Evaluating of biophysical variables to identify suitable areas for rapeseed (*Brassica napus* L.) in Central and West South Iran by GIS approach

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Abstract

Rapeseed or canola (*Brassica napus* L.) is the most important industrial and new crops (alternative). Canola contains both high oil and protein. Rapeseed oil crop has recently been exploited to boost cultivation areas in Iran. Evaluation of biophysical variables is usually a first step in land use analysis. Geographic Information System (GIS) was used to identify suitable areas for rapeseed crop production in Central and West Iran. Relevant environment-components such as climate (weather parameters includes precipitation, temperature, day duration, humidity and etc), soil (chemical and physical characteristics includes texture, gravel percentage, pH, EC, soil depth and etc), and topography (DEM) at different spatial and temporal resolutions were considered. The results indicated that the most important variables affecting the growth of rapeseed crop were some of the climate and soil variables. Soil depth was the most important soil characteristics affecting on seed yield of rapeseed in Central and West Iran. This research provided information at regional level that could be used by farmers to select crop pattern and suitability. The results of maps this study by ILWIS $_{ver\ 3.2}$ identified with high suitable (S_1), suitable (S_2), moderate suitable (S_3) and not suitability (N) for rapeseed cultivation in lands of Isfahan and Chahr Mahal & Bakhtyairi.

Keywords: Rapeseed, Biophysical databases, GIS, Suitable area.

Introduction

The increase in the burgeoning population of the world and the shortage of the resources to meet the requirements for food has increased the need for oil and protein sources. The plants are the most important sources of oil and protein for humans and animals nutrition. There are over 350 species oil-producing plants and thousand of sub-species (Calisir *et al*., 2005).

Rapeseed and mustard are edible oil crops and new crops. Thesis species the largest source edible oil following soybean, sunflower, cotton seed and palm oil. Also, rapeseed and mustard are now the largest sources of biodiesel production in the world (Calisir *et al*., 2005). The Yellow flowering oil crop called canola in the United States and is know rapeseed in Europe (Calisir *et al*., 2005). Winter oilseed rape (*Brassica napus* L.) the most important of oilseeds. This species belong to the *Brassicaceae* or mustard family. Rapeseed contains both high oil and protein content on seed. Rapeseed oil crop has recently been exploited to boost cultivation areas in world. In most counties of Iran, the first record of rapeseed cultivation is from 1997 to 1998 with area of 2893 ha. In 2004-2005 years, this oilseed crop occupies about 119321 ha of agricultural lands of Iran with on average yield 2035 kg ha $^{-1}$. The cultivating area of winter rapeseed in Isfahan and Chahar Mahal & Bakhtyairi counties are 1626 and 347 ha and mean yield 2196 and 1185 kg ha $^{-1}$ on 2004-2005, respectively.

The potential of land for agricultural use is determined by an evaluation of the climate, soil, and topographical environmental components, and the understanding of local biophysical restraints. This evaluation is an essential step for the development of agriculture. It is necessary to assess the land suitability for rapeseed cultivation in the area by integrating various kinds of information with spatial analysis technique. The result of land suitability assessment presented in the form of map and report are meaningful to a local user.

Geographic Information System (GIS) has the ability to perform numerous tasks utilizing both spatial and attribute data. One of the most useful features of GIS is the ability to overlay different layers or maps.

Subjects of study

GIS can be effectively applied to handle such kinds of work and to complete study objectives, these are (1) to construct the geographical databases of land suitability for rapeseed (*Brassica napus* L.) sowing, (2) to assess land suitability for

rapeseed using Geographic Information System and (3) to select the possible lands for new rapeseed sowing in Central and West South.

Methods and Materials

One of the most important areas for rapeseed (*Brassica napus* L.) production in Iran is the Isfahan and Chahar Mahal & Bakhtyiari Counties. This area is located between latitude 30° 40' N and 33° 40' N and between longitude 49° 30' W and 51° 50' W (Central and West Iran). The elevations range between 1000 and 4500 masl. The natural vegetation is rangeland and oak forest Most of the area are used for rain-fed agriculture. The rapeseed crop was chosen in this investigation because has recently been exploited to boost cultivation areas in Isfahan and Chahar Mahal & Bakhtyiari provinces. Meteorological information was obtained from variation weather stations located within the study area and the surrounding zone. The number of years registered at the weather stations ranged from 5 to 35. Average values for each variable per 10-day calendar period were calculated and an interpolation procedure was applied in IDRISI. The minimum and maximum temperature maps were adjusted by a thermal gradient. This regional thermal gradient was generated by a regression model that took into account the elevation and temperature of weather stations located in Central and West Iran.

Physical soil characteristics were taken from a soil-sampling database from INIFAP (1994). Using these variables a textural-class map was created using a geometric method based on a textural triangle, which permits the identification of textural class per pixel of a raster map, according to the percentages of sand, silt, and clay (unpublished model result). The slope and elevation information were obtained from the Digital Elevation Model (DEM) using two well-known GIS software packages ILWIS (ITC, 1998) and IDRISI. This array was georeferenced using a metric UTM coordinate system and the geometric correction was carried out in the GIS ILWIS.

Results

The results indicated that the most important variables affecting the growth of rapeseed crop were some of the climate and soil variables. Soil depth was the most important soil characteristics affecting on seed yield of rapeseed in Central and West Iran. This research provided information at regional level that could be used by farmers to select crop pattern and suitability. The results of maps this study by ILWIS and ARC GIS identified with high suitable (S1), suitable (S2), moderate suitable (S3) and not suitability (N) for rapeseed cultivation in lands of Isfahan and Chahr Mahal & Bakhtyairi.

Discussion

This research confirmed that the methodology used was adequate to integrate database of climate, soil and topography with different spatial and temporal resolutions. GIS, of climate, soil and topography environment-components proved to be useful in the identification of suitable areas for rapeseed oil crop production, within a GIS environment. This investigation is a biophysical evaluation that provides information at a regional level that could be used by farmers to select their crop pattern. As well, decision-making regarding adequate crop patterns could be based not only on the information provided by this approach, but also on other aspects such as: production supports (by local and federal governments), marketing, technological level, economic evaluation, in addition to local customs, which are also highly important. The method applied is an interesting contribution for the specialists of those countries or counties with similar economy to Central and West Iran, as an alternative and reliable approach to evaluate the biophysical environment for agricultural use.

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