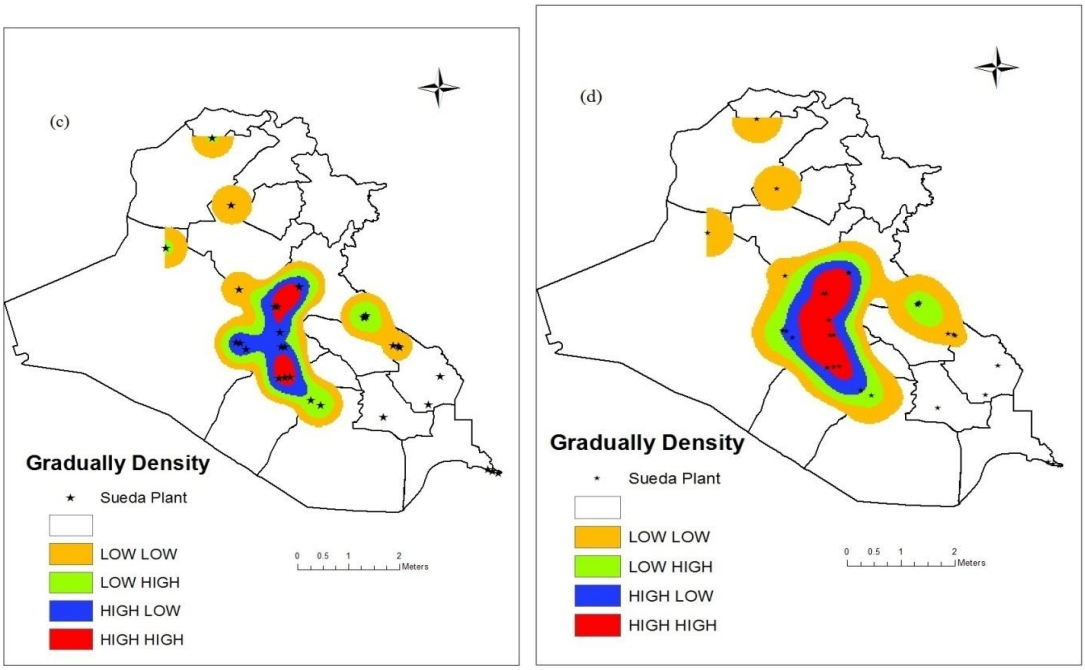


Figure 9- illustration, different bandwidt using at study area of sigma = (0.25, 0.5, 0.75, 1) kilo meter square consecutively.

Then, in Figure-9 (a) applied Choice for one Kernel density function after locations of sample points at sigma=0,25 km^2, by observing the change of density smooth values over a arrange points and consideration the estimator the density surface, then apply different sigma to reach satisfaction smoothing case naturaly diversed of plants, hence, difficult determine the better value of bandwidth, but, when applied several density surfaces for different bandwidth, and notice the result to determining the best densities as Figure -9 (b) and (c). moreover, experimental results vary of bandwidth reveal that the kernel density estimation (KDE) is a choice methods for ideal analytic modelling.
to consider this results density of plantations that the Figure -9 (c) is resultant efficient and to postulate optimum, the Figure-9 (b) is below obtimum, so the Figure-9 (d) considered above obtimum.

4- Conclusion

The purpose this search find style to monitor and capture the wide area of plantations, and share with world effort to environmental improvement, In addition encouragement people are preservation and sponsorship growth proliferation utilize to use numerous objects by apply remote sensing (RS) and geographic information system (GIS) techniques.
More arguments can conclude below;

1. Utilization from characteristic of KDE bandwidth (sigma) determined regions optimal distribution of *Suaeda aegyptiaca* by suitable choosing depending on planning.
2. Likewise, can utilization this study to monitoring and dominate the area involve *Suaeda aegyptiaca*.
3. Finding the *Suaeda aegyptiaca* plantations are determined in middle and south western of Iraq.
4. Producing smooth and continuous surface maps of *Suaeda aegyptiaca* plantations at Iraq.
5. Producing patterns visualization should be mapped at plants (Suaeda aegyptiaca)event over a three-dimensional ground surface.
6. Finding earth fundamentally understood of the exact mechanisms of species of Suaeda aegyptiaca plantations distribution in Iraq by using descriptive data set of sample sleeping in grass laboratory.

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