Evolution of land suitability and capability for some crops growth using LSSM model at Al-Gabbanah valley, Ibb, Yemen
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Abstract

This study aimed at finding the productivity of the land and its suitability for the growth of some agricultural crops (field crops, vegetable crops and fruits), namely sorghum, potatoes and figs. The study area was evaluated according to its production capacity according to Sys et al. 1991 for the first and second grades (S1, S2) using a special digital model to illustrate this cartography. These lands were also classified according to their suitability to grow three types of crops, vegetables and fruits according to Sys et al. 1993, and using a special digital model to illustrate this cartography. The studied crops were suitable for cultivation in the Al-Gabbanah valley, as the results showed that sorghum in the ground sectors (1, 4) is very appropriate (S1), while in the ground sectors (2, 3) it is moderate suitability (S2). The potato yield showed very appropriate result (S1) in sectors (2, 4) and moderate suitability in sectors (1,3). As for the fig crop, the results showed moderate suitability (S2) in all sectors.

Keywords: Land productivity, suitability of crop growth, sorghum, potatoes, figs, Ibb Governorate, Yemen.

Introduction:

Yemen occupies the southern end of the Arabian Peninsula. The country has many interior mountains separated by western and central highlands. The western highlands have peaks reaching to 3660 meters, with relatively fertile soil and sufficient plentiful rainfall. Although the central highlands are more like a plateau of about 2000-3200 meters, with rolling hills, small knolls, and some very prominent peaks, they still relatively very high. Those regions have less rainfall, but they still receive sufficient rain in summer months for extensive cropping pattern Fig.(1)

Only 2.9% of Yemen is considered to be arable land, and less than 0.3% of the land is planted with permanent crops. About 4900 km² of land are irrigated. According to the United Nations,
Yemen has 19550 km of forests and other wood lands, which constitute almost 4 % of the total land area, (Wikipedia, (13).

Limited information are available on the soils of Yemen. Few soil surveys which were conducted previously were not sufficient or adequately correlated in national or international system to serve development needs. They varied in giving details and required complementary studies to respond to an increasing demand for soil resource information.

Ibb city is the capital of Ibb Governorate (the area under study). It is situated on mountain ridge, surrounded by fertile land and is known as "the green City". The region of Ibb has many notable mountains such as Ba'dan, which overlooks most of the city. Ibb Governorate has many famous valleys.

Dar AL- Handasah (2) described the four main stratigraphic units outcrop in the Ibb city. These are from younger to older as follows:

Quaternary deposits are represented by valley alluvium and terraces which unconformable overly the bedrock at the base of main valleys or on the slope terraces of the mountain ranges, respectively. The alluvial deposits are principally composed of gravel, sand boulders, and large detritus of volcanic rocks, while the terraces deposits are composed of loess with calcareous concentrations, alluvial fans, gravel, silt, loamy sands as well as sandy loam texture.

Ibb has a cool continental climate, varied in the mountainous highlands and mild in the central plains, while it is warm in the southern and western regions. It rains over most parts of the province. A summer seasonal rainfall in most districts reaches 800-1200 mm. The soil moisture regime for Ibb Governorate, according to the SOIL SURVEY Staff (9), is Ustic and/or Udic. The soil temperature regime is classified as Iso-thermic (Bruggeman, (1)), fig.(2).

The aim of the current study is to investigate the characteristics and classification of the soils representing the four main valley AL-Gabbanah located at directorate Ibb from Yemen. This research could serve as a base management of these soils for sustainable agriculture. Therefore, this study aims at finding the productivity of the land and its suitability for the growth of some agricultural crops (field crops, vegetable crops and fruits), namely sorghum, potatoes and figs.

Materials and methods:

The studied area is located at Ibb Governorate, Al-Makhader directorate, Yemen Republic, which is about 15 km from Ibb. Al-Gabbanah valley was chosen for the current study around the
Ibb city. The studied area is (about 15 km) bounded between latitude 14 04'40.00 N and longitude 44 10'05.00 E, as shown in Figs. (3) and (4).

![Geomorphology and soil mapping using GIS](image)

**Fig. (3): Yemen and Ibb Governorate topographic map. (Yemen international information center)**

**Fig. (4): Ibb Valley and Location of the studied profiles.**

**Geomorphology and soil mapping using GIS**

Geomorphologic map was carried out using digital image processing of land Sat7.0 ETM+ image (Path/row 166/50) dated 2012, executed using ENVI software 5.0 (ITT, 2012). Image was stretched using linear 2 %, smoothly filtered, and their histograms were matched according to
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LilleSand and Kiefer (7). Image was atmospherically corrected using FLAASH module (ITT (6). GIS works were performed to produce geomorphologic and soil map for the studied area using Arc GIS software 10.1 (ESRI, (4).

Field Work
Four soil profiles were chosen representing the different valleys and geomorphologic units and morphologically described according to FAO (5). Soils were collected according to the vertical morphological variation and prepared for the different physical and chemical analysis.

Physio-chemical Analyses
Particle size distribution was carried out according to KLUT (3). Electrical conductivity (EC), pH, organic matter (OM), calcium carbonate (CaCO₃), gypsum, cation exchange capacity (CEC) and exchangeable Na percentage (ESP), were determined according to Page et al. (8).

Results and discussion
GIS works resulted in valley and stream order as well as geomorphologic figs of Al-Gabbanah valley Fig (4). Also, satellite images interpretation indicated that the investigated area includes three geomorphologic units, i.e. Low over flow valley, high decantation valley and low decantation valley, Fig. (5).

Fig. (5) : Geomorphologic map of the studied area.
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### Table (1) : Morphological description of the studied soil profiles

| Wadi No. | Profile No. | Elevation (m asl) | Depth (cm) | Color Moist | Texture | Structur e Moist | Consistence Moist |
|----------|-------------|------------------|------------|-------------|---------|-----------------|-------------------|
| Al-Gabbanah | 1 | 1508 | 0 – 25 | 10 YRS/3 | 3/2 | s.g. Sand Loam | 2 m sbk | v.hard | Friable |
| | | | 25-50 | 10 YRS/3 | 3/2 | s.g. Sandy | 1 m gr | s.hard | Friable |
| | | | 50-70 | 10 YRS/3 | 3/2 | s.g. Sandy L. | 2 m bk | Hard | Firm |
| | | | 70-85 | 10 YRS/3 | 3/2 | g. Sandy L. | 2 m pk | Hard | Firm |
| | | | 85-125 | 10 YRS/3 | 3/2 | g. Sandy L. | 2 m pk | Hard | Firm |
| Al-Gabbanah | 2 | 1484 | 0-30 | 10 YRS/3 | 3/2 | g. Sandy L. | 2 m sbk | v.hard | Firm |
| | | | 30-60 | 10 YRS/3 | 3/3 | g.L. Sandy | 2 m sbk | v.hard | Friable |
| | | | 60-90 | 10 YRS/3 | 3/2 | s.g. Sandy L. | 2 m gr | ex.har d | Firm |
| | | | 90-130 | 10 YR/4/3 | 3/2 | g. Sandy L. | 2 c sbk | ex.har d | Friable |
| Al-Gabbanah | 3 | 1478 | 0-25 | 10 YR/4/3 | 3/2 | v.g. Sandy L. | 2 m sbk | v.hard | Friable |
| | | | 25-50 | 10 YRS/3 | 3/2 | v.g. Loam | 2 c gr | s.hard | Friable |
| | | | 50-70 | 10 YRS/3 | 3/2 | v.g. Loam | 2 m gr | s.hard | v.friabl e |
| | | | 70-85 | 10 YRS/3 | 3/2 | v.g. Clay L. | 2 m sbk | Hard | v.friabl e |
| | | | 85-100 | 10 YRS/3 | 3/2 | g. Clay L. | 1 m sbk | Hard | v.friabl e |
| | | | 100-130 | 10 YRS/3 | 3/2 | g. Clay L. | 1 m sbk | Hard | Friable |
| Al-Gabbanah | 4 | 1482 | 0-30 | 7.5 YRS/3 | 3/2 | g. Sandy L. | 2 m bk | Hard | Firm |
| | | | 30-60 | 7.5 YRS/3 | 3/2 | g.L. Sand | 2 m sbk | Hard | Friable |
| | | | 60-90 | 7.5 YR/4/3 | 3/2 | s.g. Sandy L. | 2 c bk | ex.har d | Firm |
| | | | 90-130 | 7.5 YR/4/3 | 3/2 | g. Sandy L. | 2 m bk | v.hard | Firm |

**Abbreviations:** Texture : s=slightly , g=gravelly , L=loam ; Structure: 1=weak, 2=moderate , f=fine, m=medium, co=coarse , gr=granular, sbk=sub-angular blocky ;Consistence: s=slightly , v=very , ex= extremely
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| Wadi | profile No. | Depth (cm) | Gravels (%) | Particle size distribution (%) | Texture Class | pH 1:2.5 | EC (dSm) | CEC 100g soil | Esp | CaCO (%) | Gypsum (%) | OM (%) |
|------|-------------|------------|-------------|-------------------------------|---------------|----------|----------|----------------|-----|-----------|------------|--------|
|      |             |            |             | Sand | Silt | Clay |             |       |               |     |           |            |        |
| 1    | 0-25        | 9.20       | 72.25       | 23.14 | 4.61 | Sandy L. | 8.00 | 0.50 | 6.10 | 5.27 | 7.51 | 2.01 | 1.59 |
|      | 25-50       | 6.65       | 90.79       | 2.73 | 6.48 | Sandy | 8.03 | 0.41 | 4.30 | 5.30 | 7.53 | 2.24 | 1.01 |
|      | 50-70       | 10.30      | 78.01       | 8.50 | 13.49 | Sandy L. | 8.31 | 0.38 | 9.15 | 4.25 | 6.43 | 2.83 | 0.59 |
|      | 70-85       | 21.50      | 77.00       | 11.37 | 11.63 | Sandy L. | 8.90 | 0.49 | 7.10 | 4.46 | 5.95 | 2.54 | 0.49 |
|      | 85-125      | 11.40      | 80.86       | 1.58 | 17.56 | Sandy L. | 7.91 | 0.46 | 6.16 | 4.79 | 6.78 | 2.41 | 0.18 |
| W.P.M | 79.11      | 58.81      | 9.46 | 10.75 | Sandy L. | -- | -- | 6.56 | 4.81 | 6.84 | 2.41 | 0.77 |
| 2    | 0-30        | 24.00      | 78.00       | 03.33 | 18.67 | Sandy L. | 8.10 | 1.40 | 9.80 | 12.82 | 6.04 | 3.25 | 1.50 |
|      | 30-60       | 18.32      | 87.17       | 2.43 | 10.40 | L. Sand | 8.16 | 1.90 | 5.93 | 13.21 | 6.80 | 1.59 | 1.49 |
|      | 60-90       | 13.01      | 76.00       | 12.00 | 12.00 | Sandy L. | 8.36 | 1.20 | 10.01 | 14.40 | 6.42 | 2.78 | 0.89 |
|      | 90-130      | 23.35      | 82.67       | 9.00 | 8.33 | L. Sand | 8.11 | 1.18 | 6.51 | 11.25 | 12.59 | 2.40 | 0.38 |
|      | W.P.M       | 67.19      | 96.80       | 69.6 | 35.12 | Sandy L. | -- | -- | 8.06 | 12.92 | 7.96 | 2.51 | 0.71 |
| 3    | 0-25        | 44.01      | 48.90       | 44.80 | 6.30 | Sandy L. | 8.00 | 0.40 | 8.55 | 9.35 | 5.88 | 2.15 | 1.58 |
|      | 25-50       | 8.012      | 51.90       | 36.80 | 11.30 | Loam | 8.01 | 0.55 | 16.40 | 11.50 | 4.22 | 2.59 | 1.00 |
|      | 50-75       | 55.92      | 92.80       | 2.90 | 4.30 | Loam | 8.52 | 0.60 | 15.20 | 14.95 | 4.82 | 2.86 | 0.50 |
|      | 75-85       | 61.60      | 28.70       | 43.50 | 27.80 | Clay L. | 8.30 | 0.41 | 17.30 | 10.20 | 1.01 | 4.06 | 0.36 |
|      | 85-100      | 23.65      | 31.20       | 31.60 | 37.20 | Clay L. | 8.45 | 2.00 | 21.70 | 10.50 | 1.13 | 4.89 | 0.38 |
|      | 100-125     | 24.44      | 32.00       | 30.10 | 37.90 | Clay L. | 8.56 | 1.95 | 22.00 | 11.45 | 1.19 | 4.95 | 0.29 |
|      | W.P.M       | 27.36      | 47.58       | 31.62 | 20.80 | Loam | -- | -- | 16.89 | 11.30 | 3.04 | 3.58 | 5.40 |
| 4    | 0-30        | 13.22      | 78.00       | 4.00 | 18.00 | Sandy L. | 8.06 | 1.22 | 11.58 | 8.93 | 4.20 | 1.74 | 2.50 |
|      | 30-60       | 29.00      | 86.00       | 6.00 | 8.00 | L. Sand | 8.15 | 1.50 | 8.30 | 8.90 | 5.06 | 2.09 | 2.00 |
|      | 60-90       | 13.98      | 66.67       | 18.00 | 15.33 | Sandy L. | 8.36 | 1.30 | 12.78 | 10.22 | 8.42 | 2.95 | 1.01 |
|      | 90-130      | 25.00      | 74.67       | 14.66 | 10.67 | Sandy L. | 7.79 | 1.76 | 8.89 | 9.01 | 7.80 | 2.67 | 0.49 |
|      | W.P.M       | 30.20      | 76.34       | 10.66 | 13.00 | Sandy L. | -- | -- | 10.39 | 9.27 | 6.37 | 2.39 | 50.1 |

w.p.m = whited profile mean
Land Evaluation:
Evaluating and classifying the soil according to its agricultural productivity is essential to narrow the gap between food production and consumption.

Evaluation of land capability:
Quantitative estimation of soil characteristics, namely slope, soil profile depth, drainage, erosion, texture, CaCO₃, gypsum, salinity and sodicity, were used for evaluating land capability index according to Sys et al., (13). The mapping units were placed into grades according to their calculated capability indexes Table. (3).

| Grade | Soils              | Rate         |
|-------|--------------------|--------------|
| I     | Excellent soils    | 100-80%      |
| II    | Good soils         | 79-60%       |
| III   | Fair soils         | 59-40%       |
| IV    | Poor soils         | 39-20%       |
| V     | Very poor soils    | 19-10%       |
| VI    | Nonagricultural soils | Less than 10% |

Table (4) shows the values that were used as a guide in rating the studied soils according to Sys et al (11). The ratings of soil characteristics, capability indexes and soil grades calculated for the mapping units are presented in Table. (5) and Fig. (6).
### Table (4): Soil properties rating.

| Factor | Soil properties | Rating % |
|--------|-----------------|----------|
| A      | Availability and quality of irrigation water |          |
|        | Pure irrigation water | 100      |
|        | Mixed irrigation with drains water 1000 ppm | 90       |
| B      | Soil Texture |          |
|        | L., Si.L., S.C.L., S.L., SiC.L., C.L. | 100      |
|        | Si. | 95-90 |
|        | L.S., S.C. | 85-80 |
|        | F.S., M.S., Si.C., C. | 75-60 |
|        | C.S. | 55-40 |
|        | Slight. Gr. | 80 |
|        | Gravelly | 70 |
|        | Very gr. | 60 |
|        | L., Si.L., C.L. | 70 |
|        | S.L. | 60 |
|        | L.S. | 50 |
|        | S | 50 |
|        | C | 40 |
| C      | Soil profile depth (cm) |          |
|        | > 120 | 100 |
|        | 120-90 | 100-90 |
|        | 90-60 | 90-70 |
|        | 60-30 | 70-40 |
|        | < 30 | < 40 |
| D      | Wetness (drainage conditions) |          |
|        | Well drained | 100 |
|        | Moderately drained | 95-85 |
|        | Imperfectly drained | 85-75 |
|        | Poorly drained | 75-45 |
|        | Very poorly drained | 45-25 |
| E      | Salinity level (EC dS/m) |          |
|        | < 4 | 100 |
|        | 4-8 | 95-85 |
|        | 8-16 | 85-45 |
|        | > 16 | < 45 |
### Table (4): Cont.

| Factor | Soil properties   | Rating % |
|--------|-------------------|----------|
| **F**  | Sodicity (ESP)    |          |
| < 10   |                   | 100      |
| 10-15  |                   | 95-85    |
| 15-30  |                   | 95-75    |
| 30-50  |                   | 75-55    |
| > 50   |                   | < 55     |
| **G**  | Carbonate as CaCO3 content % |        |
| < 5    |                   | 100      |
| 5-10   |                   | 95-90    |
| 10-20  |                   | 90-75    |
| 20-50  |                   | 75-40    |
| > 50   |                   | < 40     |
| **H**  | Gypsum (CaSO\(_4\)-2H\(_2\)O) content % |    |
| < 3    |                   | 95       |
| 3-10   |                   | 100      |
| 10-15  |                   | 95       |
| 15-25  |                   | 75       |
| **I**  | Slope %           |          |
| Flat or Almost flat | 0-20%    | 100      |
| Undulating | (2-8%)   | 95-90    |
| Rolling  | (8-16%)       | 90-85    |
| Hilly    | (16-30%)      | 95-70    |
| Steep    | (20-45%)      | 70-35    |
| Very steep | (> 45%)    | < 35     |
| **J**  | Erosion          |          |
| Wind erosion : |         |          |
| Non     |                   | 100      |
| Slightly |                 | 95-90    |
| Moderately |             | 90-75    |
| Severe  |                   | 75-20    |
| Water erosion : |       |          |
| Non     |                   | 100      |
| Slightly |                 | 95-90    |
| Moderately |             | 90-75    |
| Severe  |                   | 75-40    |
| Very severe |           | 40-10    |
The calculated soil capability index in Table. (5) reveals that the investigated soils can be classified into the following grades, Fig. (6).

![Capability Map](image)

**Fig. (6): Capability grades of the mapping units at the studied area.**

Conventional methods of land evaluation assume that soil characteristics are homogenous within the land unit and hence it gives a suitability map of discrete value which does not represent the real situation. Therefore, there is a need to develop a method that takes the spatial variability of soil properties into account Fig. (7).

The evaluation of agricultural sustainability status helps in identifying specific indicators that constrain the achievement of sustainable agriculture.
Land Sustainable Spatial Model (LSSM)

LSSM was built according to ESRI (4) as follows: File geo-database was created. Spatial model for environment settings was specified. A series of values for input criteria was calculated resulting in five datasets. Each derived dataset was reclassified to a common measurement scale, giving each range a discrete and integer value between 1 and 4. Higher values were given to attributes within each dataset that are more suitable for sustainability classes. Conditional expressions were used to get sustainability raster classes. Datasets were weighed through setting equal influence with different scale values. Sustainability raster classes were converted into sustainability polygons in the geo-database and Sustainability layers, then, were created. Four suitability classes were selected by attribute (values). Hence, the final layers that represent sustainability classes (I, II, III and N) were resulted Fig. (8).

Model verification

However, quantitative assessment was executed for SLMSM, it is very important to identify and measure the map errors derived from the model. In this assessments, map data were compared with ground truth data obtained from two sources: 1-from field measurements & observations on farming system level and 2-from laboratory analyses that assumed to be 100% correct. The overall accuracy assessment of thematic maps recorded 98.34%.
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Fig. (8): Land suitability spatial modeling Chart
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- **Grade II**: (Good). These soils have slight limitations and their rates ranges from 60.0 to 79.000. They include mainly some locations represented by profiles No's 3 with capability index. They have mainly a slight limitation intensity of soil texture, sometimes erosion and both total carbonate and gypsum contents.

- **Grade III**: (Fair). These soils are affected by moderate limitations and have capability rates between 40.0 and 59.0%. They include some locations represented by soil profiles No's 1, 2 and 4. They have mainly a slight limitation intensity of, sometimes, erosion, irrigation water and ESP, and both carbonate and gypsum for all soils where profiles belonging to grade III. Also, they have moderate limitation intensity of soil texture.

### Evaluation of soil suitability for growing main crops:

Studied soil profiles were evaluated to determine their suitability for growing 15 field crops, vegetable and fruits according to Sys et al., (12). The soil parameters used for estimating suitability index (Si) for the different crops were defined through matching climate condition, slope, soil profile depth, drainage, gravels, texture, CaCo3, gypsum, salinity, alkalinity and soil fertility (PH, CEC and O.M) with crop requirements. Land suitability classes are defined according to the value of the suitability index (Si) as follow:

**Table (6) : Land suitability classes**

| Symbols | Suitability classes | Soil index (Si) |
|---------|---------------------|-----------------|
| S1      | Very suitable       | 100-75          |
| S2      | Moderate suitable   | 74-50           |
| S3      | Marginally suitable | <25             |

Suitability indexes and classes were estimated in the mapping units for the major field crops, vegetable and fruits which are shown in Table. (7) and represented in Figs. (9-11).

### Suitability class of Al-Gabbanah Soils:

Data in Table (7) that illustrated in Figs. (9-11) shows that the soils of this valley represented by profiles No's 1,2,3and 4 are very suitable S1 and/or moderate suitable (S2) for growing sorghum, potato and figs from field crops. Also, the soils are disparately suitable from S1 to S for growing vegetable and fruit crops. The suitability classes differ from site to another according to their parameters variations. From vegetables and from fruits at all sites of this valley are unsuitable. Also, it is considered as unsuitable at some sites.

**Table (7) : Suitability index (Si) for Al-Gabbanah valey**

| Studied basin | Prof. No. | Suitability indices for different crops |
|---------------|-----------|----------------------------------------|
|               |           | Field crops | Vegetables | Fruits |
|               |           | Crop | Si | Class | Crop | Si | Class | Crop | Si | Class |
| Al-Gabbanah   | 1         | Sorghum | 75 | S1    | Potato | 58 | S2    | Fig  | 58 | S2    |
|               | 2         | Sorghum | 68 | S2    | Potato | 75 | S1    | Fig  | 65 | S2    |
|               | 3         | Sorghum | 68 | S2    | Potato | 62 | S2    | Fig  | 60 | S2    |
|               | 4         | Sorghum | 79 | S1    | Potato | 81 | S1    | Fig  | 60 | S2    |
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Fig. (9): Suitability classes for Sorghum in the studied area

Fig. (10): Suitability classes for Potato in the studied area

Fig. (11): Suitability classes for fig in the studied area
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Tقييم قدرة إنتاجية الأرض وملاءمتها لنمو بعض المحاصيل باستخدام موديل LSSM

في وادي الجبانة، محافظة إب، اليمن
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الملخص

أجريت هذه الدراسة في وادي الجبانة، محافظة إب، مديرية المخادر، الجمهورية اليمنية، والذي يبعد حوالي 15 كم عن مدينة إب. وهدفت هذه الدراسة لمعرفة قدرة إنتاجية الأرض وملاءمتها لنمو بعض المحاصيل الزراعية (الحقلية، الخضروات والفواكه) وهي الذرة الرفيعة، البطاطس والتين. تم تقسيم منطقة الدراسة حسب قدرتها الإنتاجية تبعاً لـ Sys et al.1991 الاستخدام موديل رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي رقمي عن دائرة الدراسة: قدرة إنتاجية الأرض، مدى الملاءمة لنمو المحاصيل، الذرة الرفيعة، البطاطس، التين، مديرية إب، اليمن.