Investigating the process of landuse agriculture changes in Dasht–e- Akbar region via artificial neural network and satellite images

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ABSTRACT: The map of land use and coverage in which the spatial type and model, also the way of land using have been clarified, is one of the important devices in outcoming landuse plannings. Nowadays, the satellite images and remote sensing techniques, due to delivering in time data and their high capability of analysis, have plenty of applications in many fields specially agriculture, natural resources and in providing landuse maps as the base maps in land planning. In the present study, there has been used Landsat satellite images dated back to years 1985, 2000 and 2013. After geometric & radiometric corrections and final processing, was prepared the classifying map in five classes via the classifying method of art map fuzzy artificial neural network. The results obtaind in this study show that in this period of 22 years, the area of farmlands has been developed with the rate of %28.5 while the area of ranges has been decreased with the rate of %21.55. Also, the accuracy of plant coverage maps resulted from satellite data classification via algorithm neural network has been equal to %91, %92 & %89 respectively for Landsat images 1985, 2000 and 2013. This indicates the high accuracy of this algorithm in satellite data classification.

Keywords: Agriculture, Landsat, art map fuzzy, Dashte–e- Akbar, Dehloran.

INTRODUCTION

Land use is a description for the kind of human beneficitation from a piece of a land for one or more purpuses. From the old times, knowledgeability of the kind and the rate of farm & garden land uses, also the potential capability of cultivating each farm land have been in great importance in supplying human food and agricultural plannings. Remote sensing and the technology of Geographical Information System (GIS) is one of super and useful technologies in investigating the environmental changes and resource management which provides updated information for management goals (Feyzi zadeh & Haji mir rahimi, 1387: 15). The remote sensing images with high spatial resolution are in great use in precise agriculturing. Providing wide and & integrated view of a region, repeatability, easy accessibility and high accuracy of information together with time saving are among the characteristics of this technology (Mokhtari et al, 2000:82 & Huete, 2004:208). Thanks to the high efficiency of this technology in agriculturing, there has become possible the derivation of landuse maps and estimation of the area under cultivation for farming and gardening products via remote sensing data. In the recent years, applying remote sensing technology and GIS in agricultural studies, also preparing thematic maps, have been increasingly developed (Feizizade and Haji Myrrhymy, 2008: 15). Preparing land use & coverage maps are the basic necessity for environmental management & supervision. These maps are employed in plannings and decision makings in different sectors. The study of under cultivation areas via available satellite data and preparing the map of under cultivation lands each year can help the government in optimal management of these lands and planning for crops distribution (Khalfi & Davarpanah, 2008). Meanwhile, applying remote sensing techniques plays a significant role in obtaining in time data (Howarth & Wichware, 1981:277; Jensen & Toll, 1982: 629; Maxwel et al, 2003: 3). On this
basis, many researchers benefitize the remote sensing data for investigating the plant coverage and evaluate it as a proper technology for the studies of these kinds.

Nagamani & Ramachandran (2003) prepared the land use & coverage map of Pondicherry area via satellite images & GIS and concluded that the remote sensing data is provided with a unique capability for derevating landuses and detection of changes. Wardlow et al (2007), investigated the time process of vegetation indexes to classify big farms of alfalfa, corn, soya & wheat via MODIS image with resolution of 250m and categorized different classes via different time process of EVI & NDVI indexes. Their obtained results showed that the segregation of cereals is more salient in time period of their maturity than their growing time. Sawasawa (2003), estimated the under cultivation areas of agricultural products, like rice, by compiling remote sensing & GIS with management parameters. In this study, were analyzed and explained the satellite data via using IRS images with spatial resolution of 23m and Panchromatic images of the above mentioned satellite with spatial resolution of 6m and also time range images of spot satellite. in Nezam Abad, a region located in Andhra Pradesh in India, were estimated the area under cultivation of rice via field data gathering, different maps of the related region, applying management parameters and also concerning the products phonologic steps and using plant indexes like NDVA. Salimi and Kazemi (2008) calculated the the area under cultivation of rice via two time range of LISS images of IRS –PS satellite by using maximum probability algorithm and NDVI & SAVI indexes. Khajeddin et al (2007) used the digital data of IRS-ID satellite to determine the the area under cultivation of rice in Esfahan. They did it via the methods of maximum probability & minimum difference from the average and also water index of the area under cultivation. The aim of this paper is to investigate the changes and developments of Agriculture in Dashte Akbar, a region in Dehloran, via remote sensing and GIS techniques and also using remote sensing data including Landsat satellite images related to a time period of 22 years.

MATERIALS AND METHODS

The position of the area of study

Dehloran desert region with 46 ° 23' 59" to 47 ° 11 44" eastern longitude and 23 ° 29' 32" to 32 ° 25' 25" northern latitude, has been extended from south to southeast of Ilam (Figure 1). Based on investigations carried out by meteorology organization, this region, with respect to Kopen climate classification, is classified as a xeric one with warm summers. Based on metrological reports, the mean precipitation is 264.4 mm; the annual mean vaporization is 3553 (mm) the pan, and 3117 (mm) the free surface, the annual mean temperature is 31.4 centigrade (Shahriari et al, 2010). The area of the region under study has been estimated as 55986.6 ha.

![Figure 1. The map of country and province position of the region under study](image)

Used data & data analysis
In this research, have been used Landsat(TM) satellite images dated 1985, 2000 and 2013, aerial photos in scale of 1:20000 and land use map(taken from agricultural ministry) in scale of 1:2500000.

After providing satellite data, were carried out geometric matching operations and image coordinating via Vectory map of route networks and aerial photos in order to prepare data for processing and deriving useful information. Resampling operation was done via nearest neighbor interpolation method and all used bands were geometrically matched via the above method. Spectral correction of the images was done with the aim of manifesting the phenomena, promoting the quality of images and eliminating the unfavourable effects of light and atomospher. Afterwards, via inter band correlation method, the False-Color combination was created for years 1985, 2000 and 2013, also was carried out supervised classification of artmap fuzzy neural network. With respect to the the goals of the research and the coverage types of the region, were identified and classified five classes including farmlands, Fair rangeland, poor rangeland, residential area & salty lands. A comparison with the available landuse maps together with field observations were done to ensure about the accuracy of classification. To do that, the base map (the map of land realities), covering the whole area, was prepared via the help of other methods like field observation method. The above mentioned map was prepared for about %96 of the whole area (Tables 1 & 2).

In this research, random sampling method was used for data classification. With respect to the landuse map and local surveys of the area under study, the samples were recorded randomly from each group of plant coverages or landuses via GPS of some polygons. In order to ensure about the accuracy of image classification, the trial samples were used and mesures were taken to calculate the rate of accuracy via error matrix, and moreover to calculate statistic parameters of the overal accuracy, Kappa coefficient, producer's and user's accuracies the results of which have been figured out in table 2. Then, the majority filter was applied to obtain fine images and eliminate scattered pixels on the classified images. The outcomes of the classification have been given in figures 3 & 4.

Table 1. The area of land realities

<table>
<thead>
<tr>
<th>Land class</th>
<th>Area (ha)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>224.55</td>
<td>0.4</td>
</tr>
<tr>
<td>Fair rangeland</td>
<td>74.33</td>
<td>0.13</td>
</tr>
<tr>
<td>Poor rangeland</td>
<td>148.41</td>
<td>0.26</td>
</tr>
<tr>
<td>Residential area</td>
<td>30.42</td>
<td>0.05</td>
</tr>
<tr>
<td>Salty lands</td>
<td>68.04</td>
<td>0.12</td>
</tr>
<tr>
<td>total</td>
<td>546.75</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Figure 2. The map of land realities in the area of study on the map of False-color combination (RGB)

**Image classification**

Satellite data classification refers to separation of the same spectoral sets and their classification concerning the same spectoral behaviors. In other words, classification of image pixels and categorizing each pixel into a special
class is called satellite data classification (Alavi Panah, 2005:478). In this classification, pixels with the same values are categorized into the same group. The above classification can be done with or without supervision. In the supervised form, the trial samples are employed for pixel categorization i.e. by defining the specific pixels from the image for each class, the issue of classification is carried out in form of the considered classes. In this study, random sampling method has been employed for data classification. With respect to the local surveys of the area under study, the samples were recorded optionally from each group of landuses via GPS of some polygon. In the selection of the trial samples, it was all tried that they be proper definer of their classes and have got proper distribution too. Concerning the field survey and studying areal photos, it was found out that the year three image sets were used, there have exist five identified classes of Agriculture, Fair rangeland, poor rangeland, residential area and salty lands. In the present study, there have been used artmap fuzzy artificial neural network in preparation of plant coverage map.

ARTMAP FUZZY ARTIFICIAL NEURAL NETWORK METHOD

The theory of fuzzy sets was first introduced by professor Askarzadeh (1965). This theory has been now developed more and applied in different fields. To sum up, the theory of fuzzy sets is a hypothesis for operation in misgiving conditions. It is capable of mathematizing so many variables, concepts and inaccurate systems and paves the ground for argumentation, deduction, control and decision making in misgiving conditions (Ranjbar & Honarmand, 2004: 4729).

Artmap fuzzy artificial neural network has been built upon adaptive resonance theory. The structure of the networks reliant on adaptive resonance theory has been known as artmaps (Carpenter et al, 1991). Each ARTMAP system consists of two modules (ARTa, ARTb) that are created recognition categories in response to arbitrary sequences of input patterns.

These two modules are linked Encapsulation of an interface module called Mapped region (Fab). ARTMAP binary is used ART1 system as the modulus of ARTa and ARTb while Uses for this purpose, Fuzzy ART of fuzzy ARTMAP systems, Thus, for example, " operator (Æ) is replaced with fuzzy AND operator (Zadeh, 1965). However, we will continue to investigate the development of theoretical methods, Fuzzy ARTMAP:

Definition 1 - Vectors of activity: ART system consists of three layers, F1 and F2. Nodes indicate the current input vector to form Layer. F1 layer is received to the bottom layer inputs of themselves and the top layer of themselves (F2) that is displayed Activity vector with and normal components li. And are displayed F1 activity vector with and F2 activity vector with.

Definition 2 - vector of weights: For each node determines the category in F2 layer, as long-term memory there is weight vector.

Definition 3 - Parameters: in Fuzzy ART network are considered. Parameters of Choice (α > 0), learning rate (β ∈ [0,1]) and care (ρ ∈ [0,1])

Definition 4 - Select a Category: For each input I and node j in F2 layer, selection function Tj is defined as according to equation (1):

\[ T_j = \frac{|I \Lambda w_j|}{a + |w_j|} \]

1

The operator are defined as such software \(0\): \(\Lambda\)

\[ |p| = \sum_{i=1}^{M} |p_i| \]

2

\[ (p \Lambda q)_i = \min(p_i, q_i) \]

3

Selected class is defined by J:

\[ T_j = \max \{T_j : j = 1 \ldots N \} \]

4
In this conditions \( y_1 = 1 \) and \( j \neq 1 \); \( y_j = 0 \), The F1 activity vector follows equation (5)

\[
x = \begin{cases} 
1 & \text{if f2 be disabled;} \\
I & \text{if J neurons be selected f2 layer} \\
I \wedge w_j & \text{Definition 5- Resonance or reset: if the following condition is satisfied, When occurs resonance:}
\end{cases}
\]

\[
|I \wedge w_j| \geq \rho
\]

(6)

It is evident that Otherwise the condition Command reset Demonstrates a mismatch Issued and New profile Instead of J choosing Search Continues for a group by condition (5) must meet.

Definition 6 - learning: Upon completion of the search process, the weight vector \( w_J \) is revised according to equation (7):

\[
w_j^{\text{(new)}} = \beta (I \wedge w_j^{\text{(old)}}) + (1 - \beta)w_j^{\text{(old)}}
\]

(7)

Input ARTa and ARTb in network of Fuzzy ARTMAP are as complementary codes, Output vectors \( F_1^a \) and \( F_2^a \) respectively, and \( y_a \) and \( y_a \) are represented. The same notation is also considered to RTb. Mapping of the area \( a \) indicates that the output vector \( F_a^a \) and \( F_a^b \) is represented weight vector of the \( j \)-th node \( F_a^b \) to \( F_a^a \).

Definition 7- Mapping of the area: If one of the categories ARTa and ARTb active Then \( F_a^b \) will be activated. If both ARTa and ARTb are active, If ARTa to render that ARTb predicted the same batch, this \( F_a^b \) will enable.

Output vector is determined by of equation (8):

\[
x^{\text{ab}} = \begin{cases} 
y_j^{\text{ab}} & \text{J-th node } F_a^b \text{ is active and } F_b^b \text{ enabled} \\
w_j^{\text{ab}} & \text{J-th node } F_a^b \text{ is active and } F_b^b \text{ is Inactive.} \\
y_j^{\text{b}} & \text{F}_2^b \text{ Inactive and } F_2^b \text{ active} \\
0 & \text{else}
\end{cases}
\]

Table 2. Structure and Architecture Neural network of Rtmp Fuzzy show for classification of area

<table>
<thead>
<tr>
<th>Year</th>
<th>F1 layer neurons</th>
<th>F2 layer neurons</th>
<th>Interations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>12</td>
<td>3137</td>
<td>25524</td>
</tr>
<tr>
<td>2000</td>
<td>12</td>
<td>5148</td>
<td>34388</td>
</tr>
<tr>
<td>2013</td>
<td>12</td>
<td>3991</td>
<td>39520</td>
</tr>
</tbody>
</table>

Accuracy assessment

Accuracy assessment is significant in understanding the obtained results and applying them in substantial decision makings. The most common accuracy assessment parameters are as follows: overall accuracy, producer's accuracy, user's Accuracy & Kappa coefficient (Lu et al, 2004).

Kappa coefficient is one one of the characteristics of the accuracy which is derivated from error matrix. The valu of Kappa can indicate the accuracy of the classification comparing with a tatally random one (like the unsupervised classification in which the images are classified randomly). This can be paraphrased as follows: after the elimination of chance in classification, will be calculated the rate of accordance with land reality (Equation 5) (Richards and Jia, 2006).
In which \( K \) is the total pixels in land reality, \( X_{i+} \) is the sum of ingredients in \( i^{th} \) row and \( X_{+i} \) is the sum of ingredients in \( i^{th} \) column. Hence, a Kappa value equals 0.8 means that the results of classification are better to the rate of 80% than the state in which the pixels are labeled randomly. A Kappa value equals 0 means that the classification has been done all randomly.

In view of probability theory, the overall accuracy cannot be a proper criterion for assessment of classification results. The reason is that in this index the role of chance is considerable. The overall accuracy is calculated by dividing the sum of main diameter ingredients of the error matrix on the total number of pixels in the following equation 6 (Alavi panah, 2005).

\[
OA = \frac{1}{N} \sum_{ij} P_{ij}
\]

In this equation:
\( OA \)= overall accuracy
\( N \)= number of trial pixels
\( \sum P_{ij} \)= sum of main diameter ingredients of the error matrix

Due to the deficiencies of the overall accuracy, there will often be used Kappa index in executive operations in which the comparison of classification accuracy is concerned. Kappa index is capable of recognizing wrongly classified pixels. It is calculated from the following equation 7 (Bonyad & Haji Qadri, 2007).

\[
Kappa = \frac{P_o - P_e}{1 - P_e} \times 100
\]

In the above equation:
\( P_o \)= observed accuracy
\( P_e \)= expected accordance

Producer’s accuracy is the probability for a pixel in the classified image to be located in the same class on the ground. The user’s accuracy, on the other hand, is the probability for a specific pixel on the ground to be located in the same class on the classified image. They can be calculated in the following equations 8 and 9 (Bonyad & Haji Qadri, 2007):

\[
PA = \frac{Ta}{Ga} \times 100
\]
\[
UA = \frac{Ta}{n_1} \times 100
\]

In the above equations:
\( PA \)= the rate of class “a” accuracy for producer’s accuracy
\( Ta \)= the number of truly classified pixels as class “a”
\( Ga \)= the number of class “a” pixels in land reality
\( UA \)= the rate of class “a” accuracy for user’s accuracy
\( n_1 \)= the number of class “a” pixels in the classification result

In this study, has been used Google Earth software, areal photos in scale of 1:20000 and the experts’ views to indicate the points in land reality based on field surveys.

RESULTS

For the classification of satellite images (1985, 2000 and 2013), were classified the landuses into five classes of Agriculture, mean rangr, poor rangeland, residential area and salty land. Then, the trial samples of the area were collected via Google earth satellite images and field surveys. In the next step, the landuse classes were entered
into the confines of the area of study. After determining the classes, were done the classification via artmap fuzzy artificial neural network based on which the landuse maps of the related years were prepared (Figures 3-5).

Figure 3. The landuse of the year 1985

Figure 4. The landuse of the year 2000
In the next step, were taken 250 samples from the area of study via field operations, areal photos in scale of 1:20000, Google earth satellite images and random sampling as well (Figure 6). Then the following statistic parameters were obtained: error matrix (Errors of Omission and Errors of Commission), producer's accuracy, user's accuracy, overall accuracy & Kappa coefficient (Tables 3-5 & Figures 7-9).

Some significant results were obtained by analyzing the results of tables & figures: first, it was observed that the farm land class has been classified with producer's & user's accuracy rate above %95 (for all three years). When are analyzed carefully the results of estimated tables and forms; Several basic conclusions can be drawn: Firstly, it was observed that the production and use of high grade agricultural land with an accuracy of 95% (for three years) and accuracy using over 90% Is classified. A class of agricultural land and saline land (for three years)
This indicates the high capability of spectral resolution for these classes. Second, based on the obtained results, it was observed that the producer’s accuracy has been in its minimum rate for class of residential area. This class has been classified with producer’s accuracy rate equal to %79.32 for year 1985; whereas the producer’s accuracy rate shows higher values (above %90) for years 2013 and 2000. It was also observed that the minimum rate of user’s accuracy has been related to class of residential area. This class has been classified with user’s accuracy rate equal to %79.32 for year 1985.

Table 4. Error matrix of image classification (1985) - Art map Fuzzy

<table>
<thead>
<tr>
<th>class</th>
<th>Agriculture</th>
<th>Fair rangeland</th>
<th>Poor rangeland</th>
<th>Residential area</th>
<th>Salty lands</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>6208</td>
<td>46</td>
<td>205</td>
<td>0</td>
<td>10</td>
<td>6469</td>
</tr>
<tr>
<td>Fair rangeland</td>
<td>52</td>
<td>6512</td>
<td>14</td>
<td>0</td>
<td>1</td>
<td>6583</td>
</tr>
<tr>
<td>Poor lands</td>
<td>159</td>
<td>20</td>
<td>10730</td>
<td>17</td>
<td>13</td>
<td>10939</td>
</tr>
<tr>
<td>Residential area</td>
<td>1</td>
<td>0</td>
<td>26</td>
<td>81</td>
<td>4</td>
<td>112</td>
</tr>
<tr>
<td>Salty lands</td>
<td>8</td>
<td>6</td>
<td>19</td>
<td>4</td>
<td>1384</td>
<td>1421</td>
</tr>
<tr>
<td>total</td>
<td>6469</td>
<td>6588</td>
<td>10994</td>
<td>102</td>
<td>1412</td>
<td>25524</td>
</tr>
</tbody>
</table>

Table 5. Error matrix of image classification (2000) - Art map Fuzzy

<table>
<thead>
<tr>
<th>class</th>
<th>Agriculture</th>
<th>Fair rangeland</th>
<th>Poor rangeland</th>
<th>Residential area</th>
<th>Salty lands</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>16349</td>
<td>49</td>
<td>316</td>
<td>11</td>
<td>13</td>
<td>16738</td>
</tr>
<tr>
<td>Fair rangeland</td>
<td>78</td>
<td>2717</td>
<td>227</td>
<td>0</td>
<td>2</td>
<td>3024</td>
</tr>
<tr>
<td>Poor lands</td>
<td>305</td>
<td>186</td>
<td>11914</td>
<td>7</td>
<td>63</td>
<td>12475</td>
</tr>
<tr>
<td>Residential area</td>
<td>1</td>
<td>0</td>
<td>13</td>
<td>399</td>
<td>18</td>
<td>430</td>
</tr>
<tr>
<td>Salty lands</td>
<td>11</td>
<td>1</td>
<td>135</td>
<td>11</td>
<td>111563</td>
<td>1721</td>
</tr>
<tr>
<td>total</td>
<td>1659</td>
<td>428</td>
<td>12605</td>
<td>2953</td>
<td>16743</td>
<td>34388</td>
</tr>
</tbody>
</table>

Table 6. Error matrix of image classification (2013) - Art map Fuzzy

<table>
<thead>
<tr>
<th>class</th>
<th>Agriculture</th>
<th>Fair rangeland</th>
<th>Poor rangeland</th>
<th>Residential area</th>
<th>Salty lands</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>23723</td>
<td>0</td>
<td>0</td>
<td>81</td>
<td>0</td>
<td>23728</td>
</tr>
<tr>
<td>Fair rangeland</td>
<td>17</td>
<td>1</td>
<td>29</td>
<td>0</td>
<td>0</td>
<td>2448</td>
</tr>
<tr>
<td>Poor lands</td>
<td>550</td>
<td>48</td>
<td>11611</td>
<td>21</td>
<td>65</td>
<td>12295</td>
</tr>
<tr>
<td>Residential area</td>
<td>0</td>
<td>0</td>
<td>818</td>
<td>25</td>
<td>25</td>
<td>943</td>
</tr>
<tr>
<td>Salty lands</td>
<td>12</td>
<td>6</td>
<td>1350</td>
<td>842</td>
<td>2194</td>
<td>39520</td>
</tr>
<tr>
<td>total</td>
<td>22334</td>
<td>2115</td>
<td>11903</td>
<td>842</td>
<td>2284</td>
<td>39520</td>
</tr>
</tbody>
</table>

Figure 7. User’s accuracy used in the related years
Overall accuracy and Kappa coefficient are employed for investigation on the accuracy of produced maps. The analysis, given in figure 9, shows that the accuracy of plant coverage maps resulted from classification of satellite data via algorithm of attmap fuzzy artificial neural network, have been equal to %91, %92% and %89 for TM image (1985) and ETM* images (2000 and 2013) respectively. This shows the high accuracy of the related algorithm in satellite data classification.

The analogy of classification

After preparing land use/coverage map of years 1985, 2000 and 2013, the areas of five landuses were calculated. Table 7 & figure 10 show the analogy of changes in these three eras. Through the time period from 1985 to 2000, Agriculture, residential area and salty lands have been developed with rates of 9555.58 ha, 149.3 ha & 262.46 ha (%17.06, %0.26 & %0.47) respectively; whereas mean and poor rangelands have been decreased to 8861.21 ha & 1106.13 ha (%15.82 & %1.98) respectively. In other words, it can be concluded that in this period of 15 years, the most distinguished changes have occurred onto Agriculture and Fair rangeland. It means that the Fair rangeland has been decreased to less than half in 2000, from %30.07 in 1985 to %14.88. On the other hand, Agriculture have been developed from %11.46 in 1985 to %28.53 in 2000, about 3 times developing. Other landuses have been developed with smaller rates as well.

The results of changes from 2000 to 2013 show that Agriculture have been developed with rates of 6397.02 ha; whereas mean and poor rangelands have been decreased to 3208.33 ha & 3544.64 ha respectively. In other words, it can be concluded that in this period of 7 years, the most distinguished changes have occurred onto Agriculture and Fair rangeland and poor rangeland. It means that the Fair rangeland and poor rangeland have been decreased to from %14.88 & %52.99 in 2000 to %09.15 & %46.58 in 2013 respectively (Fair rangeland has been decreased to less than half). On the other hand, Agriculture has been developed from area 15972.86 ha in 2000 to 22370.06 ha in 2000, about 1.5 times developing. Other landuses have been developed with the same rates as in 1985 to 2000. The results of changes from 2000 to 2013 show that Agriculture have been developed.

The process of changes in landuses is indicator of the whole destruction process in the area of study by
substitution of Agriculture, residential area and salty lands in place of mean and poor rangelands. Decrease in the area of Fair rangeland and increase in the area of other landuses, indicates the whole destruction by substitution of weaker landuses. On the other hand, through this period of time, Agriculture and residential area have been developed the sign of which shows the increase of population and human pressure on the area of study. On the whole, all can be observed, is destruction and substitution of Agriculture, residential area and salty lands in place of mean and poor rangelands.

Table 7. The areas of different landuse classes and their change process in 1985, 2000 & 2007

<table>
<thead>
<tr>
<th>class</th>
<th>1985 Area (ha)</th>
<th>Percentage (%)</th>
<th>2000 Area (ha)</th>
<th>Percentage (%)</th>
<th>1985-2000 Difference (%)</th>
<th>2013 Area (ha)</th>
<th>Percentage (%)</th>
<th>2000-013 Difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>6417.28</td>
<td>11.46</td>
<td>15972.86</td>
<td>28.53</td>
<td>+17.07</td>
<td>22370.06</td>
<td>39.96</td>
<td>+11.43</td>
</tr>
<tr>
<td>Fair rangeland</td>
<td>17191.44</td>
<td>30.7</td>
<td>8330.23</td>
<td>14.88</td>
<td>-15.82</td>
<td>5122</td>
<td>9.15</td>
<td>-5.73</td>
</tr>
<tr>
<td>Poor lands</td>
<td>30733.56</td>
<td>54.9</td>
<td>29627.43</td>
<td>52.92</td>
<td>-1.98</td>
<td>26082.79</td>
<td>46.58</td>
<td>-6.34</td>
</tr>
<tr>
<td>Residential area</td>
<td>120.51</td>
<td>0.22</td>
<td>269.81</td>
<td>0.48</td>
<td>+0.26</td>
<td>409.95</td>
<td>0.73</td>
<td>+0.25</td>
</tr>
<tr>
<td>Salty lands</td>
<td>1523.79</td>
<td>2.72</td>
<td>1786.25</td>
<td>3.19</td>
<td>+0.47</td>
<td>2001.78</td>
<td>3.58</td>
<td>+0.39</td>
</tr>
<tr>
<td>total</td>
<td>55986.6</td>
<td>100</td>
<td>55986.6</td>
<td>100</td>
<td>0</td>
<td>55986.6</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 10. The areas of different landuse classes in 1985, 2000 & 2007

DISCUSSION AND CONCLUSION

In this study, were used Landsat images dated 1985, 2000 and 2013. First, the borders of the area under study were resoluted on the map. Then the data related to three image sets (in three time periods) were gone under initial processing and geometric corrections. In the next step, different classes were identified via digital processing methods like the analysis of main parameters, filtering and field surveys. The type and the nature of changes were determined then via classification analogy and other methods of detection. Landuse data of the past and loso present time can be derived through applying satellite images and be compiled with other map data as well. Via using classification analogy method and composing the resulted landuse maps in pairs, the change processes can be determined and the influence of landuse developments on the other landuses can be estimated as well. One of the goals of this study is to determine the type and the nature of land use/coverage changes. In this study, supervised classification method of artmap fuzzy artificial neural network has been used for landuse classification of Dashte – e – Akbar region (located in Dehloran County) in 1985, 2000 and 2013. In provided classification, which is usual in remote sensing, the trial points and the classification results are all based on one pixel – one class method. In fact one pixel should belong to only one class. A mixed class can not be considered as one class or a set of trial points because in such a class the membership rate in pixels is not clear. The fact is that in classic classification methods, the borders of trial regions change all of a sudden rather than gradually. These obvious limitations lead to undervaluation of classification and deriving poor data in the result of which some valuable data may be missed. This problem is due to the concept of membership in the theory of classic sets based on which each set has got borders and each member can belong completely or not to a specific set. The theory of fuzzy sets, the aim of which is to eliminate the ambiguity of data, is a new concept based on which the partial membership pave the way to expose and apply data better in more complicated conditions as in complex coverages or in intermedite conditions. Although the analysis of remote sensing images via fuzzy sets is a difficult
task, with respect to the fact that borders determination between two different classes is not an easy job, the theory of fuzzy sets can be applied qualitatively well (Safyanyan & Khodakarami, 2011). Unlike the usual methods of classification in which every trial region includes net materials with no gradual changes, in this method, homogeneity of trial points is not a necessity (ERDAS software guide, 2007). In this study, have been attained the same results as the ones some researchers have concluded in various regions. Examples are Borak and Strahler (1999); Sugumaran (2001); Lizarazo (2006); Safyanyan and KhodaKarami (2011); Niazi et al (2010) In a comparison between neural network method and other methods of classification, it was found out that this method enjoys higher classification accuracy. The results of the studies carried out by Sawasawa (2003) and Salimi et al (2009), also approve the capability and efficiency of satellite images in assessment of area under cultivation of Agriculture.

Based on the obtained results, the changes occurring in the area of study can be explained as follows: during 1985 to 2013 (22 years), the most distinguished positive change in Dashte-e-Akbar region has been considerable increase in farm land areas. In this period, the area of farm landuses has reached from 6417.28 ha in 1985 to 22370.06 ha in 2013 (an increase equal to %28.5). On the other hand, the most distinguished negative change has occurred onto Fair rangeland landuse. The area of this landuse has reduced from 17191.44 ha (%30.70) in 1985 to 5122 ha (9.15) in 2013 (a decrease equal to %21.55). These landuse changes and increase in farm land areas can be associated to increase of population and human pressure in the related region. The increase in farmland areas in this period of 22 years is due to increase of pumping water wells dugged in high number and used for irrigation of Agriculture. Besides, development of the area of dryland farms in the region is due to landuse changes and increases of the area of Agriculture in Dashte-e-Akbar. In this period of 22 years, mean and poor rangelands also have gone under change the negative changes of which can be associated to ruin of ranges & Vehicle plant coverage and dedicating them to farming instead. Developing of desertification due to the improper management of these lands is also another cause. Also, the accuracy of plant coverage maps resulted from satellite data classification via algorithm neural network has been equal to %91, %92 and %89 respectively for Landsat images in 1985 2000 and 2013. This indicates the high accuracy of this algorithm in satellite data classification.

GENERAL CONCLUSION

The results of this study showed that the satellite images are highly capable of segregating farming products, preparing landuse maps and determining the area under cultivation with proper accuracy in all over the region. Easy accessibility and high accuracy of information together with time saving and repeatability are among the characteristics of satellite data compared with other surveying methods. On the other hand satellite data can have extra applications in agriculturing like forecasting and estimating the rate of damage. Plant stress condition and Status drainage.

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