CHAPTER 21

Analysis of suitability for urban expansion

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Summary

In this exercise the suitability of land for urban expansion in the city of Villavicencio, Colombia, will be analyzed. Factors taken into account include hazards, slopes, distance to the city center, and existing land uses.

Getting started

The data for this case study are stored on the ILWIS 2.1 CD-ROM in the directory d:\appguide\chap21. If you have already installed the data on your hard-disk, you should start up ILWIS and change to the subdirectory where the data files for this chapter are stored, c:\ilwis21\data\appguide\chap21,. If you did not install the data for this case study yet, please run the ILWIS installation program (see ILWIS Installation Guide).

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- Double-click the ILWIS program icon in the ILWIS program group.

- Change the working drive and the working directory until you are in the directory c:\ilwis21\data\appguide\chap21.

Now you are ready to start the exercises of this case study.

21.1 Available data

The urban land use map of 1991, and raster maps of the hazards, the slopes and the distance to the city center are needed. Additionally, vector maps of the main roads and the rivers are included for orientation purposes.

Luse91	Raster map of the urban land uses in 1991.
Cendist	Raster map of the distance zones from the center.
Hazards	Raster map of the hazard classes.
Slopes	Raster map of the slope classes.
Mroad91	Vector map of the main roads in 1991.
River	Vector map of the rivers.

21.2 Terminology and definitions

21.2.1 Defining suitability

One of the main concerns of physical planning is the proper designation of *suitable* sites for appropriate land uses. The selection of suitable sites for specific land uses must be based upon a set of local criteria to ensure that the maximum cost-benefit ratio for a community is attained.

The various characteristics of a site (e.g. present land use, slope, water availability, distance to employment, development costs) influence its *suitability* for a specific land use. A scoring and weighting system can be applied to the various aspects of suitability to assess the overall suitability for a specific land use.

Certain characteristics may lead to *non-suitability* of a site for a specific urban land use. For instance, steep slopes, religious values (old graveyard), or designation as government-reserved land, may exclude the use of a site for development, or make it unavailable.

Moreover, a site may be rated highly suitable for several land uses, which then compete for the same site, e.g. a commercial center versus low-cost housing, or agricultural versus recreational use. The necessary choices are the subject of the overall urban development planning.

Caution has to be exercised with the land value as a suitability aspect: land value is not an independent factor, but in principle it integrates all suitability aspects, with a weighting system.

Suitability ratings unavoidably contain an element of subjectivity: extreme caution should be observed in their application. Scores and weights may have an untraceable result when many aspects are included. They are no more than a tool for a rational selection of suitable sites.

21.2.2 Defining hazards

A *natural hazard* can be defined as the probability of occurrence, within a specific period of time in a given area, of a potentially damaging natural phenomenon (Varnes, 1984). These phenomena can be earthquakes, mass movements, floods, droughts, hurricanes, etc. All of them occur with different intensities and frequencies, producing different levels of environmental impact.

In the Villavicencio area (Colombia) the following natural hazards are present:

Flooding: A flood occurs whenever run-off exceeds the discharge capacity of a river channel, causing water and mud to flow over riverbanks and spread out over the floodplain beyond. Factors that are important: climate (rainfall), land use changes, seismic activity.
Small river flooding zones: undercutting (lateral erosion) river banks and subsequent landslides in the higher terrains, cause flooding in the lower areas. This applies to the *caños* (small rivers) where variable occurrence and intensity of the hazard is experienced.

Landslides: Downslope movement of rock, soil, mud or a mixture of these materials. Some landslides occur gradually and others abruptly. Important factors are: climate (rainfall), topography (slopes), rock type (structure, material), soil type (water content), tectonic activity (earthquake), land use (deforestation).

Subsidence: The sudden sinking or gradual downward settling of the earth's surface with little or no horizontal motion. Soils with cohesionless materials with a high water content are very susceptible to this liquefaction or solifluction when an external disturbance occurs (earthquake, conventional landslide).
[The experts do not fully agree on the existence of a subsidence hazard in Villavicencio. Some regard the suspected subsidence area as stable. However, if there is a real hazard, the risk is considerable.]

21.2.3 Defining risks

A *natural risk* can be defined as the vulnerability of the area in terms of expected number of lives lost, persons injured, damage to property and disruption of economic activity due to a potential natural damaging phenomenon. In other words, a natural hazard becomes a natural risk when population and property might be affected. Therefore when cities are constructed in a hazardous zone, the zone is considered not only hazardous but also risky.

The level of the potential risk affecting the city is not the same in the entire city, because the type of natural hazard as well as the land uses (e.g built-up and non-built-up areas) vary over the city (Salas, 1992).

21.3 Modelling land requirements for urban expansion

21.3.1 Urban growth speed

The urban change in the previous years can be established by studying a time series of land use information. The percentage change per year of the urban land uses (or particular land uses) can be calculated. The arithmetic mean change per year in the periods 1960-1978 and 1978-1991 was 11% and 7.5%, respectively. The geometric mean change per year was 6.3% and 5.4%, respectively.

In this exercise assume a 6.0% annual increase in the urban land uses in the years after 1991, following a geometric progression (the exponential law, usually also assumed when calculating population growth).

Another approach (quite similar) would be to use the observed population growth rate (of the last period) as the basis for assuming a rate of increase in the urban land uses.

The effect of the (exponential) growth rate can be calculated using the following formula:

$$A_f = A_b * \left(1 + \%\!\!\Big/\!\!100\right)^{(f-b)} \qquad\qquad [21.1]$$

where *A* is the area, *f* is the future year (e.g. 1996), *b* is the base year (e.g. 1991) and % is the growth rate per year (e.g. 6.0 percent).

Example: $A_{1996} = A_{1991} * (1 + 6/100)^{(1996\text{-}1991)}$

$A_{1996} = 1665 \text{ ha} * (1.06)^5 = 1665 * 1.06 * 1.06 * 1.06 * 1.06 * 1.06$

$A_{1996} = 2228 \text{ ha}.$

Based on the map Luse91, in this exercise, you will create a new class map Urban which should contain the land use classes residential, commercial, industrial, institutional, recreational, transportation, under construction and demolition.

The map Luse91 has the following classes (table 21.1):

Table 21.1: Codes and class names usedfor the domain Landuse

code	Class	Code	Class
co	Commercial	re	Recreational
de	Demolition	rs	Residential
id	Industrial	ri	River
is	Institutional	tr	Transportation
ni	No information	ud	Under development
nb	Non built-up		

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- Create a new domain `Urban`, type **Class**. Add the following classes: `Urban`, `Non urban`, `River`, `No info`. Do not fill in codes. A representation is automatically created.

- Edit the representation `Urban` by double clicking on each class:

Class	Color
Urban	red
Non urban	green
River	blue
No info	gray

- Create a new table `Landuse` with class domain `Landuse`. Add a column `Urban`,with domain `Urban`. Assign the name `Urban` to the classes `residential, commercial, industrial, institutional, recreational, transportation, under development,` and `demolition,` the name `Non urban` to the class `non built-up`, the name `No info` to the class `No information`, and the name `River` to the class `river`.

- With the operation **AttribRas** use the raster map `Luse91`, the table `Landuse`, and the attribute `Urban`. Create and show the attribute map `Urban91`.

- Calculate the histogram for the map `Urban91`.

- Calculate the size of the urban area in future years (base year 1991, use the exponential growth rate) and the `non urban` area in 1991 in hectares. Fill in the tables below..

Table 21.2: Estimated expansion of the urban area in the period 1991-2010. Fill in the table based on the explanation above

Land use	Area (ha)									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Urban										
Non-urban										

Table 21.2 continued

Land use	Area (ha)									
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Urban										
Non-urban										

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>
> - Calculate the new urban area required in the year 2006, disregarding any suitability or non-suitability aspect. Assume all non-urban land (as it existed in 1991) is available. The table will give you a quick idea of land requirements and scarcity just 15 years after the base year 1991. Use ILWIS or a pocket calculator for the calculations. Fill in the table below.

Table 21.3: Urban and non-urban land use areas in ha in 1991 and 2006

Land use		Ha	
Urban	2006		
Urban	1991 -		
New urban	2006		= required
Non-urban	1991		= available
New urban	2006 -		
Non-urban	2006		

21.3.2 Factors considered and assumptions

A number of factors, important in reality, will not be considered in this exercise: municipal plans, road and bridge construction projects, reserved land, environmental constraints, ownership, densification of residential areas, succession (e.g. commercial land use replacing residential land use), socio-economic classes (affordability), political and commercial factors, urban developments in the proximity, but outside the study area.

The basic assumption is that all non-urban land (land use class 8) in the study area in 1991 is available for urban expansion

The expansion models, therefore, are simplified and generalized.

21.3.3 Scenarios

Urban expansion may be limited by natural hazards (and the corresponding risks) which threaten certain areas.

Two urban expansion scenarios, based on the occurrence of natural hazards and the corresponding risks, will be considered:

the *risky (carefree)* scenario A: urban growth nearly everywhere, but not in high risk zones

the *safe* (*cautious*) scenario B: urban growth only in relatively safe areas

The period to be considered is the next 15 years (1991-2006).

23.3.4 Procedure

A suitability model is designed to assess the amount of suitable area for urban expansion.

A suitability map will be created by weighting and combining maps with rated suitability factors.

This map will be classified into areas which are highly suitable, moderately suitable, marginally suitable, or unsuitable for urban expansion.

The suitability factors considered are:

– distance to the city center;

– slopes;

– hazard zones.

These suitability factors are available in maps.

Each class in each map has to be assigned a proper suitability score: the value 1 ... 10 (just suitable → highly suitable) or -100 (unsuitable or no information).

The values of the map `Hazards` will be rescored to map `Hazscor` (hazard suitability factor). Similarly, the map `Cendist` (distance to the city center) will be rescored to map `Censcor` (suitability factor based on the distance to the city center) and the map `Slopes` will be rescored to map `Slopscor` (slope suitability factor).

The output maps, containing the scores: `Hazscor`, `Censcor`, and `Slopscor` will be multiplied by a weighting factor and then added to produce the composite suitability map `Suitscor`.

The final suitability map `Suitclas`, containing suitability classes, will be derived from the map `Suitscor`.

21.4 Risky and safe growth

The map `Hazards` contains the following hazard classes (table 21.4):

Table 21.4: Codes and class names used for the domain Landuse

code	Class
fv	Flood hazard very high (>1/year)
fh	Flood hazard high (1/year)
fm	Flood hazard moderate (0.2 year)
fl	Flood hazard low (0.04/year)
fs	Small river flooding hazard (lateral erosion and flooding along caños
lv	Landslide hazard very high
lv	Landslide hazard moderate
lm	Subsidence hazard
nh	No hazard
ri	River
ni	No information

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- Display the raster map `Hazards`.

- Cross the land use map of 1991 (`Luse91`) with the hazard map (`Hazards`). Study the cross table.

❗ Evaluate the cross table on the basis of the two scenarios:

Scenario A (risky urban expansion): expansion everywhere, except in high hazard zones
Consider the classes with the codes `ri`, `fv`, `fh` and `lv` in the hazard map as `high hazard` classes. In the high hazard zones no urban expansion will take place. The area for which no information is available (code `ni`) is also considered to be a high hazard zone, in which no urban expansion will take place according to the model. Everywhere else in the non-urban area in 1991 (class `non built-up` in the land use map `Luse91`) expansion is expected.

Scenario B (safe urban expansion): expansion only in relatively safe zones
Consider only the classes `No hazard` and `Flood hazard very low` in the hazard map as `Safe` classes. The urban expansion should only take place in the safe zones in the non-urban area in 1991 (class `non built-up` in the land use map `Luse91`), nowhere else.

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- Collect the data from the cross table and fill in the table below.

Table 21.5: Urban expansion area required and available until the year 2006 with two scenarios (in ha)

Scenario	Urban expansion area until the year 2006 in ha		
	available	required	+ surplus - shortage
Risky (carefree) scenario A			
Safe (cautious) scenario B			

21.5 Scoring suitability factors

In this section the hazard classes of the map `Hazards` have to be assigned proper suitability scores.

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- First create a new domain Score with the domain Value, a range −100 to +10 and precision 1. This domain will be used again for scoring the other maps.

- Create a new table Hazards using the domain Hazards.

- Add a column Hazscor, with the value domain Score and insert the values as shown below:

Class	Hazards map class	Hazcor value
River	1	-100
Stable	2	10
Flooding hazard very high	3	1
Flooding hazard high	4	2
Flooding hazard moderate	5	3
Flooding hazard low	6	7
Small river flooding zone	7	5
Land slide hazard very high	8	1
Land slide hazard moderate	9	2
Subsidence hazard	10	4
No info	99	-100

The distance map Cendist has the distance classes to the city center:

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- Display the raster map Cendist.

- The classes of map Cendist have to be assigned proper suitability scores, considering that the proximity to the city center is taken as highly suitable. To do so, create a new table Cendist, with domain Cendist. Add a column Censcor, with the value domain Score. Insert the Censcor column values as shown below:

Distance zone	Cendist code	Censcor column value
(center)-0 m	ce	10
1-1000 m	c1	10
1001-2000 m	c2	8
2001-3000 m	c3	6
3001-4000 m	c4	5
4001-5000 m	c5	3
5001-6000 m	c6	2
6001-7000 m	c7	1
7001-8000 m	c8	1
river	ri	-100
no information	ni	-100

❗ The scores are chosen to represent a non- linear relationship between suitability and distance to the city center. As the center is already fully built-up, it is not necessary to assign a different score.

The raster map Slopes contains slope classes as indicated in Table 21.6.

Table 21.6: Codes and class names for the map Slopes (domain Slopes)

Code	Class name
fl	flat (< 7%)
in	inclined (7-15%)
st	steep (> 15%)
ri	river
ni	no information

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- Display the map Slopes. The slope classes in the map Slopes have to be assigned proper suitability scores taking into account that flat land is considered highly suitable.

- Create a new table Slopes with domain Slopes.

- Add a column Slopscor with the value domain Score. Insert the Slopscor column values as shown below:

Class	Slopes map code	Slopscor column value
Flat (< 7%)	fl	10
Inclined (7-15%)	in	6
Steep (> 15%)	st	1
River	ri	-100
No info	ni	-100

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- To improve the display of the rescored maps the representation Score has to be created. Edit the representation Score. Insert a limit with a value 10 and assign the color green. Insert a limit with a value 1 and assign the color yellow. Set Stretch Steps to a value 10. Insert a limit -100 and assign the color red.

- Set the color between 1 and -100 to lower (assign the color of the lower limit to the values in between).

  The representation now contains a gradual change in color (from green to yellow) for the positive suitability scores (1 up to 10), and red for unsuitable scores (-100 up to the value 0).

The maps containing the assigned scores now can be created.

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- Click Operations, Raster Operations, Attribute Map. (Make sure you use the representation Score for the output map).

- Use raster map Hazards, the table Hazards and the attribute Hazscor. The output raster map is Hazscor.

- Use as raster map Cendist, the table Cendist and the attribute Censcor. The output raster map is Censcor.

- Use as raster map Slopes, the table Slopes and the attribute Slopscor. The output raster map is Slopscor.

❗ Three maps (Hazscor, Censcor and Slopscor) now contain suitability scores 1 to 10 or a score -100 (unsuitable).

21.6 Weighting and classifying suitability factors

The three suitability aspect maps can be combined into a composite suitability map by simple *addition* of the suitability scores, or with a *weighting system*. Weighting should be applied when not all aspects have an equal importance.

For example, most natural hazards cannot be changed or avoided in affected areas. The risk is a serious factor to consider when planning urban expansion.

A slope will cause considerably higher construction costs, which strongly affects its suitability.

The distance to a main road, on the other hand, may not affect suitability very strongly: a large distance involves some extra cost and increase in travel time. Moreover, a new road might be constructed to change the accessibility. This factor, therefore, will not be taken into account.

The importance (score and weight) of a suitability factor also depends on the intended land use: commercial activities have requirements different from those of residential activities, but this aspect is disregarded here. Ideally, separate suitability studies should be made for each activity using land.

It should be realized that the choice of a weight is most important, as it has a great effect through multiplication of the scores.

The weighting system in this case is designed to allow a maximum score of 100 (a score 10 in all three aspects). The value **-**100 is selected to make sure that unsuitable areas (including river or no info areas) in one or more aspects maps,

remain negative after combining the maps (unsuitable in one aspect map thus can never be compensated by a very high suitability in an other aspect map).

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- The three suitability aspect maps are added while applying the following weighting factors:

  Hazards   5

  Slopes   3

  Distance to the city center   2

- To do so, calculate the composite suitability by applying the weights to the previous maps and then adding the maps. The output map is Suitscor. Apply the MapCalc formula:

  Suitscor=(Hazscor*5)+(Slopscor*3)+(Censcor*2)↵

- Display map Suitscor using the representation Clrstp6. With this color scheme the main differences in the map values are made visible.

- Check the values of map Suitscor. Notice that in this map values between -1000 and +100 can occur.

The distribution of the values in map Suitscor will be made visible in a graph. From this graph the boundaries of the suitability classes will be defined.

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- Calculate the Histogram of the map Suitscor.

- Go to Options, Show Graph. Select Value for the X-Axis and Npix for the Y-Axis.

- In the Edit Graph window select Needle (with the color Red) as the form of the graphic representation. Change the Y-Axis bounds to a maximum of 8000.

The graphic display of map values can be useful to find class boundaries.

❗ The negative values in map Suitscor represent *unsuitable* values (score -100 in one of the three suitability factor maps). Only the value range 10 to 100 in map Suitscor is interesting in terms of suitability.

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- Use the graphic display of only the value range 0 to 100 to define the suitability classes unsuitable, marginally, moderately and highly suitable zones.

- Redefine the display of the graph. In the display options bar go to Graph, Graph Management, Display Options. Change the X-Axis bounds minimum from -1000.0000 to 0.0. Study the graph.

The Suitscor values can be grouped in classes according to a visible clustering ("natural" boundaries) or according to a regular interval.

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- Establish boundaries for the classes unsuitable, marginally suitable, moderately suitable, and highly suitable. Notice that according to the scoring and weighting system of the three suitability factor maps, for any suitable area a minimum score of 10 in map Suitscor must exist. The following class boundaries could be selected:

Score in map Suitscor	Class	Class Code
< 1	Unsuitable	1
1-52	Marginally suitable	2
53-78	Moderately suitable	3
79-100	Highly suitable	4

These scores can be translated into a map by a classify operation. The basis is formed by a group domain, in which the class boundary values are defined.

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- Create a New Domain named Suitclas, with domain type Class and click the box Group

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- Edit the domain by adding items:

Upper Bound	Name	Code
0	Unsuitable	1
52	Marginally suitable	2
78	Moderately suitable	3
100	Highly suitable	4

- In order to classify the map `Suitscor` into a map `Suitclas` on the basis of the domain group `Suitclas`, type the following MapCalc formula in the command line:

  `Suitclas=Clfy(Suitscor,Suitclas)↵`

- Display the new map `Suitclas`. Edit the representation `Suitclas` so that `Unsuitable` area appear in red, `Marginally suitable` in orange, `Moderately suitable` in yellow and `Highly suitable` in green.

- The river (class `river` in map `Luse91`) may be overlaid by a MapCalc operation, output map `Suitfin`.

- The segments of the main roads of 1991 (`Mroad91`) can be superimposed in black, and the river segments (`River`) in cyan (light blue).

- Save the view as `Suitview` (final suitability map view).

21.7 Applying the suitability models

21.7.1 Quantify the size of the existing urban area in unsuitable and marginally suitable zones

Parts of the existing urban area are located in unsuitable or marginally suitable zones, because of the factors distance to city center (far), slopes (steep) or hazards (high flooding risk or high land slide risk).

The urban land uses in those areas in principle should be <u>relocated</u> to more suitable zones (in reality this is not likely to happen, think of the examples of Managua and San Francisco).

The classified suitability map `Suitclas` will be crossed with the land use map of 1991 `Luse91` with two purposes:

(1) to quantify the present urban area located on unsuitable and marginally suitable land;

(2) to quantify the non-urban moderately and highly suitable area available for urban expansion in the future.

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- Cross the map `Luse91` with the classified suitability map `Suitclas` to get a quantitative cross table `Suitarea`.

- Display the cross table, calculate areas in hectares in column `Areaha`:

  `Areaha=Area/10000↵`

- Create a column `Areahasu` which contains the sum of all values in column `Areaha`. To do so, select **Columns, Aggregation**. Use the column `Areaha` and the function **fn Sum**. The output column is `Areahasu`, with domain **Value**, range `0-9999.9` and precision `0.1`.

- Calculate percentages:

  `Areaperc=Areaha*100/Areahasu↵`

  Select domain **Value**, with range `0-100` and precision `0.1`.

- Sort column `Suitclas`, using **domain** as the record sequence

- Calculate the total area for each main land use class. To do so, use **Aggregation** of the column `Areaha`, the function **fn Sum, Group by** `Luse91`. The output column is `Luse91clsum`.

- Fill in the table 21.7.

Table 21.7: Urban land uses in unsuitable and marginally suitable zones

| Land use | Area in ha in 1991 | | | | Area in 1991 |
	Total main land use	In unsuitable zone (1)	In marginally suitable zone (2)	Total in unsuitable + marginally suitable (1+2)	% land use in unsuitable + marginally suitable
Residential					
Commercial					
Industrial					
Institutional					
Recreational					
Transportation					
Under devlopment					
Demolition					
Total urban					

21.7.2   Display the locat   ion of the existing urban area on unsuitable or marginally suitable land

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- Locate the 1991 urban area within unsuitable or marginally suitable

> zones by overlaying maps Urban91 and Suitclas.
>
> - Assign the classes of map Suitclas to the urban area on unsuitable or marginally suitable land, and assign the classes of map Urban91 to all other pixels. Name the output map Nsuiturb using a **MapCalc** operation :
>
>   ```
>   Nsuiturb=iff((((Suitclas="Unsuitable")or(Suitc
>   las="Marginally suitable"))and(Urban91=
>   "Urban")),Suitclas,Urban91)↵
>   ```
>
>   Accept the request to merge the classes of the map Suitclas into the urban domain.

The resulting map Nsuiturb shows small areas in red or orange that presently have an urban land use and at the same time are considered as unsuitable or marginally suitable.

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> - Overlay road segments (Mroad91) and river segments (River) to improve orientation in the area. Save it as a view.

21.7.3 Quantify the size of suitable (and unsuitable) areas for future urban expansion

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> - Display the cross table Suitarea and sort the table with Luse91 as the class sort column. The non-built-up land (Class non built-up) in map Luse91 is considered to be available for urban expansion.
> - Enter the results in table 21.8.

Table 21.8: Suitable and unsuitable areas within the non-built-up area in 1991

Suitability class	Area in 1991 (in ha) within the non-built-up area
Unsuitable	
Marginally suitable	
Moderately suitable	
Highly suitable	
Total	

21.7.4 Display the suitability for future urban expansion

You will create a map which depicts the highly, moderately, marginally suitable and unsuitable zones in the non-built-up area 1991 to be used for future expansion. This is done by overlying the maps `Urban91` and `Suitclas`.

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- Use a **MapCalc** operation to create the new map `Suitnurb`:

  `Suitnurb=iff(Urban91="Non urban",Suitclas, Urban91)`↵

- Display map `Suitnurb`. The colors green and yellow, respectively, represent highly and moderately suitable areas that are currently non-built-up.

- Overlay road segments (`Mroad91`) and river segments (`River`) to improve orientation in the area.

21.7.5 Calculate the year when all highly and moderately suitable non-urban areas have become urban area

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- Calculate the size of the urban area in the years 1992, 1993, etc. Assume a 6% exponential growth rate per year of the urban area (see Chapter 21.3)
  (area 1992= area 1991 * 1.06, area 1993 = area 1991 * 1.06 * 1.06, etc.)

  Assume that urban areas presently located in unsuitable and marginally suitable zones will be relocated to highly suitable areas.

- Calculate the area of the remaining highly and moderately suitable areas.

- Find out in which year all highly and moderately suitable areas in Villavicencio will be urbanized and there will be no further supply of highly and moderately suitable land within the study area.

❗ In which year there will be no more highly and moderately suitable land available within the study area for urbanization ?

21.7.6 Calculate the year when all highly, moderately, and marginally suitable non-urban areas will be built-up area

☞

- Assume that only urban area presently located in unsuitable zones will be relocated to highly suitable zones. Assume that non-built-up area in marginally, moderately or highly suitable zones can be used for future urban expansion. Calculate the area of the remaining highly, moderately, and marginally suitable areas

- Find out in which year all highly, moderately, and marginally suitable areas in Villavicencio will be urbanized and there will be no further supply of highly, moderately, or marginally suitable land within the study area.

❢ In which year will no more highly, moderately, or marginally suitable land be available within the study area for urbanization ?

References

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