PERTEMUAN MG XII
PENGELOLAAN LANSKAP BERKELANJUTAN
[ARL523]

SCALE

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SEKOLAH PASCASARJANA
DEPARTEMEN ARSITEKTUR LANSKAP
FAKULTAS PERTANIAN
INSTITUT PERTANIAN BOGOR

References:

1. Principles and Methods in Landscape Ecology → **Almo Farina**
2. Landscape ecology principles in Landscape Architecture and Land use Planning → **Wenche E. Dramstad, James D. Olson, Richard T.T. Forman**
3. International Journals

PPT would be uploaded to the BLOG

MINGGU XIII

SCALE

Outline:

1. Introduction
2. Fractal Dimension
3. Geographic Information Systems (GIS)
4. Remote Sensing (RS)
5. Case Studies

CAPAIAN PEMBELAJARAN

Mahasiswa mampu menjelaskan skala manajemen lanskap, dimensi metriks lanskap, dan konsep GIS & RS untuk manajemen lanskap yang berkelanjutan.

1. PENDAHULUAN

- The study of the landscape requires **metrics** but also **additional tools** like Databases, Spatial Statistics, Geographic Information Systems, Remote Sensing Techniques and Global Positioning Systems, that are used in many other circumstances.
- These methodologies are applied in geology, geography, navigation, agronomy, climatic economics and social sciences, forecasting, etc.
- At least 4 methodological approaches to study landscape metrics: 1) **numerical analysis**, 2) **spatial analysis, 3) multiscalar analysis** and 4) **spatial modeling analysis.**

Landscape Metrics

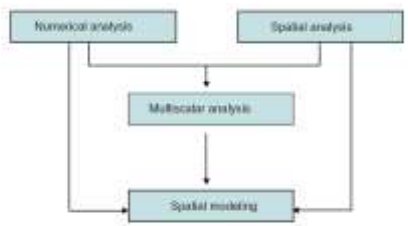
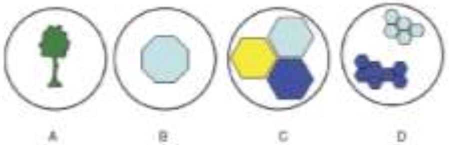


Figure 8-1. The principal approaches to landscape metrics (from Farina 2000, with permission).

Level Resolusi Spasial

Landscape analysis can be performed on at least at four levels of spatial resolution: **individual, patch, mosaic** and **landscape**



. Metrics in landscape ecology can be applied at individual (A), patch (B), mosaic (C) and finally, at landscape scales (D) (from Farina 2001, with permission).

Patch Shape Metrics

Table 8-3. Some patch shape measures applied to four types of patches (1,2,3,4)

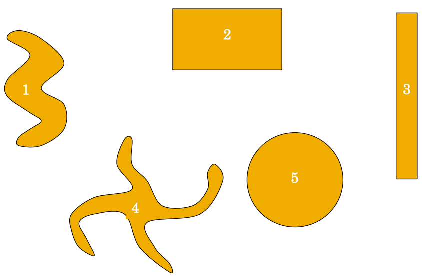
#patch= Patch Identifier
S= Area (Patch size, in pixel)
L= Perimeter (Patch edge, in pixel)
S/L = Ratio Area/Perimeter
CORR (Corrected Perimeter-Area) = .282*L/√S
RCC (Related Circumscribing Circle) = 2*(S/π)1/2)/longest-axis
Long-Axis (Longest Axis)
Data have been processed using the routine basic MPC of Box 6.1

#patch	*S*	*L*	*S/L*	*CORR*	*RCC*	*Long-Axis*
1	4838	259.52	.054	1.052	.994	70.010
2	4235	356.27	.084	1.544	.451	162.720
3	11055	521.28	.047	1.398	.367	136.900
4	5639	662.32	.117	2.487	.448	189.090

Dengan menggunakan ratio:

$$PS = \frac{L}{2\sqrt{A\pi}}$$

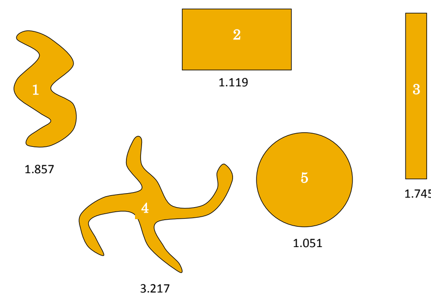
di mana L = keliling patch dan A = luas, dimungkinkan untuk mengevaluasi jumlah dari "edges". Lingkaran mempunyai nilai **Patch Shape=XX** dan menerangkan gambar geometrik dengan ratio minimum antara keliling dan area.



Gambar bentuk dan ukuran patch

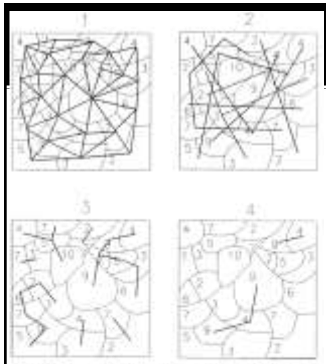
NILAI NUMERIK JUMLAH PERIMETER, LUAS DAN EDGE DARI BERBAGAI BENTUK PATCH.

Patch	Perimeter	Area	$L/2\sqrt{A\pi}$
1	659	10,027	1.857
2	277	4,900	1.119
3	373	3,652	1.745
4	1,125	9,736	3.217
5	269	5,222	1.051



Gambar bentuk dan ukuran patch

Jarak



The measurement of distances can be done according a selection of possibilities:

1. from each patch to all the adjacent neighbors of each patch.
2. from a patch to all others of the same group,
3. from each patch to the single nearest patch of a different group,
4. from a patch of a specific group to another patch of a specific group (ex. 9-4-9)

Peluang Kemunculan

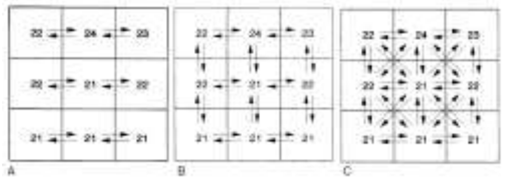


Figure 8-6. Three possibilities to calculate the co-occurrence probability p(i,j,d,q) between cells or pixels of a matrix. The number in the cells indicates the type of attribute, maybe a land-cover or vegetation or color attribute. In case A the co-occurrences have been measured only along the horizontal axis (q=0°), in B according to the four perpendicular directions (q=0°,90°) and C in all directions(q=0°,45°,90°,135°) at a distance d=1 (from Musick & Grover 1991, modified, with permission).

Complete Mosaic

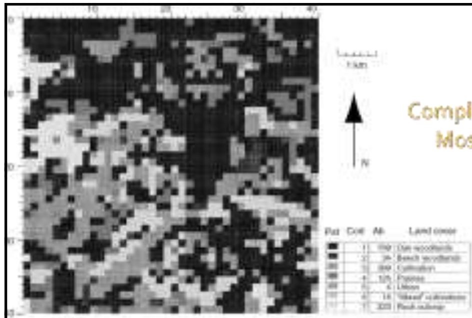


Figure 8-7. Subset of 8x8 km, 200x200 m cells, of a GIS (Routine MacGIS (Hulse & Larsen 1989)), across the northern Apennines (from Nardelli 1995). The mosaic is composed of 7 mainland covers. Pat=Graphic Pattern, Cod= Land cover code, Ab= Number of cells.

Single Land Cover

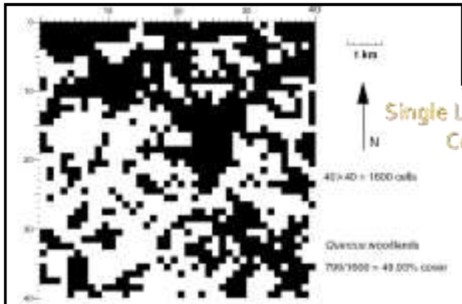


Figure 8-8. Example of landscape analysis using a single land cover, in this case the oak woodlands cover (source from Nardelli 1995) see also Fig. 8.7 for the complete mosaic.

From this image it is possible to measure:

No. Patch, Area, Perimeter, Shannon diversity of patch size, Shannon diversity of patch edge, Max., Min., Patch size and Patch edge.

2. FRACTAL GEOMETRY APPROACH

Figure 8-11. Example of regular (A) and randomized (B) Koch snowflake.

Euclidean vs Fractal

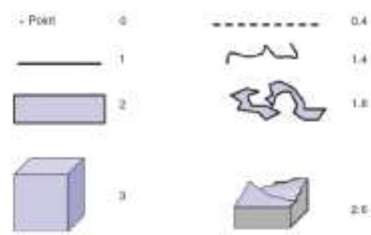


Figure 8-12. Comparison between Euclidean dimensions (left) and fractal dimensions (right).

The fractal dimension of the edges

Example of different complexity of a vegetation border expressed by the fractal dimension D, note that the increase of edges is equivalent to the increase of fractal dimension.

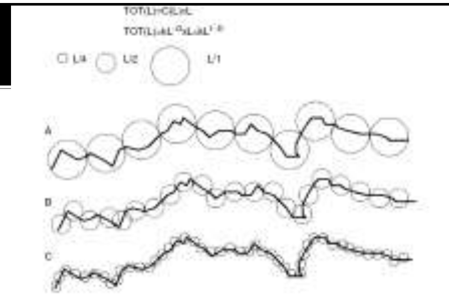


Figure 8-14. The irregularity of a border can be estimated by calculating the fractal dimension applying the caliber method. In this case, the total length of the border decreases with the increase of the caliber size. In A the caliber is L/1, the number of steps C(L)=10, the total length TOT(L)=10x1=10; in B L/2, C(L)=22, TOT(L)=22x1/2=11, in C L/4, C(L)=47, TOT(L)=47x1/4=11.75. The shorter the caliber the more border will be measured, see text for the calculation of the fractal dimension (from Farina 2001, with permission).

3. GIS

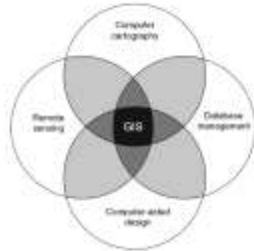


Figure 8-21. GIS is the combination of different procedures and methodologies (from Maguire 1991, with permission).

The GIS appears indispensable for most landscape investigations like:

- Land use change
- Vegetation patterning
- Animal distribution across the landscape
- Linking remote sensing with topography
- Modeling processes across the landscape

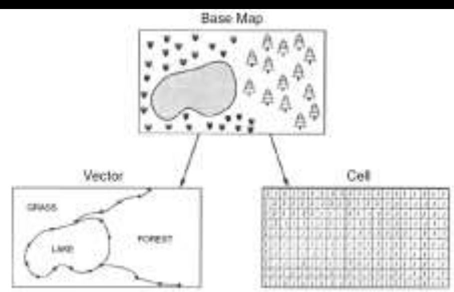


Figure 8-23. Representation of raster and vectorial format of a map (from Coulson et al. 1991, with permission).

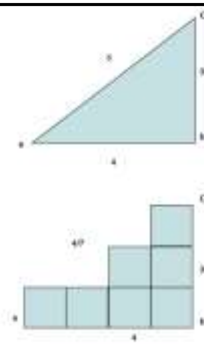
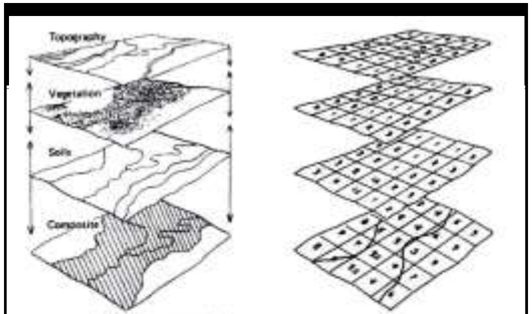
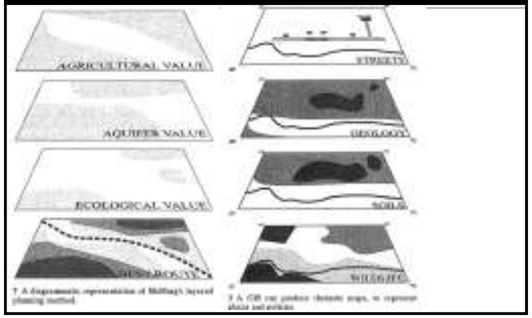
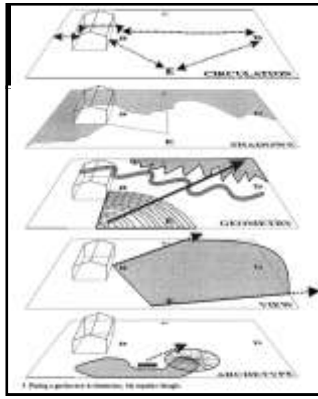


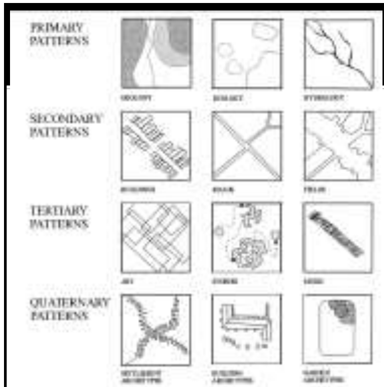
Figure 8-24. Raster versus vectorial representation of the reality. The real measures in raster format are scaled and some biases in estimations have to be considered (Burrough 1986, with permission).

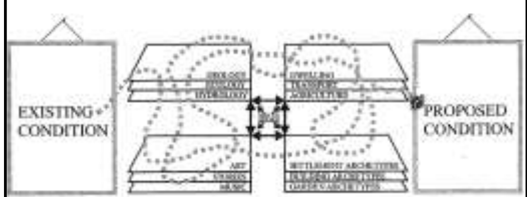


A schematic portrayal of the map overlay technique. Left, maps delineating the pertinent features; right, these features codified into a numerical scheme based on land use suitability.

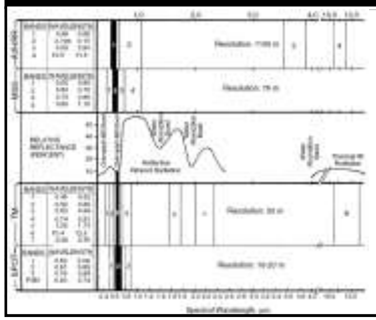








4. Remote Sensing



Spectral and spatial resolution for the commonest civilian satellites: AVHRR, MSS, TM and SPOT, and the electromagnetic spectral response curve for green vegetation (Iverson et al. 1989).

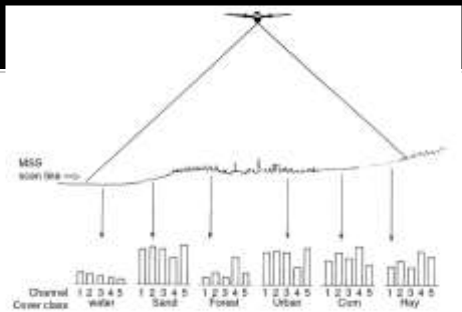


Figure 8-31. Spectral attributes belonging to different land cover types. Band 1, blue; band 2, green; band 3, red; band 4, near-infrared, band 5, thermal-infrared (from Lillesand & Kiefer 1987, with permission).

Table 8-10. Main satellite types, spatial resolution and temporal coverage (from Cracknell & Hayes 1993, with permission).

System		IFOV (Instantaneous Field-of-View)	Repeat coverage
SPOT	Multispectral	20 m	Days-variable
	Panchromatic	10 m	Days-variable
LANDSAT	MSS	80 m	Several days
	TM	30 m	Several days
NOAA	AVHRR	~ 1km	Few hours
METEOSAT		~2.5 km	30 minutes

Global Positioning Systems (GPS)

www.gpsireland.ie/

www.engadget.com

http://archaeology.about.com/

http://electronics.howstuffworks.com

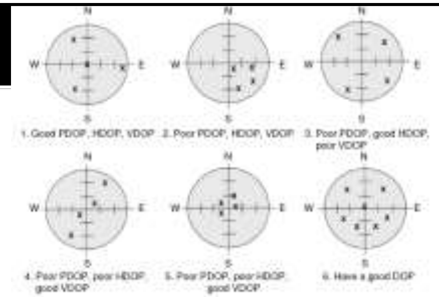


Figure 8-34. Geometry of satellite constellation and Dilution of Position (DOP) values for Position (PDOP) (longitude, latitude and altitude), Horizontal (HDOP) (latitude and longitude), Vertical (VDOP) (altitude), Time (TDOP) (clock offset). The most accurate satellite geometry is illustrated in position 1, when a satellite is directly overhead and the other three are evenly spaced around the horizon (Trimble Navigation 1994, with permission).

The use of GPS in landscape ecology

1. **Rectify aerial photographs - Disaster**
2. **Low-altitude oblique photographs – Integrated Farming**
3. **Animal community ecology - Birds**
4. **Landscape Services - Watersheds**
5. **Greenery Open Space – Urban Landcape**
6. **Mapping vegetation patches on the ground** with an accuracy of 5m after differential correction.
7. Etc.

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