GIS-based drivers and performance indicators of SLM: definitions, justification and calculation methods, results

Final Workshop "Sustainable Land Management to Achieve Land Degradation Neutrality: Options-by-Context Approach and Tools"

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CGIAR RESEARCH PROGRAM ON Dryland Systems

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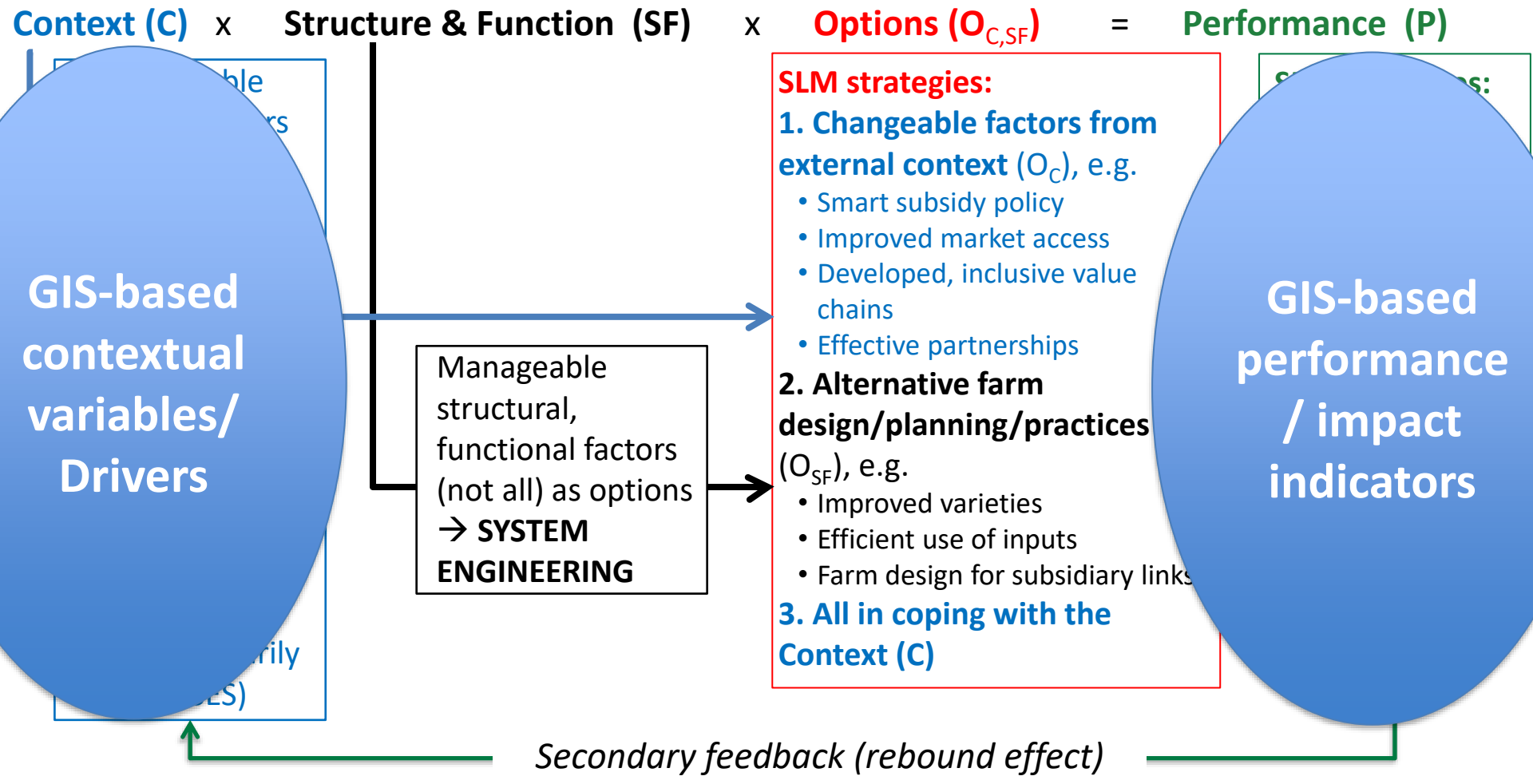
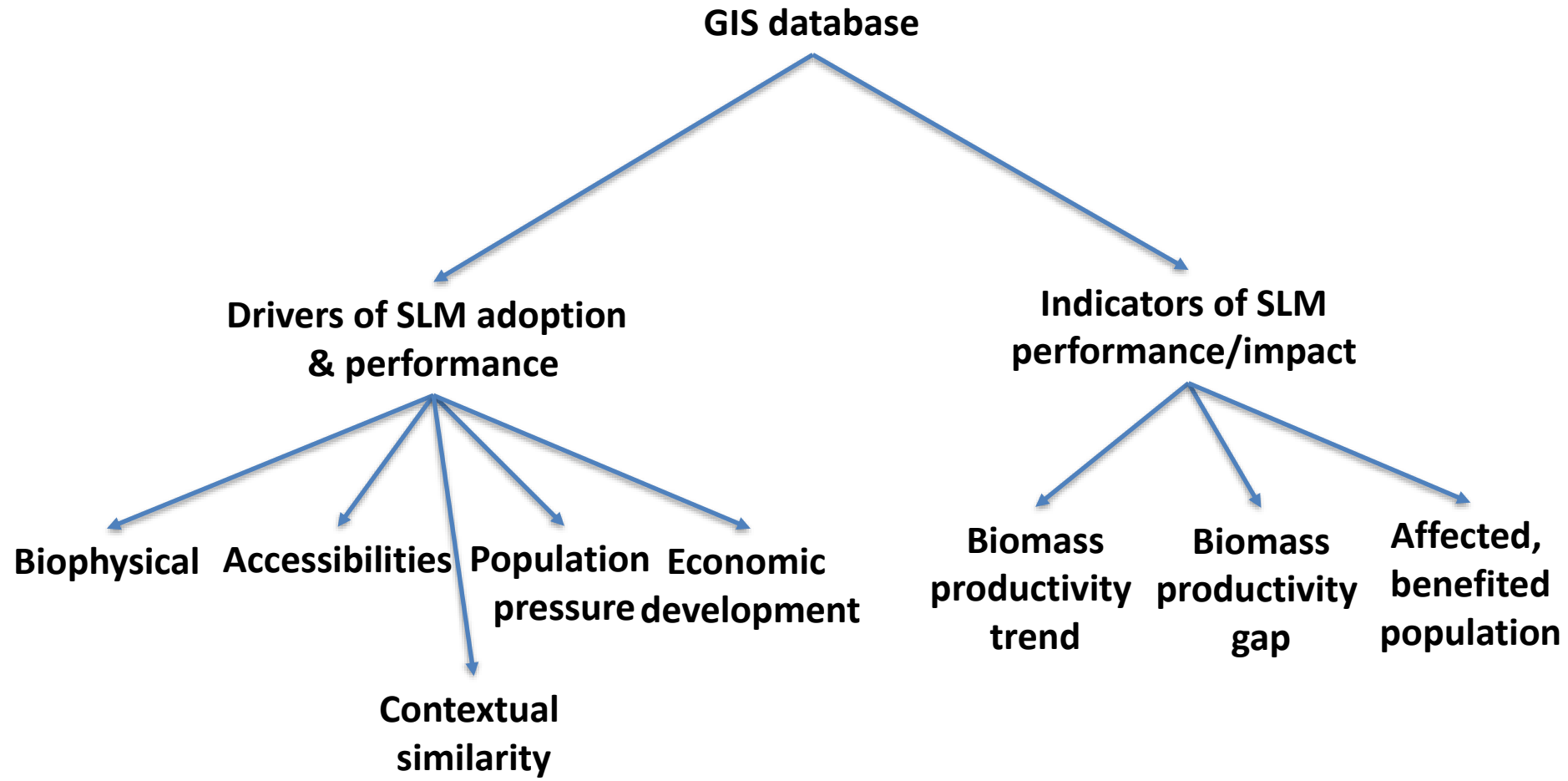
Positioning of GIS data in GeOC approach



Source: Le et al. (2017; in prep.)

Main categories of GeOC's GIS Data



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Contextual variables/drivers: Biophysical

Variable	Definition (measuring unit) (resolution) (sources)	Coverage	Originality
Biophysical driver			
ARIDITY	Index of humidity, based on the balance between rainfall and evaporating transpiration (ET) (no unit) (1 km x 1km) (Trabucco and Zomer, 2009)	Global, national	Extracted/ downscaled
PRECIP-TREND	Long-term trend of annual precipitation (floating trend coefficient) (1 km x 1km) (Le et al., 2016c)	Global, national	Calculated by team members
WATER-PROXIMITY	Proximity to water body (m) (1 km x 1km) (Bidarar/ICARDA, 2015)	Global, national	Calculated by team members
BROAD-COVER	Broad class of land cover (10 classes aggregated from 22 classes of Globcover data) ((1 km x 1km) (Bicheron et al., 2008)	Global, national	Extracted/ downscaled
TREE-DEN	Tree coverage (trees/km2) (1 km x 1km) (Glick et al., 2016)	Global, national	Extracted/ downscaled
DEM-GTOPO30	Altitude above sea level (m) ((1 km x 1km) (USGS, 1998)	Global, national	Extracted/ downscaled
SLOPE-DEG	Surface slope (degree) (calculated from GTOPO30 data (1 km x 1km) (Le, 2016)	Global, national	Calculated by team members
SRTM30	Altitude above sea level (m) (30 m x 30 m) (USGS, 2013)	National	Extracted/ downscaled
SLOPE30	Surface slope (degree) (calculated from SRTM30) (30 m x 30 m) (Le, 2017)	National	Calculated by team members
AS30	Flow accumulation or upslope area (m2/m) (calculated from SRTM30) (30 m x 30 m) (Le, 2017)	National	Calculated by team members
SDR30	Sediment delivering ratio (no unit) (calculated from SRTM30) (30 m x 30 m) (Le, 2017)	National	Calculated by team members

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Contextual variables/drivers: Biophysical (continued)

Variable	Definition (measuring unit) (sources)	Coverage	Originality
Biophysical driver			
SQC1-NUTAVA	Soil quality constraint regarding nutrient availability (4 ordinary classes from HWSD supplementary data*) (1 km x 1km) (Fischer et al., 2008)	Global, national	Extracted/ downscaled
SQC2-NUTRCAP	Soil quality constraint regarding nutrient retention capacity (4 ordinary classes from HWSD supplementary data*) (1 km x 1km) (Fischer et al., 2008)	Global, national	Extracted/ downscaled
SQC3-ROOTCOD	Soil quality constraint regarding rooting condition (4 ordinary classes from HWSD supplementary data*) (1 km x 1km) (Fischer et al., 2008)	Global, national	Extracted/ downscaled
SQC4-OXYGEN	Soil quality constraint regarding soil oxygen (4 ordinary classes from HWSD supplementary data*) (1 km x 1km) (Fischer et al., 2008)	Global, national	Extracted/ downscaled
SQC5-SALT	Soil quality constraint regarding salinity (4 ordinary classes*) (1 km x 1km) (Fischer et al., 2008)	Global, national	Extracted/ downscaled
SQC6-TOXICITY	Soil quality constraint regarding toxicity (4 ordinary classes*) (1 km x 1km) (Fischer et al., 2008)	Global, national	Extracted/ downscaled
SQC7-WORKCAP	Soil quality constraint regarding work capacity (4 ordinary classes*) (1 km x 1km) (Fischer et al., 2008)	Global, national	Extracted/ downscaled
BULK250	Bulk density of topsoil (250 m x 250m) (ISRIC, 2013)	National	Extracted
CEC250	Cation exchange capacity (CEC) of topsoil (cmolc/kg) (250 m x 250m) (ISRIC, 2013)	National	Extracted
CLAY250	Clay content of topsoil (%) (250 m x 250m) (ISRIC, 2013)	National	Extracted
SILT250	Silt content of topsoil (%) (250 m x 250m) (ISRIC, 2013)	National	Extracted
SAND250	Sand content of topsoil (%) (250 m x 250m) (ISRIC, 2013)	National	Extracted
SOM250	Organic carbon content in topsoil (permilles) (250 m x 250m) (ISRIC, 2013)	National	Extracted
K250	Exchangeable K in topsoil (250 m x 250m) (ISRIC, 2013)	National	Extracted
N250	Total N in topsoil (250 m x 250m) (ISRIC, 2013)	National	Extracted

* 4 ordinary classes: 1- no/slight constraint, 2- moderate constraint, 3- severe constraint, 4- very serve constraint

Contextual variables/drivers: Accessibilities

Variable	Definition (measuring unit) (resolution) (sources)	Coverage	Originality
Physical and institutional accessibility to land resources			
DIST-ROAD	Distance to main road (km) (1km x 1 km) (Biradar/ICARDA, 2015)	Global, national	Calculated by team members
DIST-TOWN	Distance to district capital (km) (1km x 1 km) (Biradar/ICARDA, 2015)	Global, national	Calculated by team members
PROTECT-AREA	Protected area (1= protected, 0= otherwise) (IUCN world database of protected areas – WDPA) (1km x 1 km) (UNEP-WCMC, 2016)	Global, national	Extracted/ downscaled
TENURE-SEC	USAID's tenure security level (1km x 1 km) (Mirzabaev et al., 2016)	Global, national	Spatialized by team members

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Contextual variables/drivers: Population pressure and economic development, contextual similarities/types

Variable	Definition (measuring unit) (sources)	Coverage	Originality
Population pressure			
POP-DEN2015	Average population density 2015 (persons/km^2) from GPW data (CIESIN-CIAT, 2005 and 2016)	Global	Calculated by team members
POP-DEN-RURAL	Rural population density 2000 (person/km2) (downscaled from FGGD database (FAO, 2007))	Global	Extracted/ downscaled
POP-CHANGE	Change in population density over the period 1990-2015 (persons/km^2) (calculated from GPW data) (Le, 2016)	Global	Calculated by team members
National economic development			
GDPCAP	Average GDP per capita per 15 x 15 minutes in 2008 ($US/person/yr) (*Global 15 x 15 Minute Grids of the Downscaled GDP Based on the SRES B2 Scenario, averaged for 1990-2025*) (Gaffin et al., 2004))	Global	Extracted/ downscaled
GDPCAP-GRW	Mean growth rate of annual GDP during 1990-2025 (% of baseline value in 1990) (Calculated using gridded downscaled GDP (SRES B2 Scenario) (Gaffin et al., 2004))	Global, national	Calculated by team members
AGRI-POVERTY	ICARDA's index of agricultural resource poverty	Global, national	Calculated by team members
Socio-ecological contextual similarity			
SES-TYPE	CRP-DS's socio-ecological context type (Le et al., in prep.)	Global	Calculated by team members
GLS-ASSELEN	Global land system types (Asselen et al., 2012)	Global	Extracted/ downscaled
LSA-VACLAVIK	Land system archetypes (Vaclavik et al., 2016)	Global	Extracted/ downscaled

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Performance/impact Indicators/proxies

Variable	Definition (measuring unit) (sources)	Coverage	Originality
Biomass Productivity and Water Use Efficiency			
PROD-DEG	Negative trend of biomass productivity as a proxy of land degradation* (Le et al., 2016c)	Global, national	Calculated by team members
PROD-IMP	Positive trend of biomass productivity as a proxy of land improvement* (Le et al., 2016c)	Global, national	Calculated by team members
RUE	Rain use efficiency = mean of annual sum NDVI / annual rainfall (Le, 2016)	Global, national	Calculated by team members
Pressure on land carrying capacity in term of biomass potential			
HANPP-PCT	Human appropriation of natural NPP (% of natural NPP) in 2000 (Haberl et al., 2004; Krausmann et al., 2008)	Global, national	Extracted/ downscaled
NPP-GAPPC	Gap between actual and potential Net Primary Production (NPP) in 2000 (% of potential NPP) (Haberl et al., 2004; Krausmann et al., 2008)	Global, national	Extracted/ downscaled
Affected population			
AFFECTED-POP	Approximately population affected by land degradation (affected persons/km^2) (Le et al., 2016c)	Global	Calculated by team members
AFFECTED-RPOP	Approximately rural population benefited by land improvement (affected person/km^2) (Le et al., 2016c)	Global	Calculated by team members

* approximated by inter-annual trend of NDVI with statistical test, correction of confounding effects of rainfall variation, atmospheric and artificial fertilization)

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Two ways to access to GeOC's GIS data

Way 1: GIS data embedded in GeOC's WebGIS

- Link to WebGIS: https://mel.cgiar.org/visualization
- Users'/testers need to register first: Let us click the link to see how
- Advantages:
  - Taking any geographic subset over the global coverage
- Limitations:
  - National data not yet uploaded by admin (constrained by the current design of the graphic interface)

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Two ways to access to GeOC's GIS data

Way 2: Use the off-line summary table with hyper-links to download data and their documentation

Variable	Long name	Data*	Documents**
Biophysical driver			
ARIDITY	Index of humidity	download	download
PRECIP-TREND	Long-term trend of annual precipitation	download	download
WATER- PROXIMITY	Proximity to water body	download	download
BROAD-COVER	Broad class of land cover	download	download
TREE-DEN	Tree coverage	download	download
DEM-GTOPO30	Altitude above sea level ((1 km x 1km)	download	download
SLOPE-DEG	Surface slope (1 km x 1km)	download	download
SRTM30	Altitude above sea level (30 m x 30 m)	download	download
SLOPE30	Surface slope (30 m x 30 m)	download	download
AS30	Flow accumulation or upslope area (30 m x 30 m)	download	download
SDR30	Sediment delivering ratio (30 m x 30 m)	download	download

Zip file contains: ESRI ASCII Grid (.asc) + Meta data (Excel)

** Zip file contains documents describe data and/or calculation method in details

- Advantages:
  - Fast, correct
  - Many high resolution data
- Limitations:
  - only available for Tunisia

Note: We are uploading data to CGIAR MEL system. When the data are ready (within November 2017) you will be noticed by e-mail.

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