Land Suitability Classification for Different Crops

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Each plant species requires definite soil and site conditions for its optimum growth. Although some plants may be found to grow under different soils and extreme agro-ecological conditions, yet not all plants can grow on the same soil and under the same environment. The conspicuous absence of Pinus species in inter-tropical and of eucalyptus in the temperate (cold) regions are examples. Since the availability of both water and plant nutrients is largely controlled by the physico-chemical and micro environment of soils, the success and/or failure of any plant species, in a particular area, is largely determined by these factors. The deep rooted forest or orchard plantations respond differently to soil depth and soil texture (Mishra and Sahu, 1991) than the shallow-rooted arable crops such as rice, wheat, green gram, black gram, pigeon-pea, groundnut etc.

Several soil-site studies for different plant species have been reported in the literature. These illustrate how soil depth, (sub) soil texture, salinity and drainage conditions are related to soil-site quality. The objective of various soil-site evaluation studies have been to predict and classify land for plant growth (Sehgal, 1996). Observations on growth inhibiting factors for certain species and tolerance of others to extremely adverse conditions have been evaluated by many scientists.

Suitability Criteria

Most of the plant species need well drained, moderately fine to medium texture soils, free of salinity and having optimum physical environment. Soil resource maps based on several parameters, can aid in predicting the behaviour and suitability of soils for growing field crops, horticultural crops, forest species and other plantation crops once the suitability criteria is established. Within limits, it may also find application in transfer of technology to other areas with comparable soil-site characteristics.

Several systems of land evaluation have been proposed for use in different regions, the important being that of Storie (1954) and Ricquier et al (1970).

The FAO land suitability classification system has four different categories: Orders, Classes, Subclasses and Units.

There are two orders (S and N) which reflect the kind of suitability (S for suitable and N for unsuitable land).
Order "S" - Suitable land

Land on which sustained use for the defined purpose in the defined manner is expected to yield benefits that will justify required recurrent inputs without unacceptable risk to land resources.

Order "N" - Unsuitable land

Land having characteristics which appear to preclude its sustained use for the defined purpose in the defined manner or which would create production, upkeep and/or conservation problems requiring a level of recurrent inputs unacceptable at the time of interpretation.

Land Suitability Classes:

The framework at its origin permits complete freedom in determining the number of classes within each order. However, it has been recommended to use only 3 classes within order S and 2 classes within order N. The class will be indicated by an Arabic number in sequence of decreasing suitability within the order and therefore reflects degrees of suitability within the orders.

Examples:

S1 : Suitable
S2 : Moderately suitable
S3 : Marginally suitable
N1 : Actually unsuitable but potentially suitable
N2 : Actually and potentially unsuitable

No firm criteria are given for defining the classes; this permits complete freedom in choice of the criteria in order to elaborate the degrees of suitability within the orders. For each specific case a specific method is to be suggested. Appraisal can be done according to an evaluation of land limitations.

Land Suitability Subclasses:

The sub classes reflect kinds of limitations or main kinds of improvement measures required within classes. They are indicated in the symbol using lower case letters.

c : Climatic conditions
t : Topographic limitations
w : Wetness limitations
n : Salinity(and/or alkalinity) limitations
f : Soil fertility limitations not readily to be corrected
s : Physical soil limitations(influencing soil/water relationship and management).

Land suitability units:

This grouping is used to identify land development units having minor differences in management requirements. This can indicate the relative importance of land development works. It is indicated by Arabic numerals, enclosed in parenthesis, following the subclass symbol.

Example of total unit:

The whole unit is indicated by a symbol; for example : S2w(2). Here "S" represents Order (Suitable); the number 2 after the letter S represents Class 2(moderately suitable); "w" represents Subclass w(wetness limitation); and (2) represents Unit 2.

Sys and Verheye(1975) proposed the following capability index(Ci ) based on nine parameters for crop production in the arid and semi-arid regions.

\[ Ci = A.B.C.D.E.F.G.H.I. \]
Where,

\[ A = \text{rating for soil texture (Taken as 100 for best texture, say loam)} \]

\[ B = \text{rating for calcium carbonate (Taken as fraction of 1 one)} \]

\[ C = \text{rating for gypsum (as above)} \]

\[ D = \text{rating for salinity (as above)} \]

\[ E = \text{rating for sodium saturation (as above)} \]

\[ F = \text{rating for drainage (as above)} \]

\[ G = \text{rating for soil depth (as above)} \]

\[ H = \text{rating for epipedon and weathering stage (as above)} \]

\[ I = \text{rating for profile development (as above)} \]

For example a soil has loam texture, has 5 to 10 percent calcium carbonate, 2.5 percent of gypsum, 4.8(dS/m) of salinity content, low in sodium saturation, is well drained, very deep, has well defined epipedon and matured soil horizons. The Capability index(Ci) of the soil as per the scheme will work out to be

\[ 100 \times 0.8 \times 0.8 \times 0.9 \times 1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0 = 57.6 \]

The Capability index of the above soil is 57.6. It comes under the Ci range of 45 to 60; so the soil has moderate limitation for economic production of crops.

Sys(1976) proposed the following scheme for evaluating the degree of limitation ranging from 0 (suggesting no limitation and having Ci of 80 or more) to 4 (suggesting very severe limitation with Ci of 30 or less).

No (0) : The characteristics (quality) are optimal for plant growth (Ci 80 or more).

Limitation Slight (1) : The characteristics are nearly optimal for the land utilization type and limitation affect productivity for not more than 20 per cent with regard to optimal Yield (Ci 60 to 80).

Moderate (3) : The characteristics have moderate influence on crop yield decline; limitation however, benefits can still be made and the yield remain economical. (Ci 45 to 60).

Severe (4) : Such limitations will not only decrease the yields below the limitation profitable level, but may inhibit the use of the soil for the considered land utilization (Ci less than 30).

The limitation approach has been successfully used to provide a qualitative land evaluation based on general characteristics which are made available after a quality soil survey and general study of other soil resources in the area.

The soil-site parameters considered for the purpose of evaluating land for agriculture, forestry and for plantation crops and for defining suitability classes are:

Soil-Site Characteristics Related Land Quality

- Climate - Available moisture
- Topography and Landscape(t) - Resistance to erosion
- Wetness(w) conditions
  - Available moisture
  - Drainage
  - Flooding
- Physical conditions(s) of soil
  - Texture
  - Water availability
  - Gravels/Stoniness
  - Availability of foot-hold for
(Surface and subsoil) root development
- Depth
- Availability of foot-hold for plant growth
- Calcium carbonate
- Nutrient availability
- Gypsum
- Source of nutrient sulphur

Soil fertility (f) (Not readily correctable):
- Organic matter
- Cation Exchange Capacity (CEC)
- Base Saturation
- Nutrient availability

Salinity and Alkalinity (n):
- Salinity
- Groundwater depth and its quality
- Alkalinity/Sodicity

References:

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Hon'ble Chief Minister Shri Naveen Patnaik receiving a cheque Rs. one crore from Infosys Technologies Limited at Orissa Legislative Assembly on 21.11.2007. Shri Surjya Narayan Patro, Minister, Energy, Information Technology & Culture is also present.