Food and Fuel: Glriicidia in Zambia SRWC in Africa

Jeff Skeer (IRENA)
Chris Armitage (EverGreen)

IEA Bioenergy Task 43 Workshop on *Sustainable Landscape Management for Bioenergy and Bioeconomy*

FAO, Rome
October 11, 2018

Benefits of Agroforestry

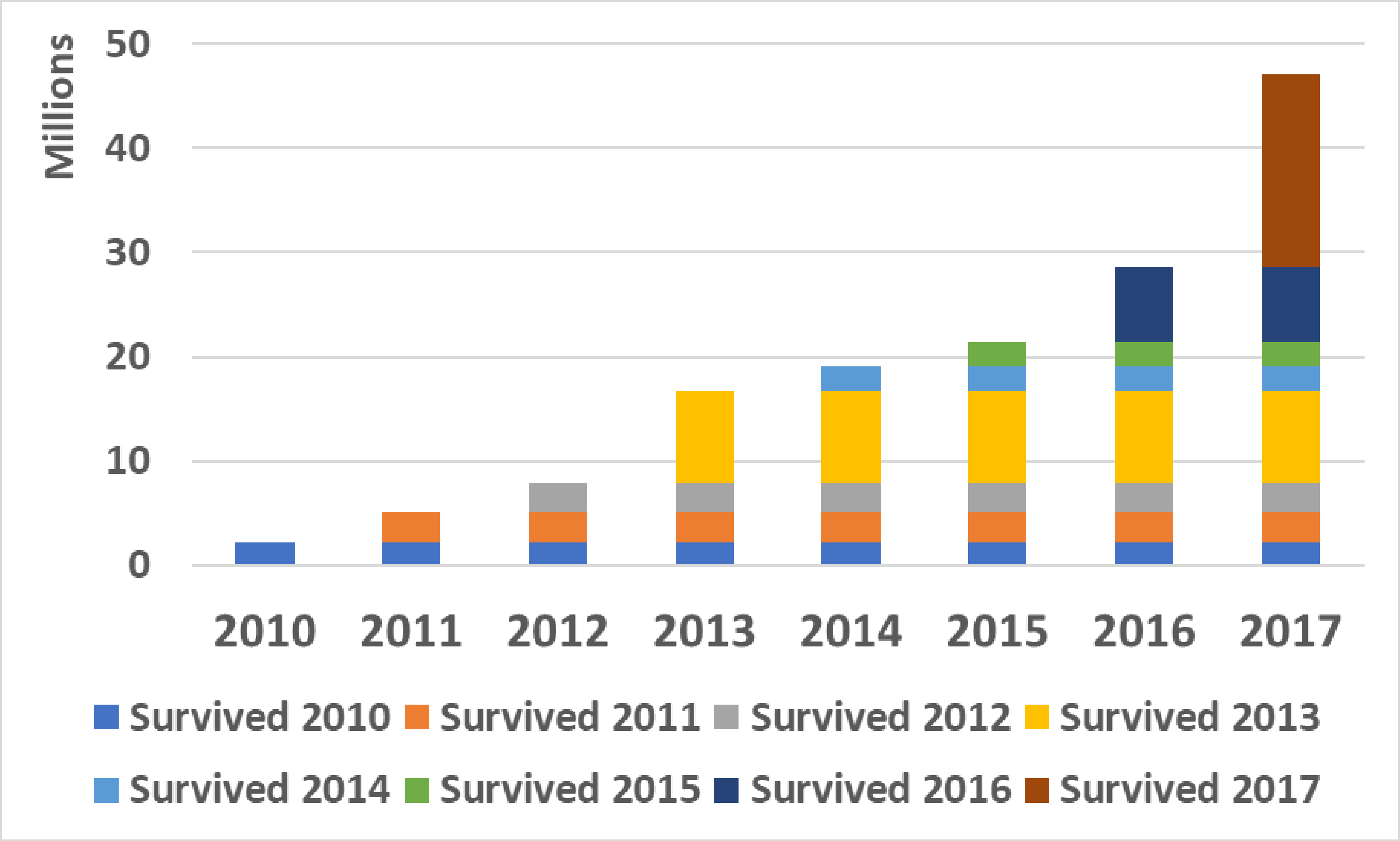
- ***Social benefits***
  - increased income and employment,
  - empowerment of rural communities
  - participation in projects by women, elderly and disabled.
- ***Economic benefits***
  - improved agricultural productivity with greater food and livestock output
  - increased rural business opportunities and job creation,
  - foreign exchange savings from reduced use of fossil fuel, and fertilizer
  - development of rural infrastructure in off-grid and marginalized areas.
- ***Environmental benefits***
  - reduced carbon emissions with increased uptake of atmospheric carbon
  - reduced land degradation with increased forest coverage
  - reduced soil erosion, enrichment of soil nutrients
  - reduced use of chemical fertilizers.

Particular Benefits of Gliricidia in Zambia

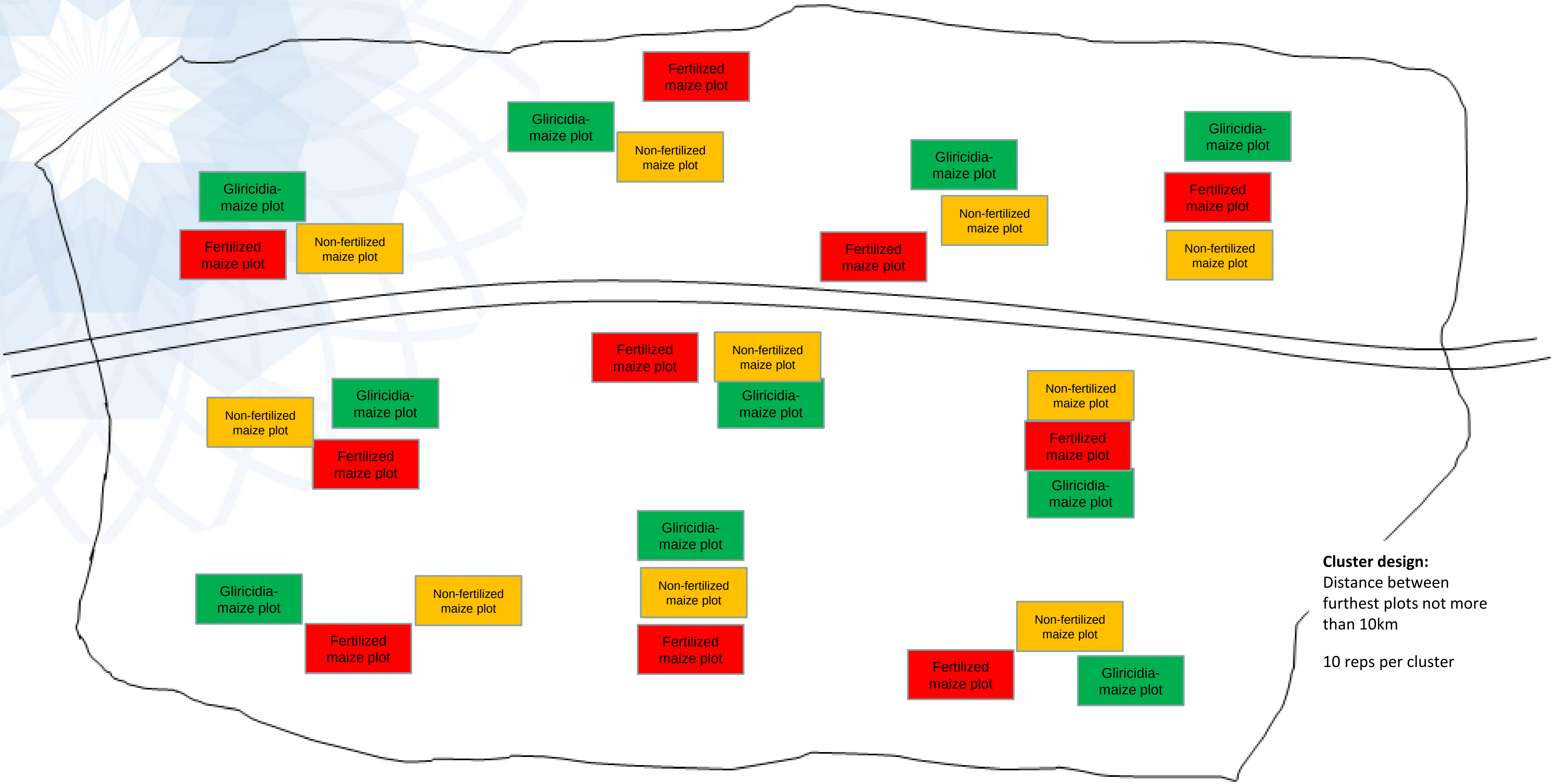
- ***Social benefits***
  - income per household increased from US$79 in 2003 to US348 in 2016
  - Food security nearly doubled from 43% to 80% of households
  - participation by more than 167,000 farmers of whom 52% are women

- ***Economic benefits***
  - Maize yields of 2 t/y roughly double those of non-participating farms
  - Fertilizer cost savings of US$80-$120 annually for farms of 0.5 ha
  - Agricultural extension service cost/farmer/year declined from $25 to $16

Gliricidia expansion in Zambia



Gliricidia raising maize yields in Zambia – study design

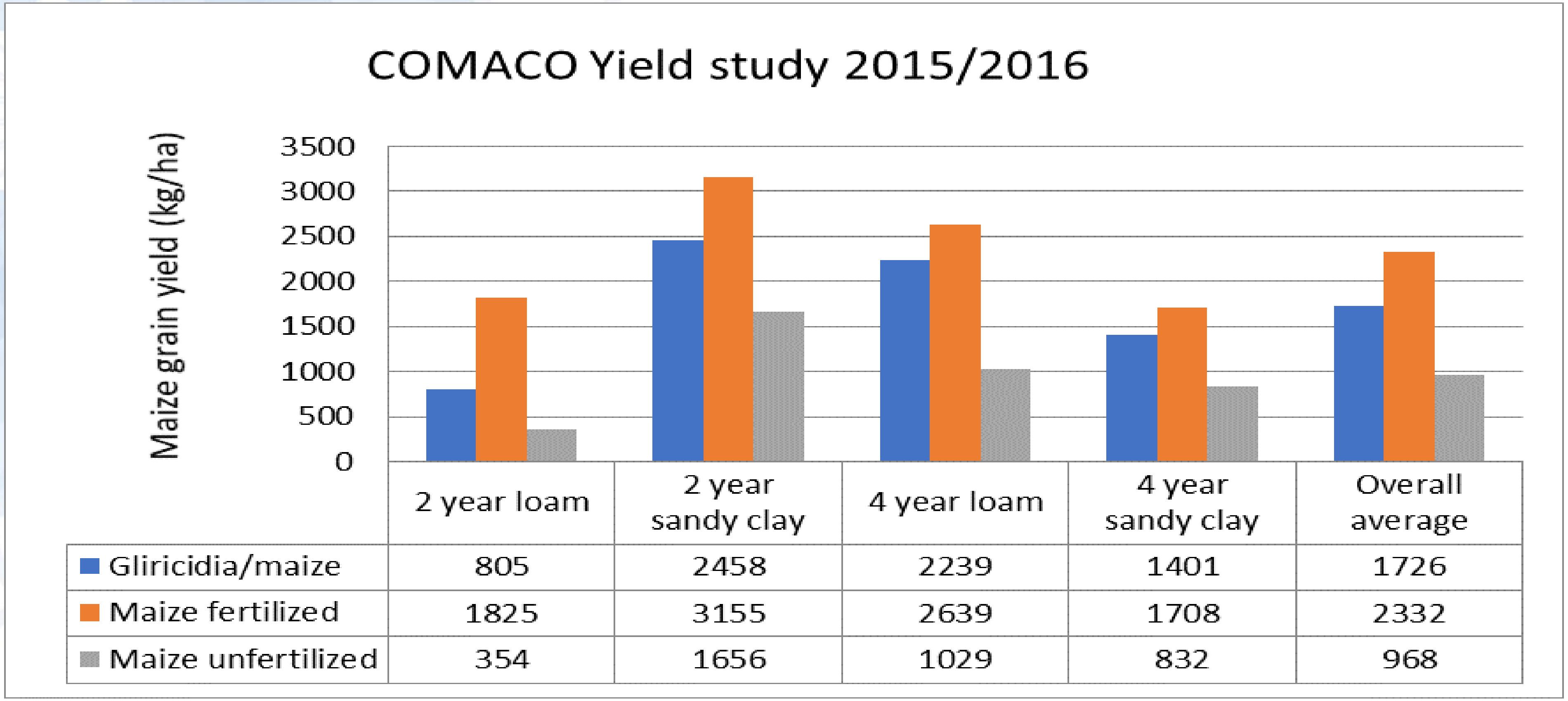


Cluster design:
Distance between furthest plots not more than 10km

10 reps per cluster

Gliricidia raising maize yields in Zambia agroforestry

IRENA
International Renewable Energy Agency



Maize yield increase from planting with Gliricidia or fertilizer, by soil type

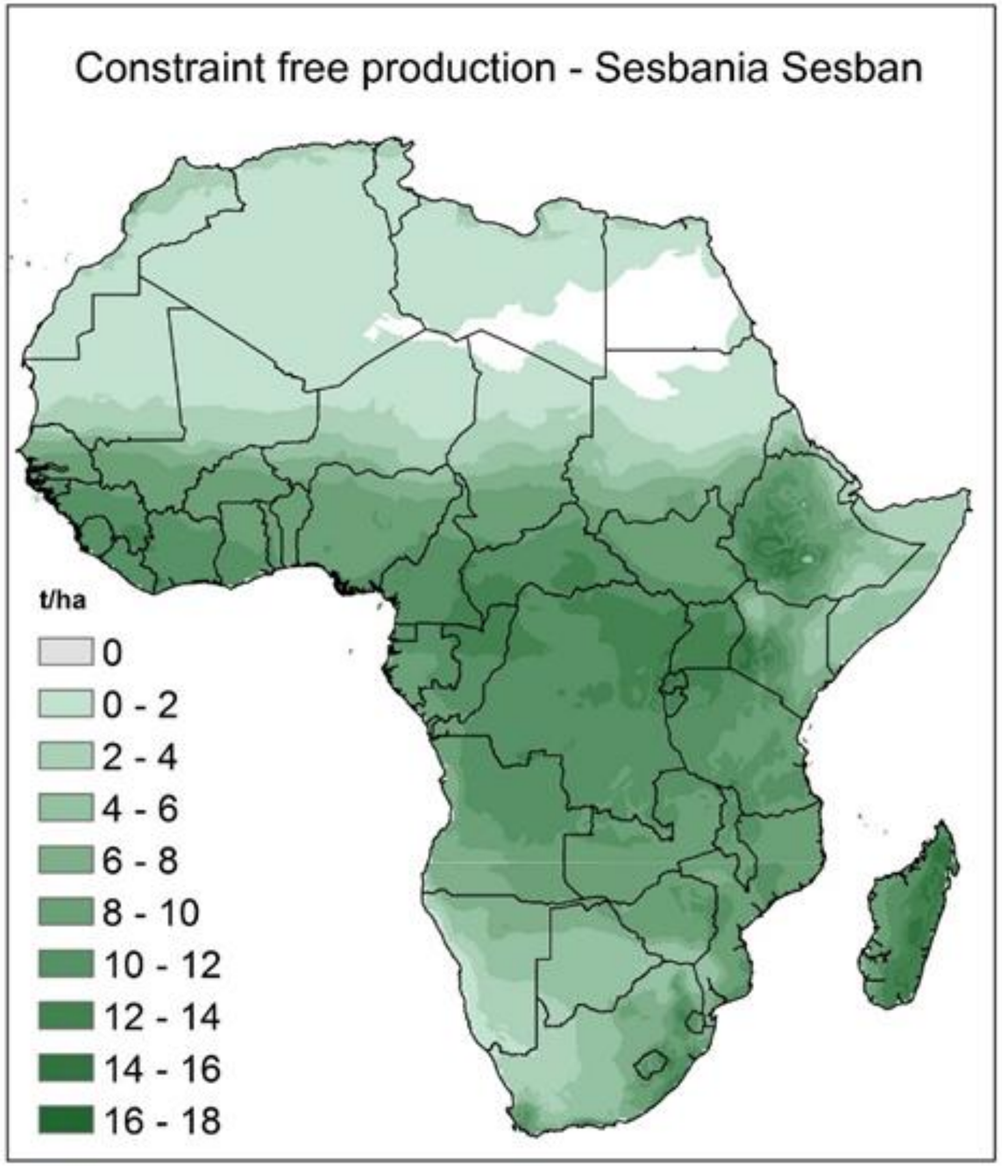
	2 year Loam	2 year sandy clay	4 year loam	4 year sandy clay	Overall average
Maize with Gliricidia	127%	48%	118%	68%	78%
Maize with fertilizer	416%	90%	156%	105%	141%

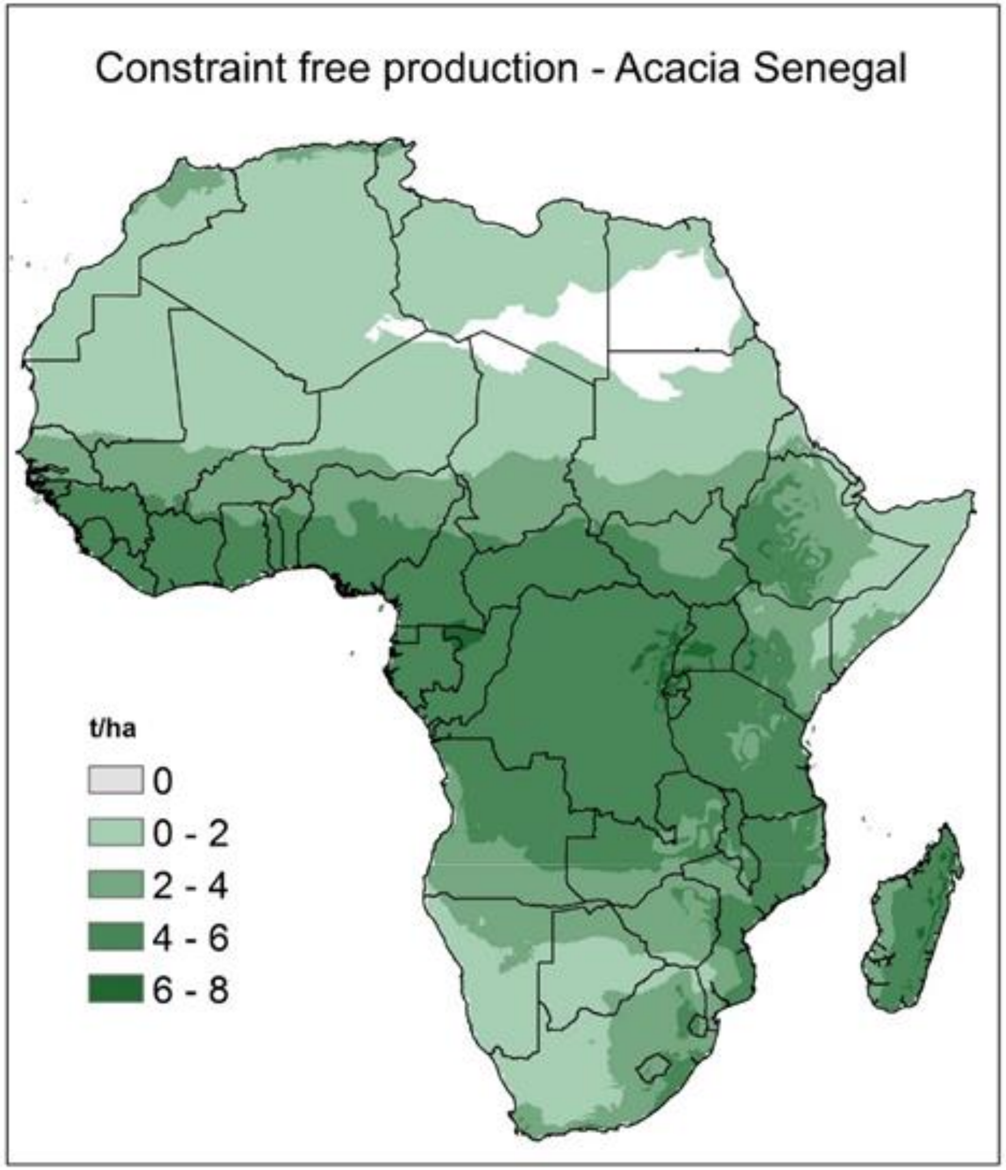
The Short Rotation Woody Crops

IRENA
International Renewable Energy Agency

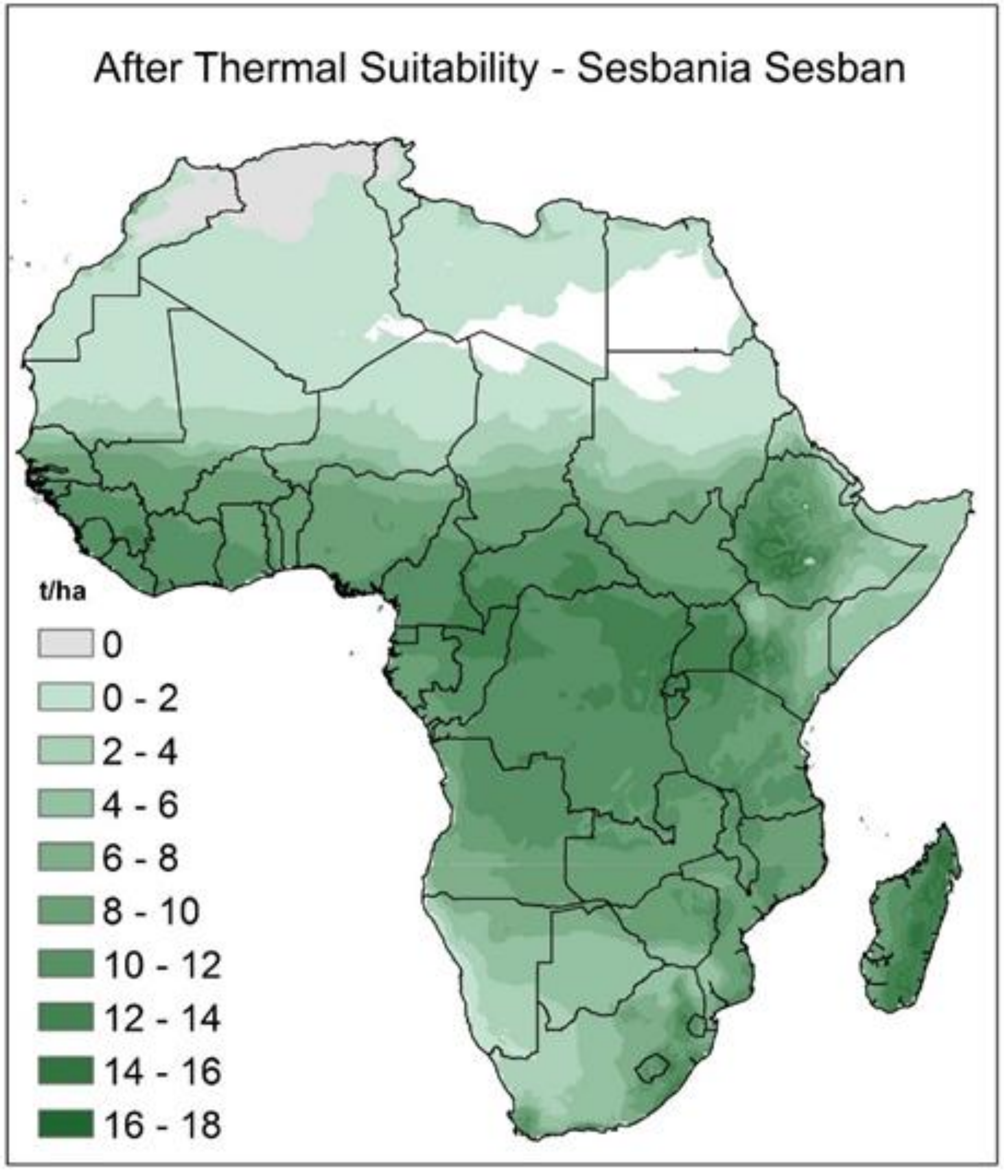
Characteristics	Group I (<20 °C) Species Suited to Cooler Climates	Group II (> 20°C) Species Suited to Warmer Climates
Temperature for maximal photosynthesis:	15°C - 20°C	20°C - 30°C
LOW RATE OF PHOTOSYNTHESIS Species in Productivity class A (Pm = 5-10 kg CH2O ha-1 hr-1)	Acacia Gerrardii	Acacia Albida
	Croton Megalocarpus	Acacia Nilotica
	Grevillea Robusta	Acacia Senegal
		Acacia Tortilis
		Calliandra Calothyrus
		Conocarpus Lancifolius
		Gliricidia Sepium
		Tamarindus Indica
MODERATE RATE OF PHOTOSYNTHESIS Species in Productivity class B (Pm = 10-20 kg CH2O ha-1 hr-1)	Casuarina Cunninghamiana	Casuarina Equisetifolia
HIGH RATE OF PHOTOSYNTHESIS Species in Productivity class C (Pm= 20-30 kg CH2O ha-1 hr-1)	Sesbania Sesban	Leucaena Leucocophala
		Sesbania Sesban

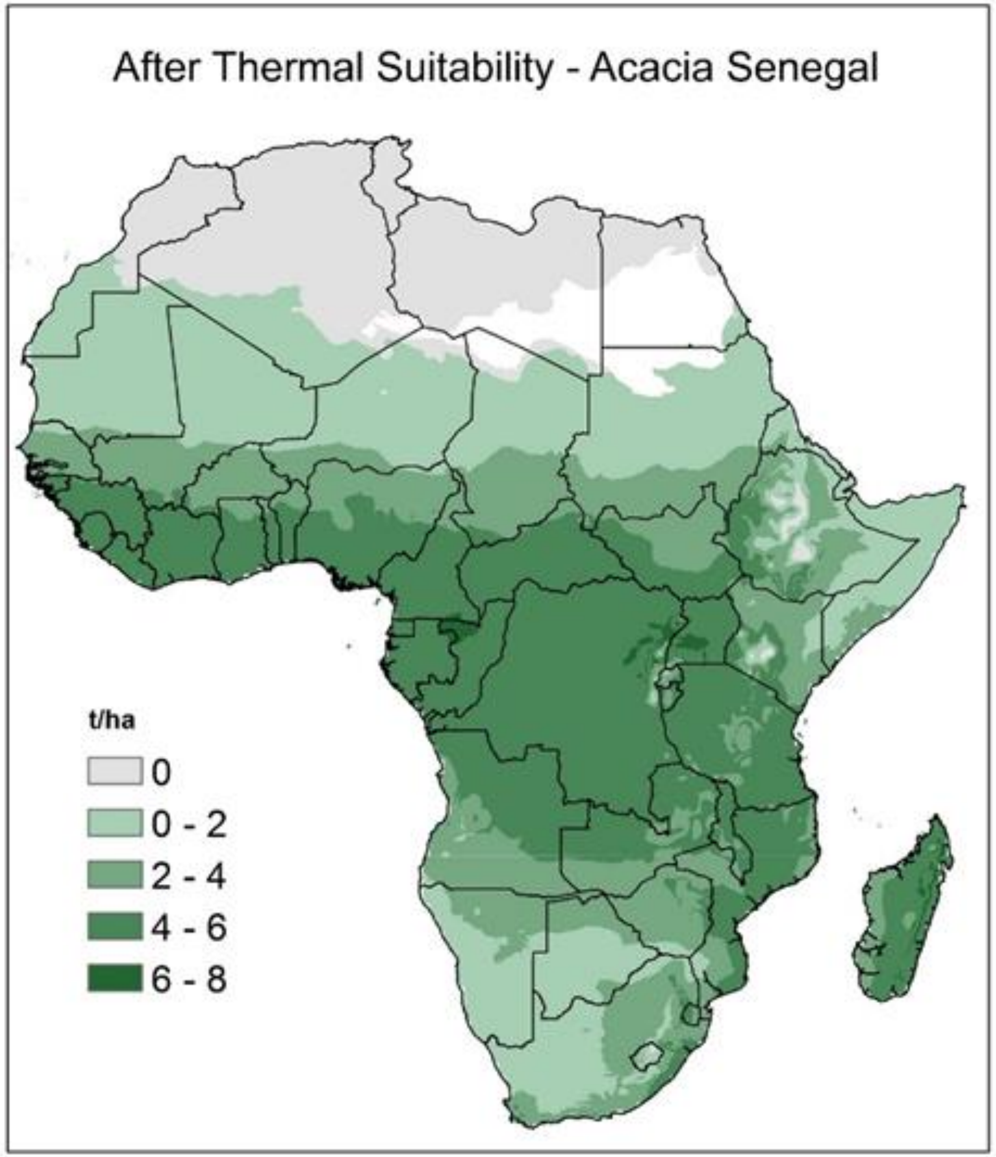
Step 1 – Calculate Constraint free production potential



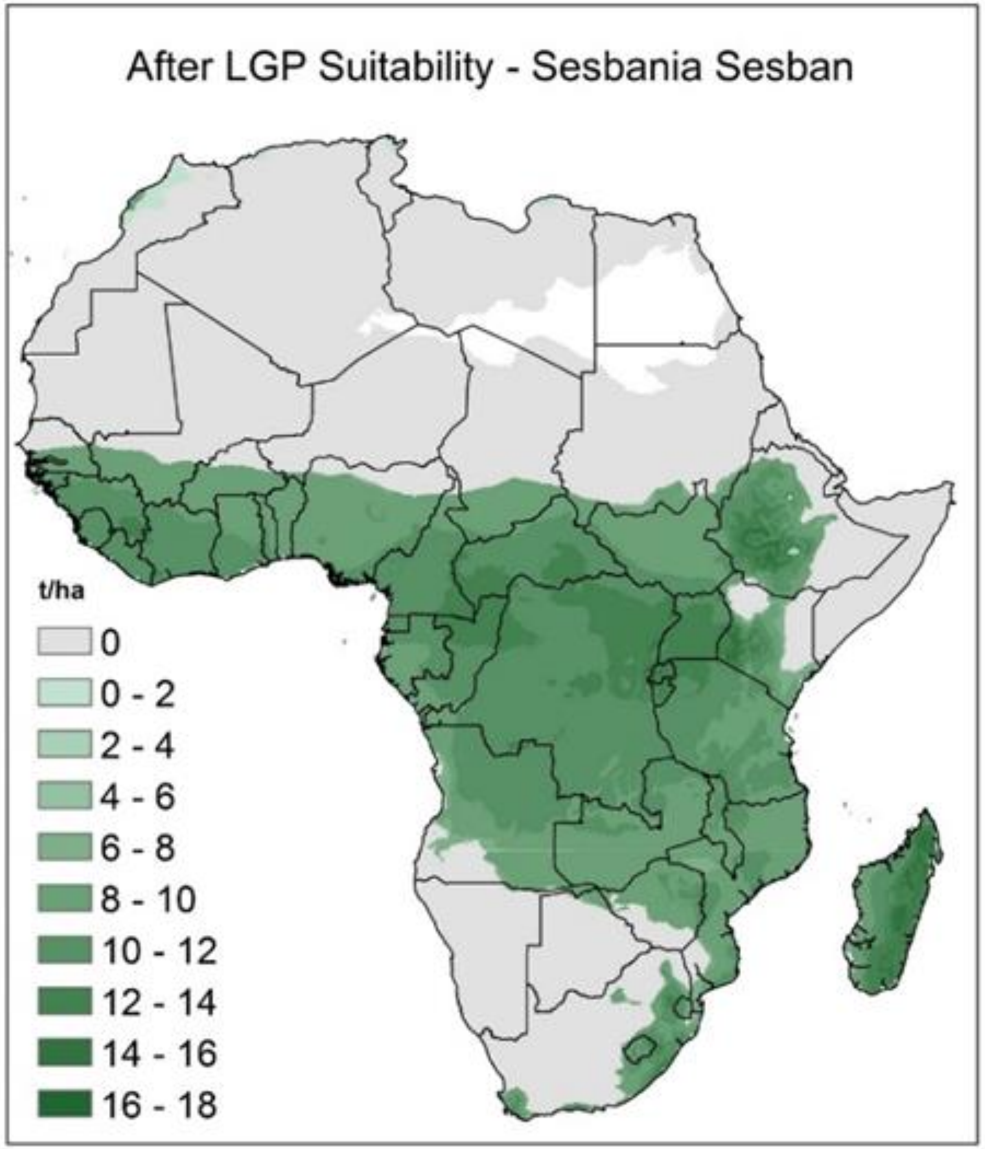


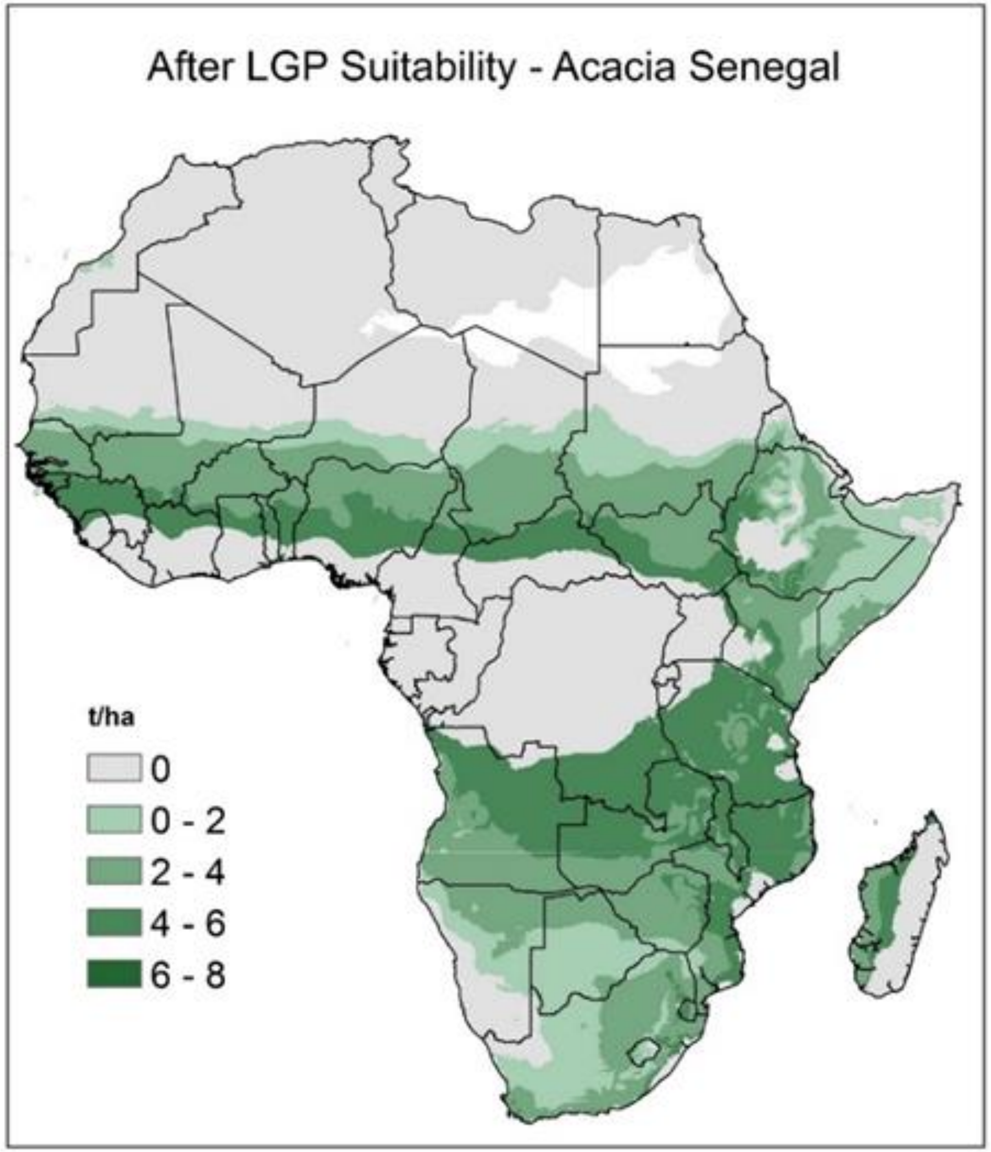
Step 2a – Climate Constraint: Temperature Suitability



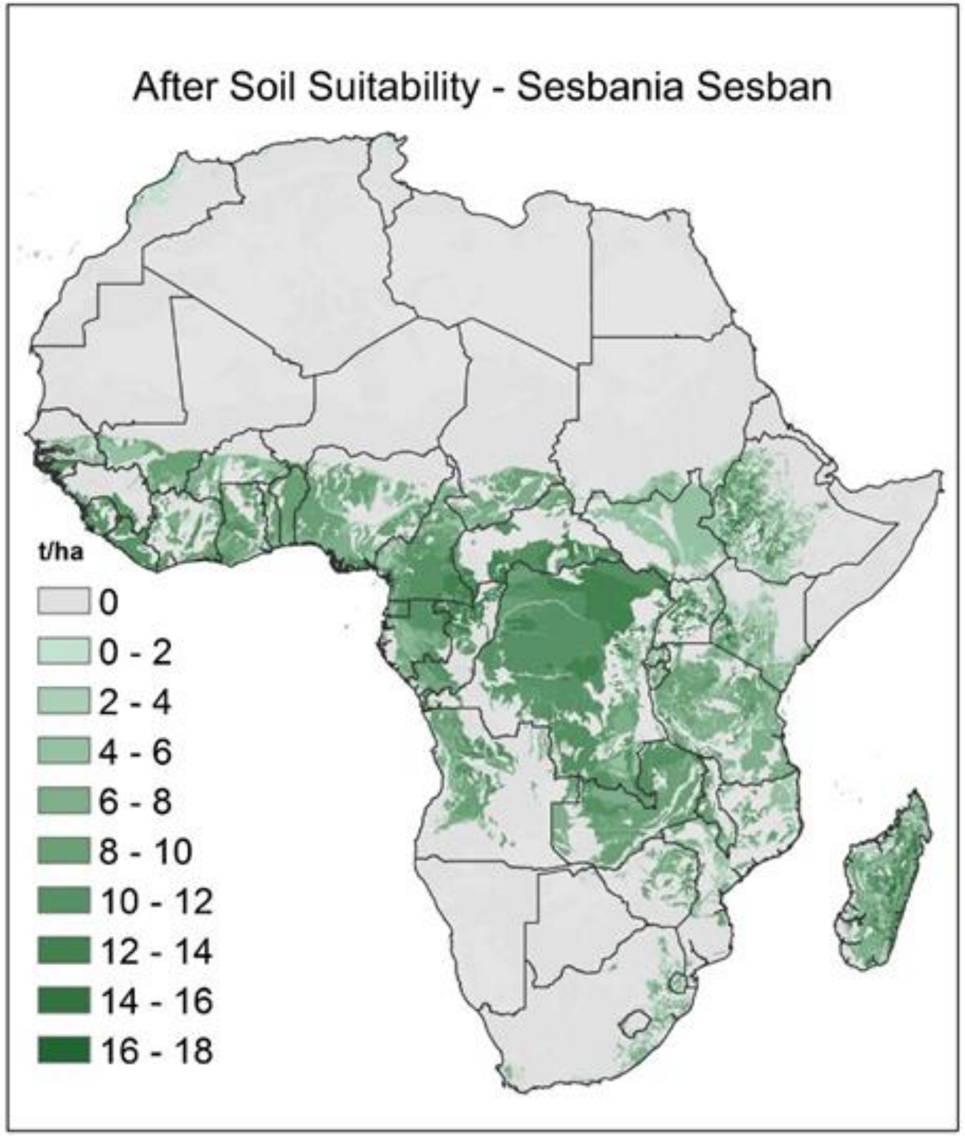


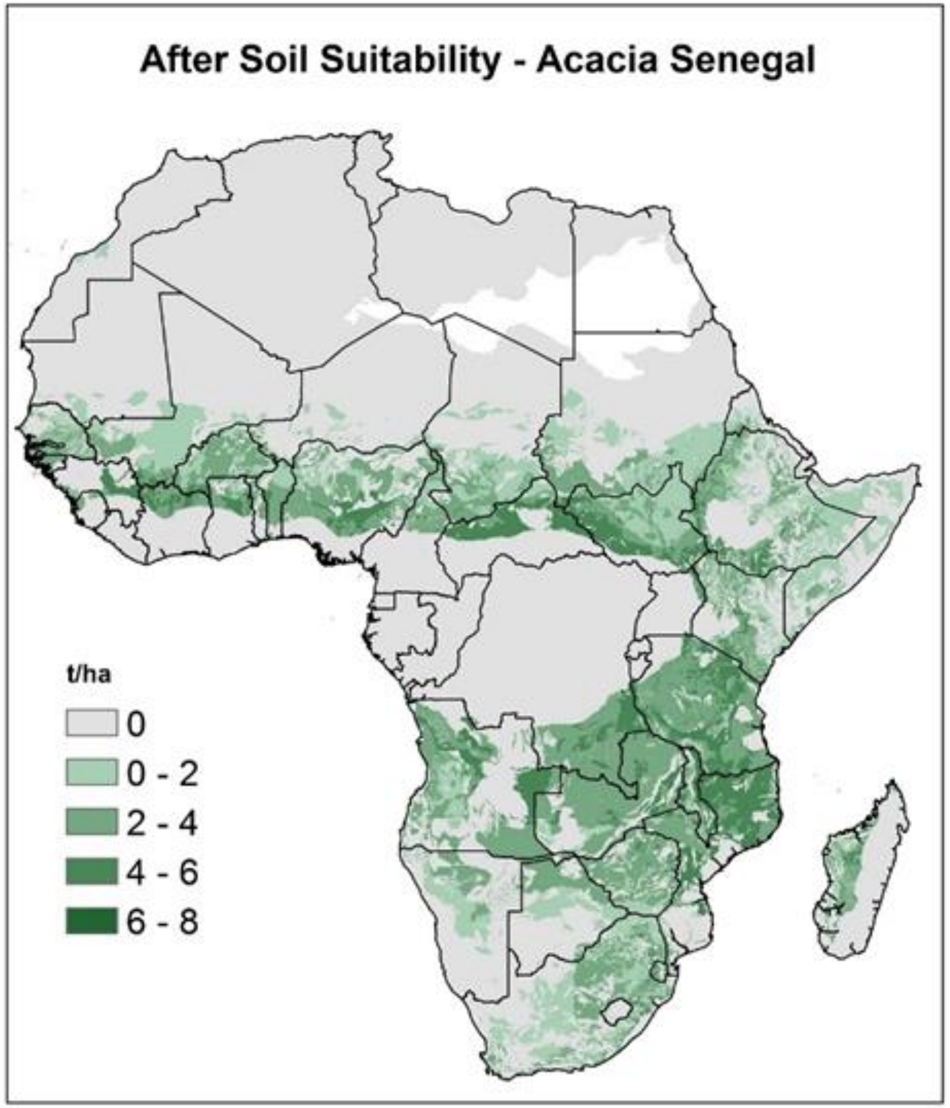
Step 2b – Climate Constraint: Length of Growing Period





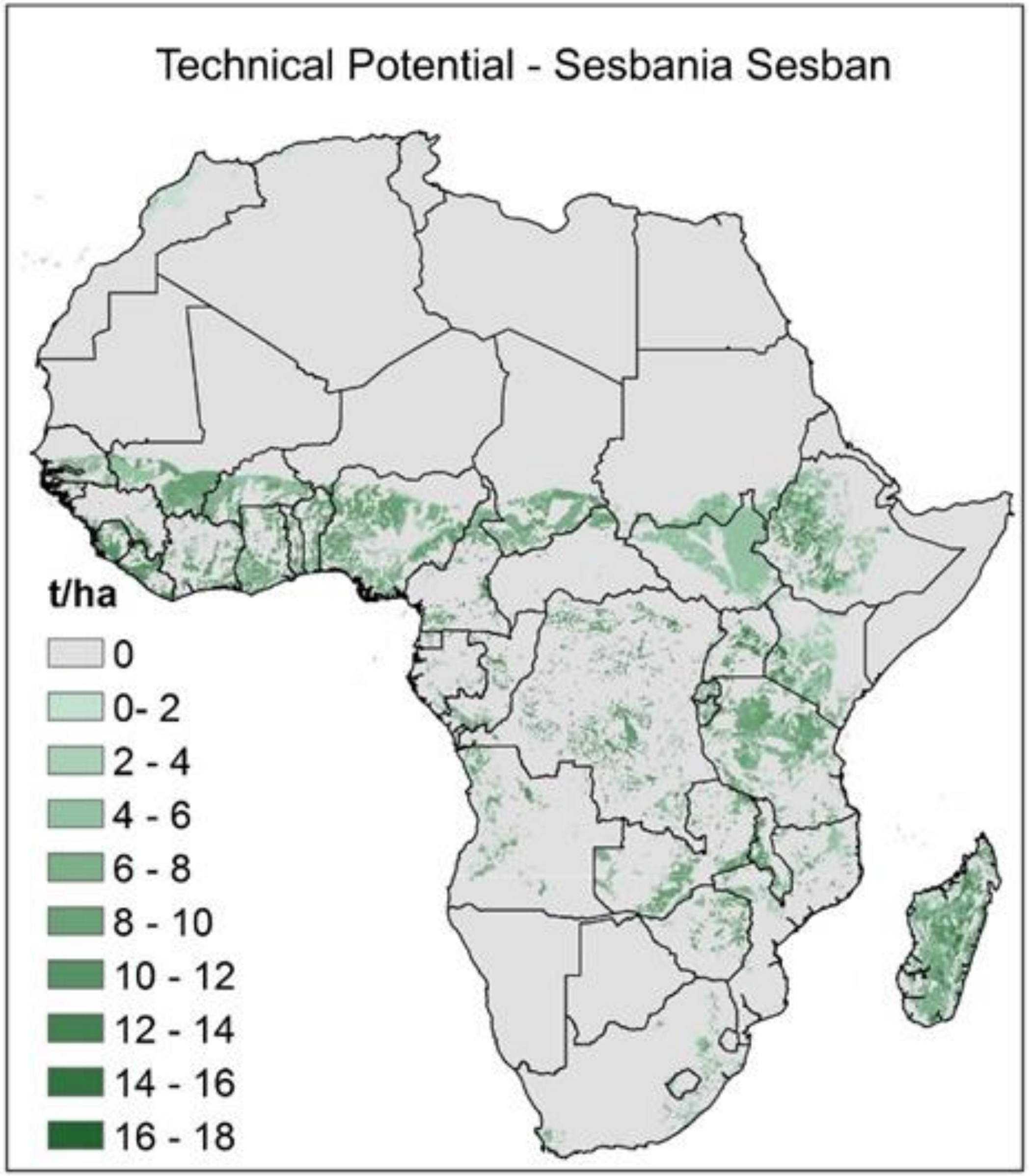
Step 3 – Soil Suitability Constraint (Arrive at Step 4 – Theoretical Yield Potential)

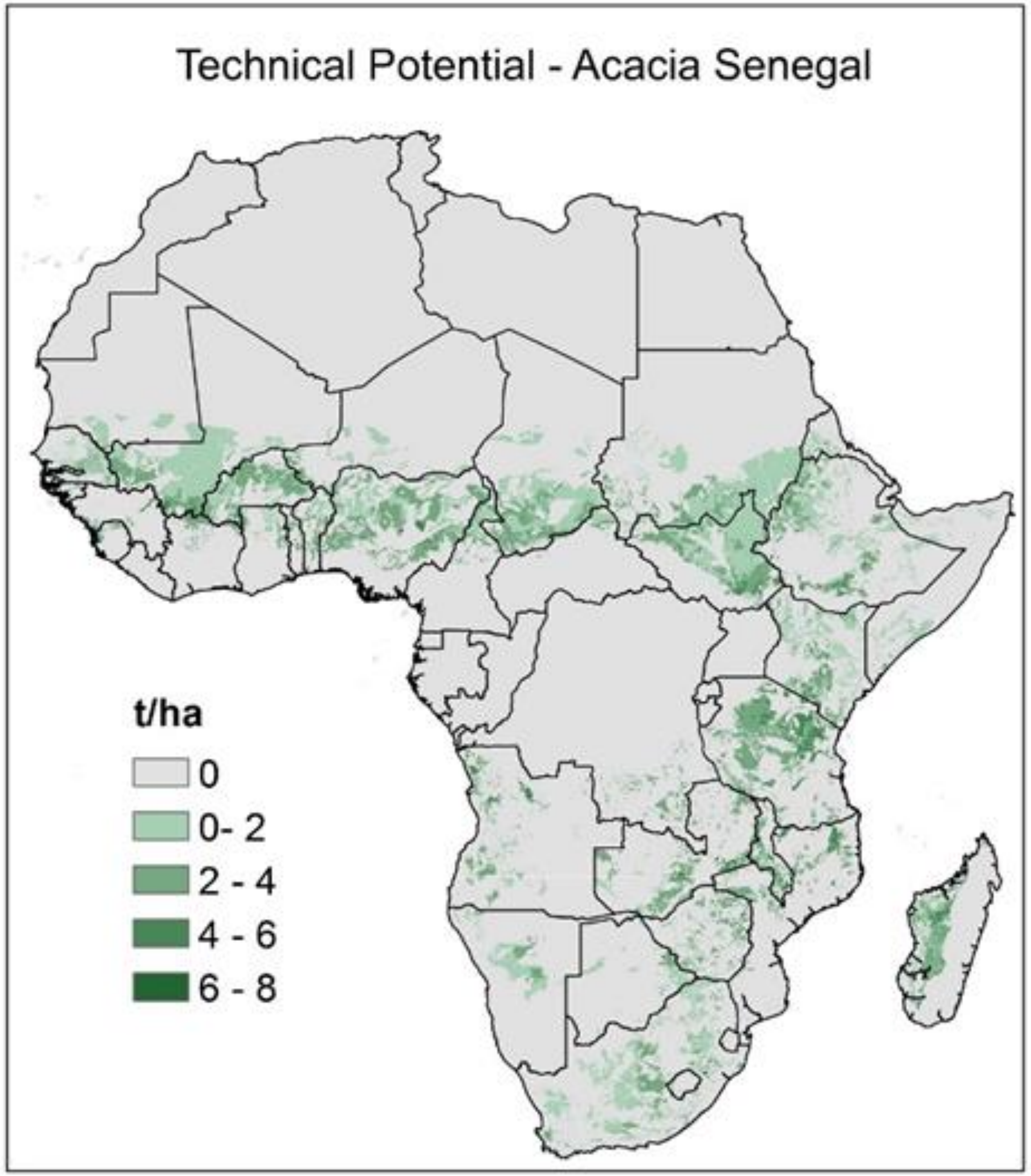




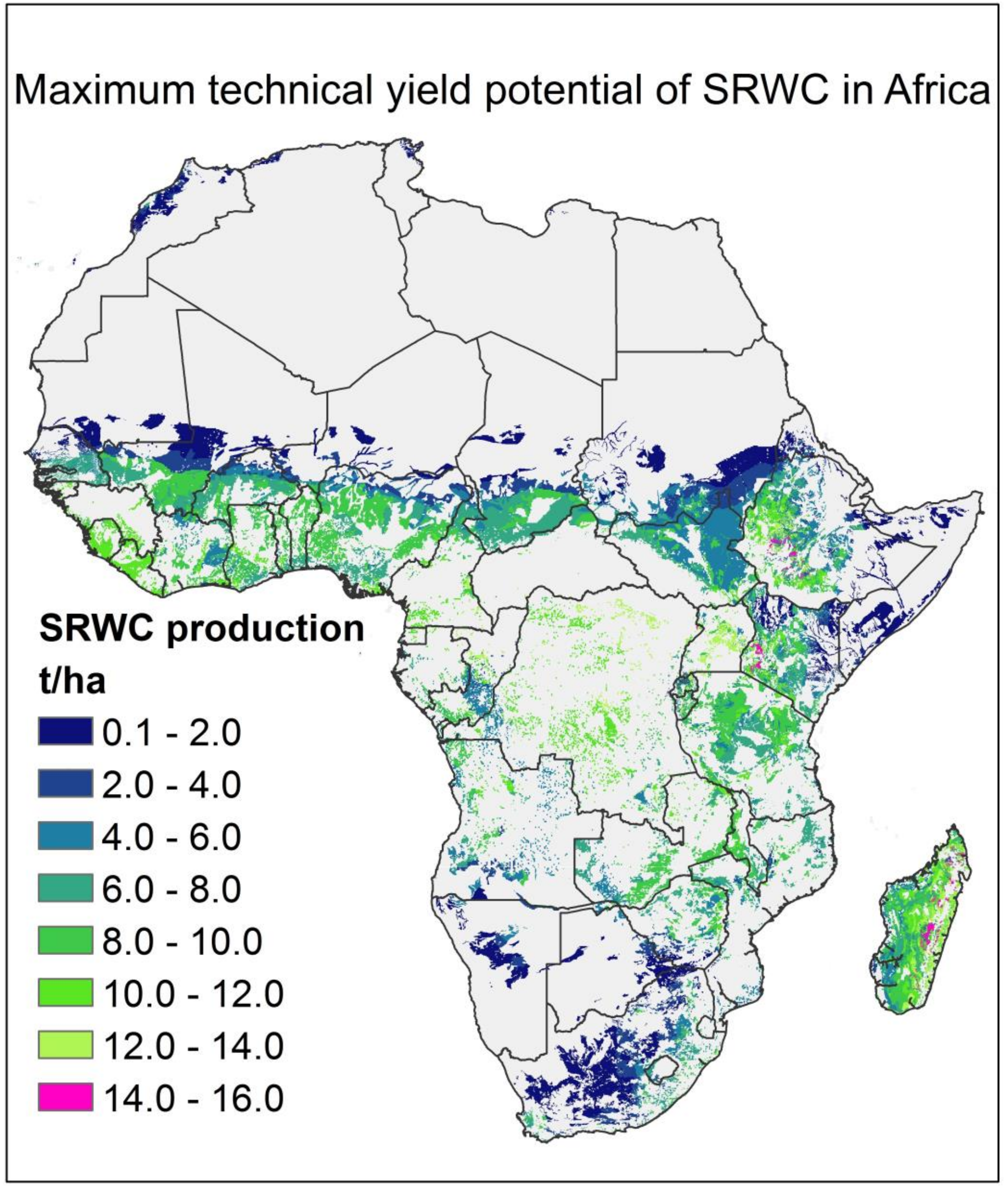
Step 5 – Land Use Constraint (Arrive at Step 6 – Technical Yield Potential)

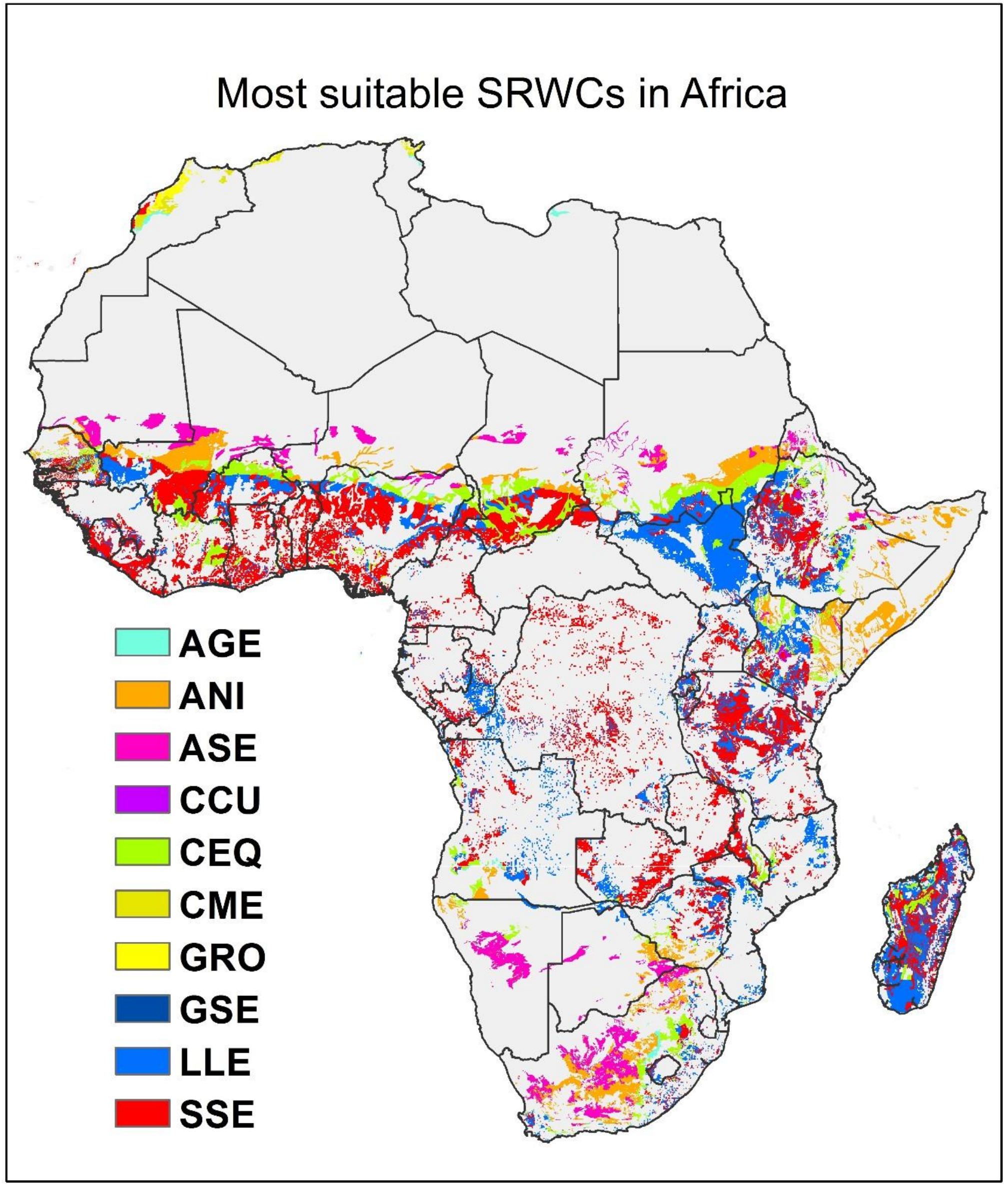
IRENA
International Renewable Energy Agency





Results – Maximum technical yield potential





Conclusions

- SRWC species are widely suited to agroforestry in Africa
  - All 15 SRWC species assessed are suitable to grow in Africa (combined range of 555 Mha)
  - Average species suited to 355 Mha, of which **158 Mha agricultural land** and **184 Mha grassland**
  - So average species could grow on **62% of Africa's farmland** and **20% of Africa's pastureland**
  - Length of growing period is most important factor in land availability
  - Soil suitability is the most important factor affecting mean yield
- SRWC potential in agroforestry setting (sharing small plots 20/80 with food crops) by type of land use
  - Greatest potential on **grassland (349 Mt on 55 M ha** at 6.3 t/ha) [275 Mha of food/fuel plots]
  - Highest yields on **agricultural land** (325 Mt on 48 Mha at **6.8 t/ha**) [240 Mha of food/fuel plots]
  - Small potential on sparsely vegetated land (8 Mt on 5.2 Mha at 1.5 t/ha) [26 Mha of food/fuel plots]
  - Small potential on barren land (2.3 Mt on 2.8 Mha at 0.8 t/ha) [14 Mha of food/fuel plots]
- Agroforestry potential for food and fuel production
  - **95% of agricultural land** (240 Mha out of 253 Mha) **is suitable** for agroforestry systems
  - Some 40 Mha of **marginal lands** (sparsely vegetated or barren) **could be restored** by agroforestry.
  - **SRWCs on 64% of 24 Mha of maize land** could provide **17 Mt more maize** (+50%), **17 Mt wood**
  - **SRWCs on 555 Mha of land in Africa** could provide 684 Mt of wood or **13 EJ** of primary energy yearly

Thank you for your attention!