

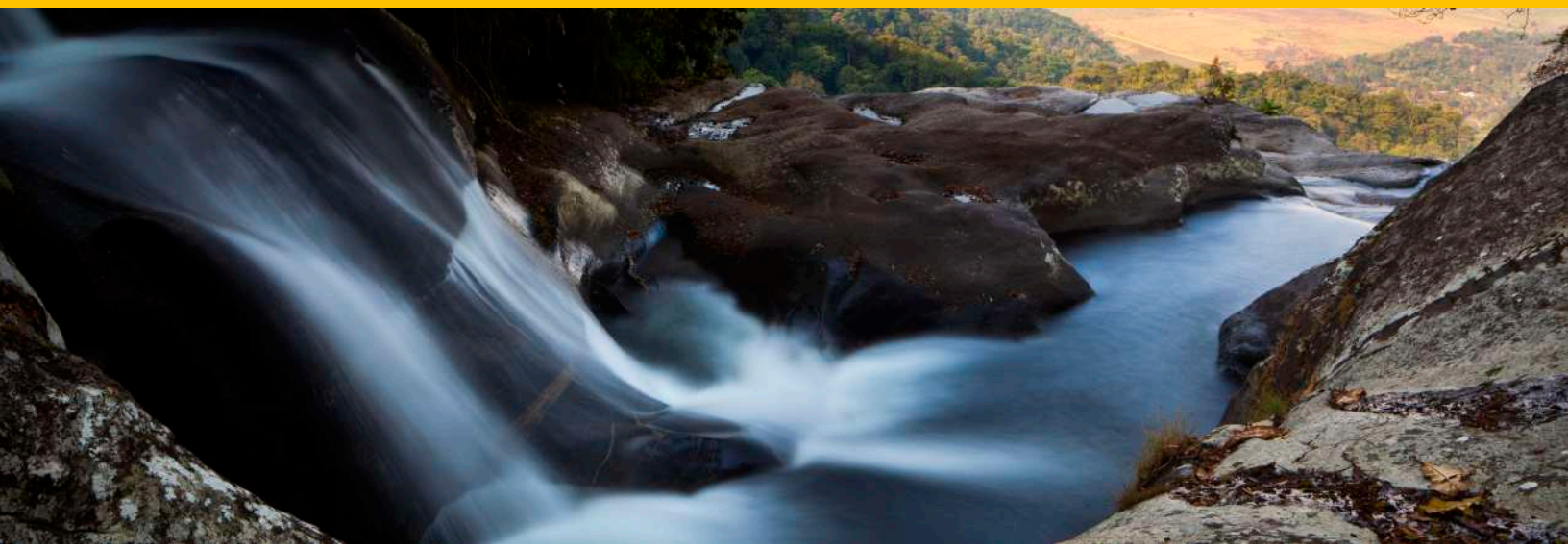


VITAL SIGNS

INDICES AND METRICS

VITAL SIGNS DECISION SUPPORT INDICES

Index	Scale	Decsription
Climate Change	• Plot • Landscape • Nation	Human-induced changes in greenhouse gases
Soil Health	• Plot • Landscape • Nation	The ability of soil to deliver ecosystem services such as food production, water and nutrient provision and regulation and climate regulation.
Water Security	• Landscape • Nation	The availability of sufficient clean water for household use, agricultural production and healthy ecosystems.
Agricultural Intensification	• Plot • Landscape • Nation	Practices that increase agricultural productivity per unit of land area using a variety of technological and agricultural management changes.
Wood Fuel Sustainability	• Landscape • Nation	The amount of consumption of wood fuel relative to the growth rate of woody biomass.
Rangeland Degradation	• Landscape • Nation	The deterioration of land productivity, e.g., soil, vegetation and/or water resources
Poverty	• Household • Landscape • Nation	A measure of standard of living, indicating whether a person has enough money or resources to meet her needs.
Food Security	• Household • Landscape • Nation	The physical, social, and economic access to sufficient and nutritious food to meet dietary needs for a healthy and active life.
Resilience	• Household • Landscape • Nation • Continent	The ability of people, agriculture and ecosystems to remain healthy and productive in the face of climate variability, shocks and other stressors.



Metrics for agriculture, ecosystem services and livelihoods. Primary measurements are carried out at four scales: 1) household; 2) plot, i.e. < 1 hectare, 3) landscape, i.e. 100 km^2, and 4) region or nation, ~350,000's km^2 (modified from Andelman et al. 2011). Note that, while there are many metrics, all of these metrics role up into a small number, ~6, of high-level decision support indicators.

METRICS

METRICS	SCALE	TIERS				CATEGORIES			DESCRIPTION	DATA SOURCE	FREQUENCY
	Spatial resolution	Tier 1	Tier 2	Tier 3	Tier 4	Ecosystem Services	Agriculture	Livelihoods			
LANDSCAPE STRUCTURE & COMPOSITION									Spatial structure & composition of land cover classes (not a service, per se, but play critical role in determining services produced	Satellite remote sensing(MODIS, Landsat1, ASTER2, Quickbird); ground validation (field campaign) HHS	3 years
Area per land cover type	L, R	•			•	•	•			As above	3 years
Area in different types of agriculture (grain, fruit, vegetables, rangelands, trees)	P, L, R	•			•	•	•			As above	3 years
Number of households	L, R	•			•	•		•		As above	3 years
Road density (km/km²)		•			•	•	•	•		As above	3 years
WATER AVAILABILITY	H, P, L, R		•	•	•	•	•	•	Water availability for household use, food production and ecosystems	FEWS ,TRMM, CMORH, MODIS, Landsat, WV2 or Quickbird, HHS, stream gauge	Daily monthly annual
Daily precipitation	L, R	•		•	•	•	•			Climate stations, CMORPH, TRMM	Daily
River/stream discharge	L			•	•	•	•			Stream gauges	Continuous
Water withdrawals for domestic, agricultural and urban uses	H, P, L		•		•	•	•	•		HHS	Annual



WATER QUALITY	**H, L**		•		•	•	•	•	Water pollution due to soil erosion and leaching	Field measurements	Annual 5 years
% bare ground	**L, R**	•				•				MODIS, Landsat, WV2 or Quickbird	Annual
Mg/L of N, P and fecal coliform	**L**		•		•	•		•		Water samples	Annual
pH	**L**		•		•	•				Water samples	5 years
Water source type for domestic consumption	**H**		•		•	•		•		HHS	5 years
SOIL HEALTH	**P**		•		•	•	•		Nutrients applied to agricultural soils minus nutrients extracted in crops and residues	HHS, agricultural surveys, field measurements	2 years
Balance of nutrients (kg/ha of cropland/y of elemental N, P, K and S)	**P**		•		•	•	•	•		HHS, field measurements	3 -5 years
Soil carbon in topsoil	**P, L**		•		•	•				Field measurements	3-5 years
Soil exchangeable P, Ca, K, Al, S, pH	**P, L**		•		•	•	•	•		Field measurements and regional maps	5 years
Soil loss (t/ha/yr) (derived from rainfall rates, slope, land cover and management)	**P, L, R**				•	•	•			Digital elevation, ppt, land cover and management, modelling	Annual
AGRICULTURE	**P, L, R**	•	•		•	•	•		Crops and livestock for production of food and cash	HHS, field measurements, Remote sensing	Annual
Crop type	**P, L, R**	•	•		•		•			HHS, field measurements	Annual
Crop area planted	**P, L, R**	•	•		•	•	•			HHS, field measurements	Annual
Crop area harvested	**P**		•		•	•	•			HHS, field measurements	Annual
Crop yield	**P**		•		•	•	•			HHS, field measurements	Annual
Length of fallow season	**P**				•		•			HHS	Annual



Fertilizer type	P				•		•		HHS	Annual
Quantity of fertilizer by type	P				•		•		HHS	Annual
Crop fraction remaining after harvest	P				•	•	•		HHS	Annual
Type, quantity of crop byproduct produced in last year (kg or L	P				•	•	•		HHS	3 years
LIVESTOCK & RANGELAND										
Livestock type, number and density	L, R		•		•	•	•			National surveys	3-5 years
Pasture area (ha)	H, L		•		•	•	•			HHS	3 years
Type and number of livestock owned	H		•		•	•	•	•		HHS	3 years
Type and percent of livestock feed or forage from different sources	H, P		•		•	•	•			HHS	3 years
FUELWOOD SUFFICIENCY	P, L, R	•			•	•		•	Sustainability of fuelwood supply	MODIS, Landsat, WV2 or Quickbird, biomass measurements, HHS	5 years
Annual production of woody biomass (kg.y)	L, R	•			•	•		•		MODIS, Landsat, WV2 or Quickbird, biomass measurements	5 years
Annual harvest of woody biomass (kg.y)	H		•		•	•		•		HHS	5 years
Time spent collecting fuelwood	H		•		•	•		•		HHS	2 years
Primary fuel for cooking	H		•		•			•		HHS	3 years
Primary fuel for light	H		•		•			•		HHS	3 years
Types of fuel purchased in last year	H		•		•			•		HHS	3 years
Percent of income allocated to fuel	H		•		•			•		HHS	3 years
CARBON STOCKS, ABOVE AND BELOW GROUND	P, L, R	•	•		•	•				MODIS, Landsat, WV2 or Quickbird, biomass measurements,	Annual 5 years
Above-ground carbon in vegetation (tons carbon/km^2	P, L, R	•	•		•	•					5 years



Soil carbon to 1 m (ton C/ha)	P, L, R	•	•		•				soil samples	5 years
CLIMATE and CLIMATE FORCING	P, L, R	•		•		•			Climate stations	Continuous
Temperature (degrees C)	P, L, R			•		•			Climate stations, ibutton sensors	Daily max and min
Precipitation (mm)	P,L, R	•		•		•			Climate stations,, CMORPH, TRMM	Daily
kWh/m^{22}day	L, R			•		•			Climate stations,	Daily
N fertilizer applied (kg N/ha)	P, R		•		•	•	•		HHS	3 years
Livestock density	P, L, R		•		•	•	•		HHS	3-5 years
Area planted to grain	P, L, R		•		•	•	•		HHS, Landsat, WV2	3-5 years
Area and type of legume	P, L, R		•		•	•	•		HHS, Landsat, WV2	3-5 years
BIODIVERSITY	L, R	•	•		•	•			MODIS, Landsat, WV2 or Quickbird, camera traps, surveys	Annual 3 years
Invasive species types / extent	L				•		•		WV2 or Quickbird, Field surveys	3 years
Protected areas	L, R	•					•		WCMC, Government	3 years
Extent of ecosystems and type	L, R	•					•		MODIS, Landsat, WV2 or Quickbird	3 years
WILD FOOD SOURCE AVAILABILITY	H, L				•	•		•	HHS	3 years
Non-timber forest products harvested (kg/year/person)	H, L				•	•		•	HHS	3 years
Kg wild meat consumed in the last week	H, L				•	•		•	HHS	3 years
Kg wild fish consumed in the last week	H, L				•	•		•	HHS	3 years
Number of medicinal plant species used in the last month	H, L				•	•		•	HHS	3 years



FOOD SECURITY	**H**		•	•		•	•	Food security is the physical, social, and economic access to sufficient and nutritious food to meet dietary needs for a healthy and active life	HHS	3 years
Food availability (calories and nutrients available from production less sales and purchase) per capita	**H**		•	•		•	•		HHS	3 years
Food Access (Affordability as percent of income spent on food purchases)	**H**		•	•			•		HHS	3 years
Food utilization (food intake and dietary diversity)	**H**		•	•			•		HHS	
Number of months without sufficient food	**H**		•	•			•		HHS	3 years
POVERTY	**H**		•	•			•	Consumption/expenditure and productive assets	HHS	3 years
Kg of food consumed in household from own production in last week	**H**		•	•			•		HHS	3 years
Kg of food consumed in household from purchases in last week	**H**		•	•			•		HHS	3 years
Price (value) per kg of food consumed in the household in last week	**H**		•	•			•		HHS	3 years
Non-food purchase by household	**H**		•	•			•		HHS	3 years
In-kind food consumed by the household in last week	**H**		•	•			•		HHS	3 years
Age, gender of household members	**H**		•	•			•		HHS	3 years
Household assets owned (car, motorcycles, phone, ...)	**H**		•	•			•		HHS	3 years
Household sanitation facility used	**H**		•	•			•		HHS	3 years
Type of floor, roofing, and wall materials used on household dwelling	**H**		•	•			•		HHS	3 years
Farm implements owned by household in past 12 months	**H**		•	•			•		HHS	3 years
Kg of food consumed in household from own production in last week	**H**		•	•			•		HHS	3 years
Kg of food consumed in household from purchases in last week	**H**		•	•			•		HHS	3 years



NUTRITION	**H, R**		•	•		•	Percentage of children under 5 - overweight, under-weight, stunting, and wasting; Body mass index for adult women	HHS	3 years
Stunting –Height (cm) for age(years, months, days) for children less than 5 years old (z scores)	**H, R**		•	•		•		HHS	3 years
Under weight –Weight (kg) for age (years, months, days) of children less than 5 (z scores)	**H, R**		•	•		•		HHS	3 years
Wasting – Weight (kg) for height (cm) of children less than 5 (z scores)	**H, R**		•	•		•		HHS	3 years
Mid upper arm circumference (cm) for children less that 5	**H**		•	•		•		HHS	3 years
Body mass index – weight (kg) for height (cm) for children under 5 and women of reproductive age	**H**		•	•		•		HHS	3 years

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