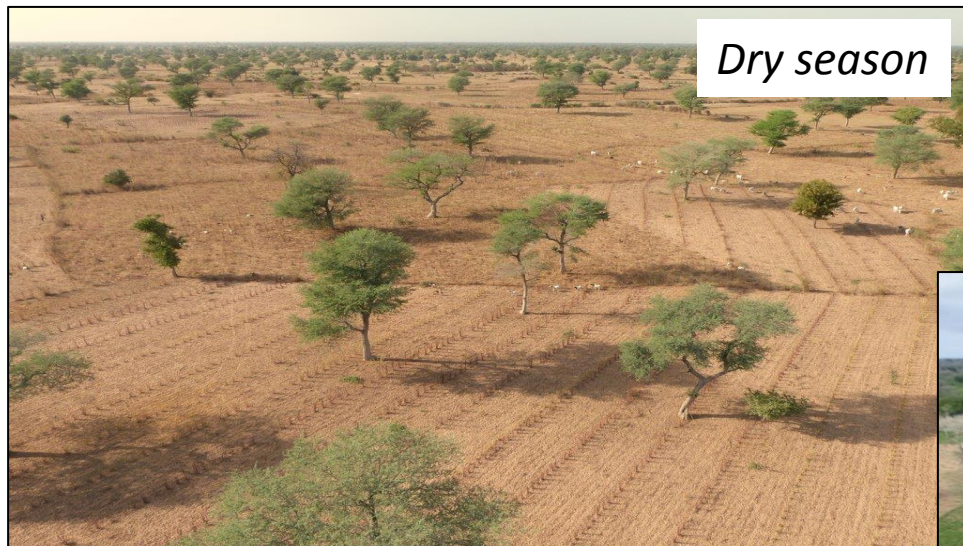


“Faidherbia-Flux”: adapting crops to climate changes in a semi-arid agro-silvo-pastoral observatory (Senegal)



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Laboratoire Mixte International

CERMA
Centre d'étude régional
pour l'amélioration
de l'adaptation à la sécheresse



Web site: AGRAF / Faidherbia-Flux:

<http://agraf.msem.univ-montp2.fr/Senegal.html>

Roupsard O., Clermont-Dauphin C., Audebert A., Ndour A., Sanou J., Koala J., Jourdan C., Orange D., Do F., Rocheteau A., Bertrand I., Faye E., Tall L., Agbohessou Y., Gaglo E., Tounkara A., Demarchi G., Brévault T., Vezy R., Le Maire G., Seghier J., Cournac L.

olivier.roupsard@cirad.fr

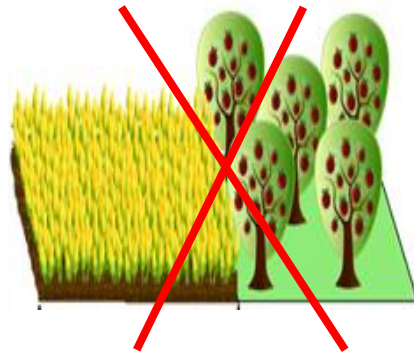
Faidherbia albida, a perfect candidate for adapting crops ?

- Widespread in semi-arid Africa
- Multi-purpose
- Domesticated and maintained by the people in parklands
- Reverse Phenology: minimum competition, forage for animals during the dry season
- N_2 Fixing
- Microclimate and fertility islets effects
- Phreatophytic (hydraulic redistributions?)
- Survived the 1970-2000 severe drought in the Sahel
- Positive effects on most crops
- Compliant with other options: livestock, mixed cropping, precision agriculture etc.



Research Questions

- How much and how far does the tree benefit to crops?
- Can we upscale results from small sampling plots to the whole stand ?
- Can we propose a simple methodology to assess the Land Equivalent Ratio (LER) in AFS, without sole crop control ?



Where?

- In the Niakhar Health-Population-Environment Observatory* (> 50 yrs of past research)

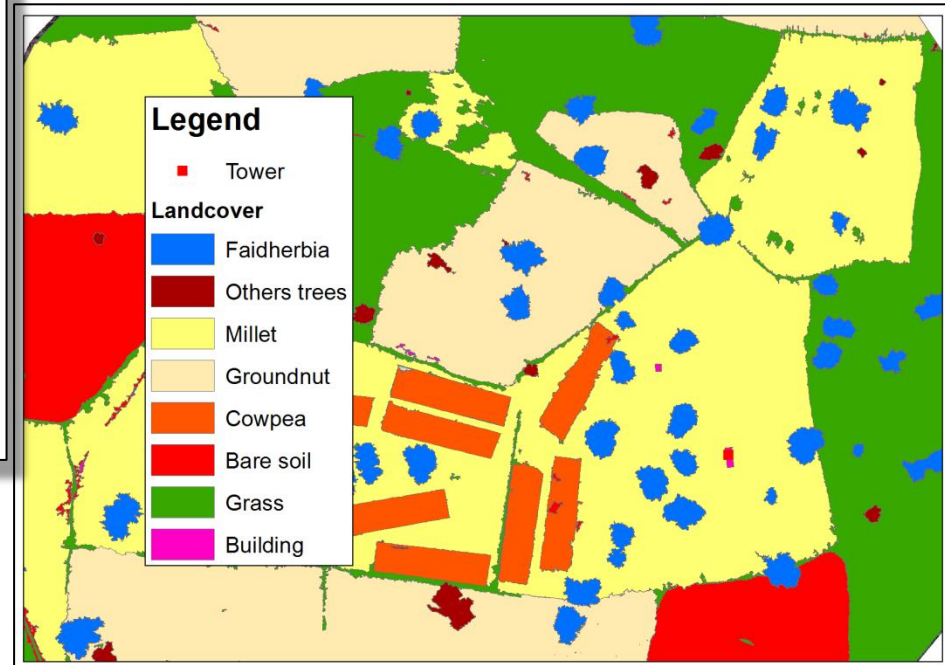


(*) <https://lped.info/wikiObsSN/>

Land Cover and soil?



*Drone Ortho-image
September 2018, wet season*



eCognition®

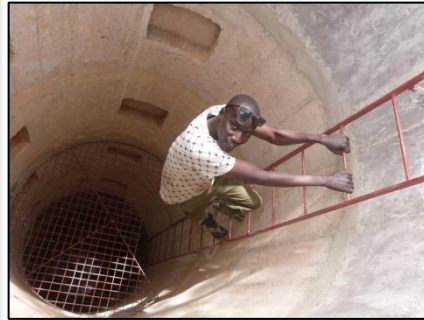
Instruments?

“Faidherbia-Flux”: a collaborative observatory for Ecosystem Services and GHG, etc.

See poster session L01.P.26



3 eddy-covariance towers



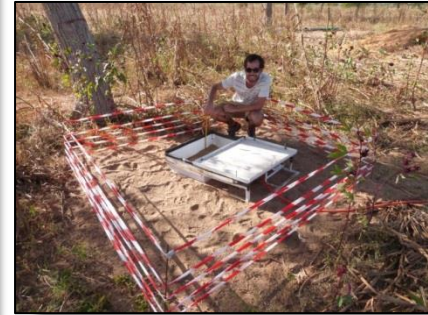
*6 Wells for deep roots
and soil monitoring*

Christophe Jourdan; Didier
Arnal; Frédéric Bouvery



*Sap flow,
hydraulic
redistributions,
ecohydrology*

Frederic Do; Alain
Rocheteau; Didier Orange



Soil GHG balance

Maxime Duthoit; Karel van
den Meersche

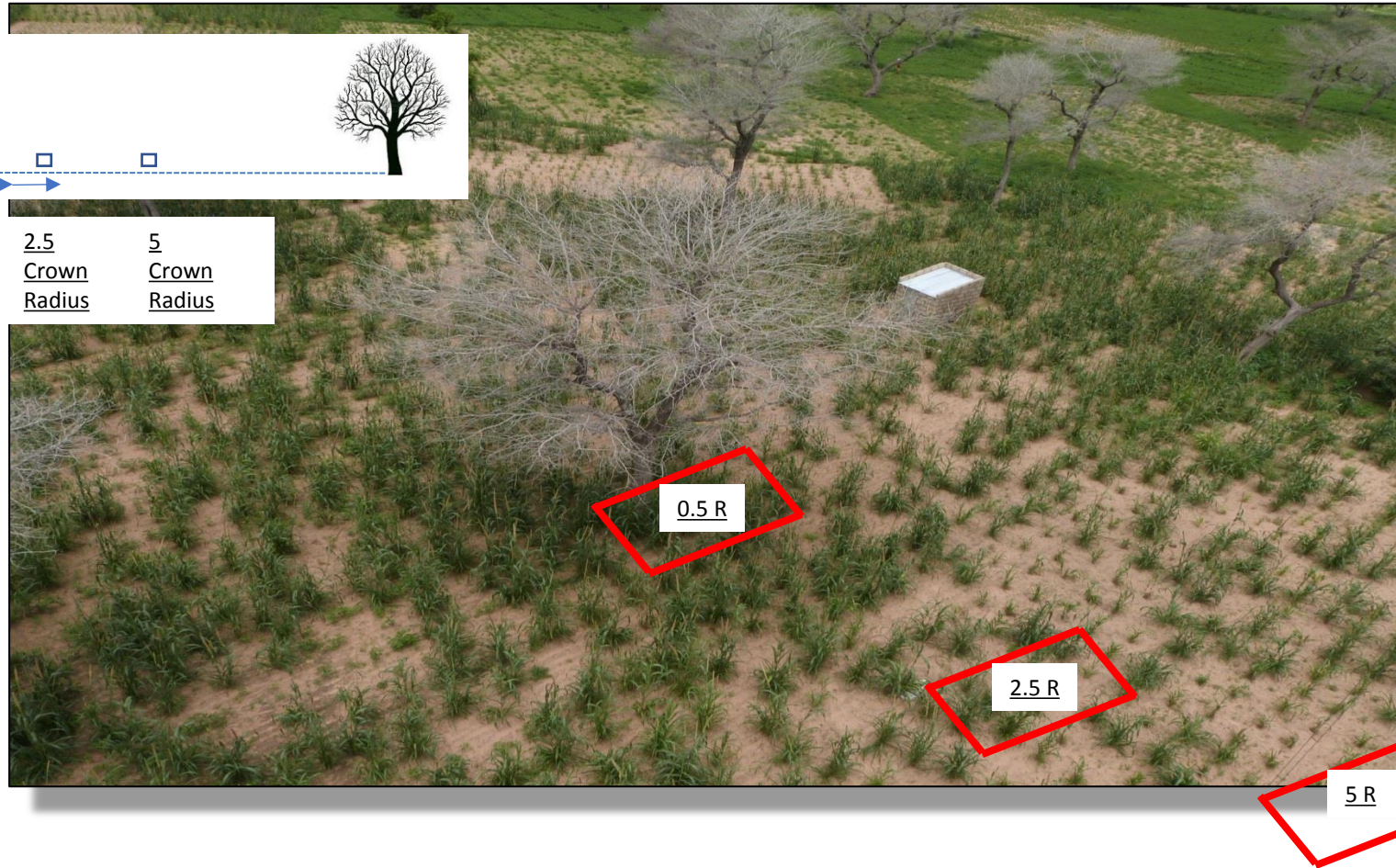
Sampling for yield ?



0.5
Crown
Radius

2.5
Crown
Radius

5
Crown
Radius



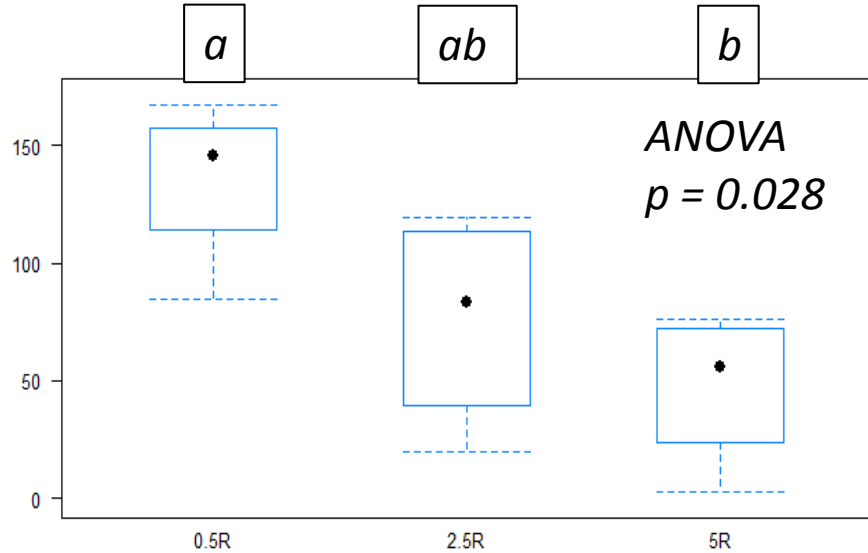
0.5 R

2.5 R

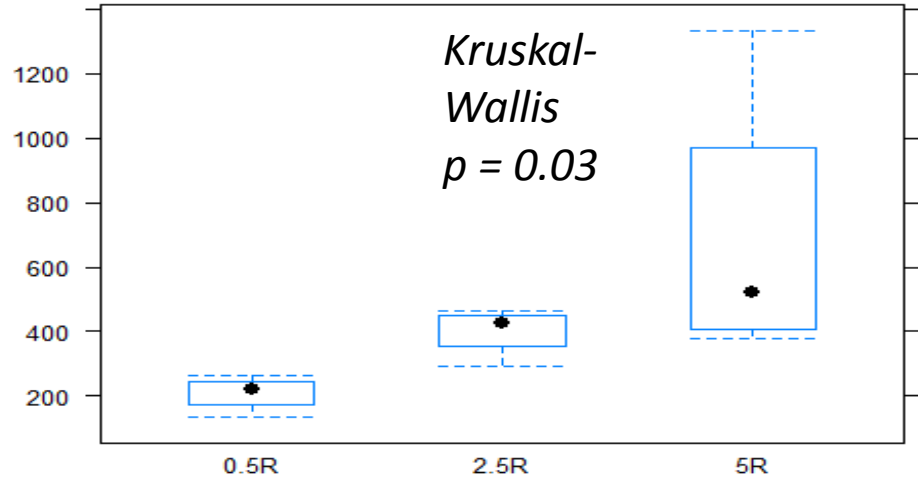
5 R

How much are the “*Faidherbia* effects”?

Millet yield (DM_grain, g m⁻²)

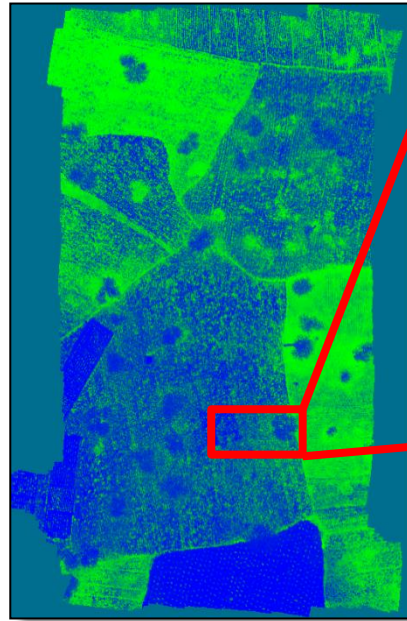


Weeds_aerial biomass (ADM, g m⁻²)

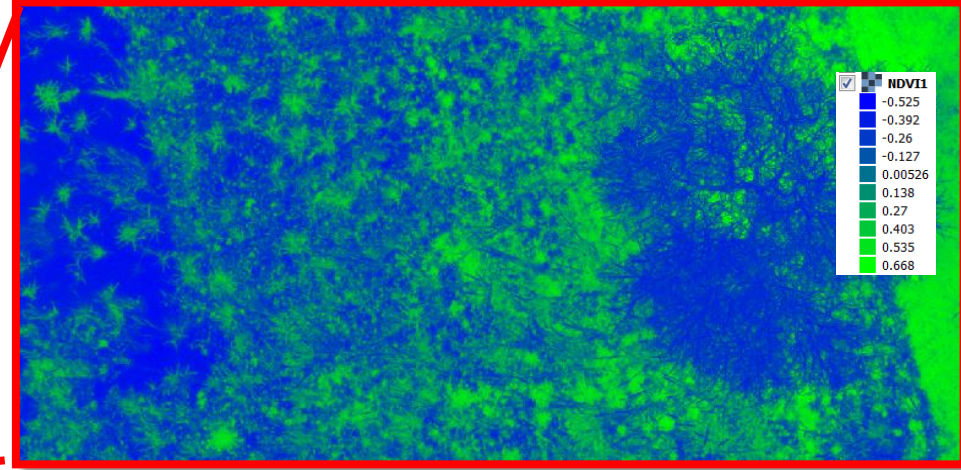
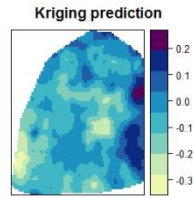


All other positive effects on biomass per compartment and LAI are significant
Effects on root:shoot, SLA, impact of leafminer are NOT significant

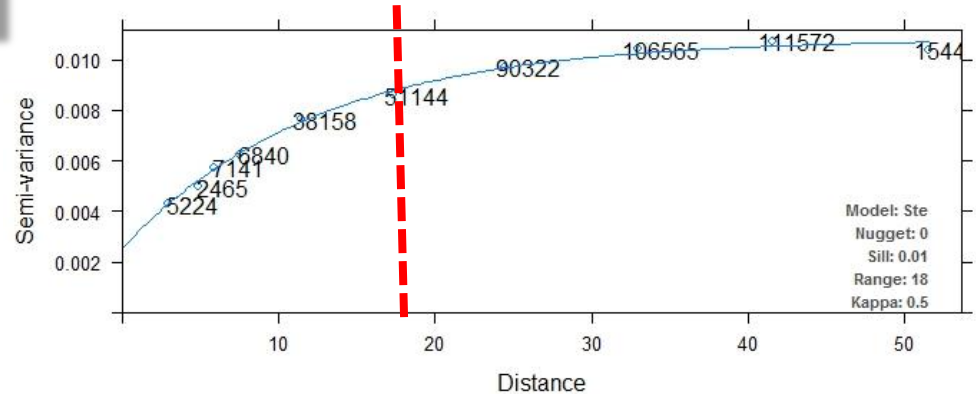
How far do trees benefit to crops ?



*Drone NDVI
October 2018, just
before harvest*

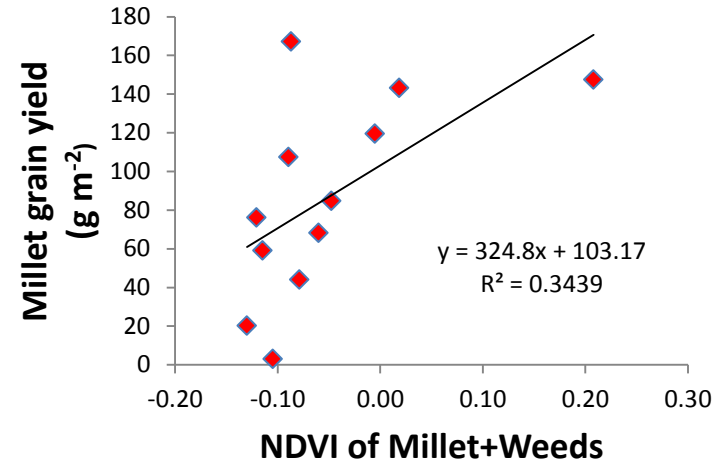
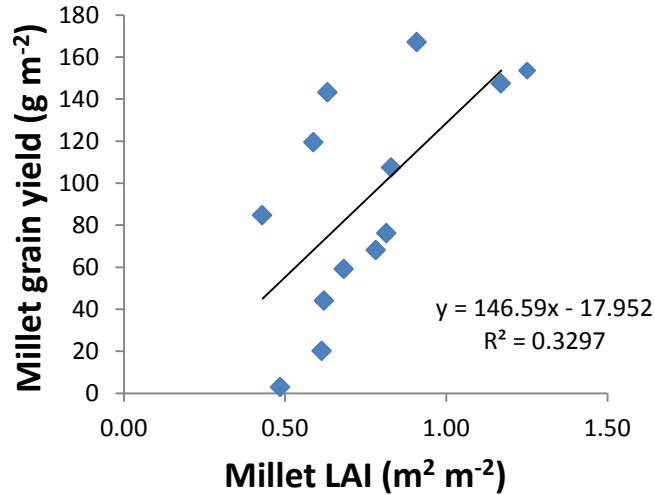


Experimental variogram and fitted variogram model



Source: Alain Audebert (CIRAD);
Adama Ndour (ISRA/CERAAS)

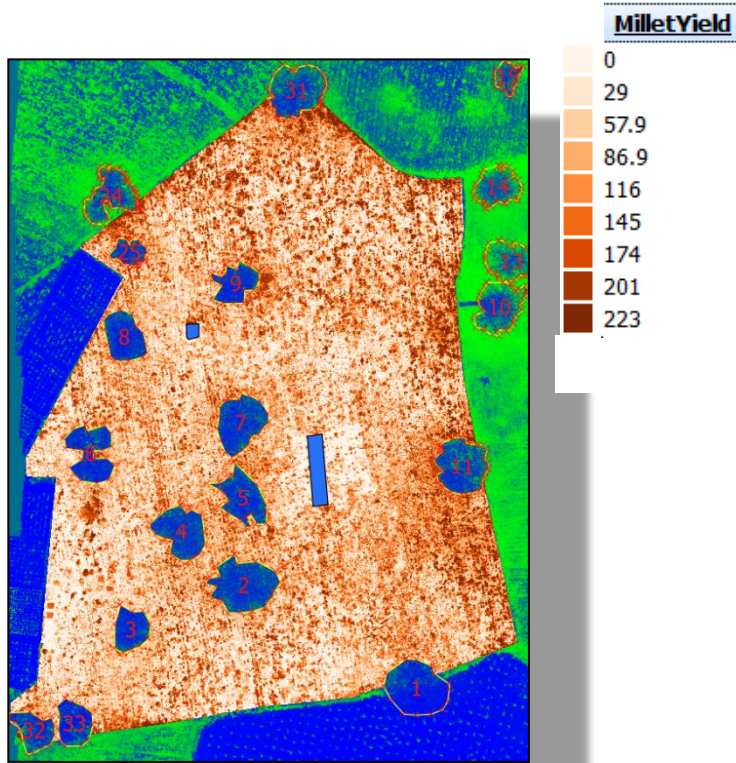
Can we upscale yield from small plots to the whole stand ?



NB: this NDVI model of yield is just preliminary. To be completed further with other indices, Clgreen, ClgreenRedEdge, gNDVI, Surface temperature, etc.

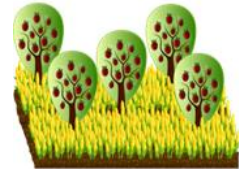
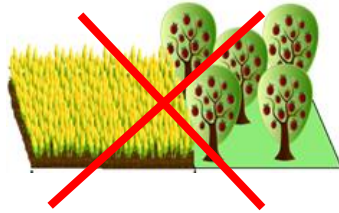
A new method to estimate whole-stand yield and LER (with drone & without sole crop field)

Millet yield



Millet yield map (DM_grain, g m⁻²)

Method	Variable of interest	Value	Unit
Manual (Reference)	Whole Plot harvest	600	kg DM grain
NDVI (Estimated)	Estimated Whole Plot harvest	690	kg DM grain
Manual (Reference)	Measured Whole Plot Yield	0.67	t ha ⁻¹
NDVI (Estimated)	Estimated Whole Plot Yield	0.77	t ha ⁻¹



$$LER_{(\text{millet only})} = \frac{Yield_{AFS}}{Yield_{sole}}$$

Method	Variable of interest	Value	Unit
Manual	Millet yield in Full Sun	0.48	t ha ⁻¹
Manual	Millet yield below Faidherbia	1.36	t ha ⁻¹
Manual (Reference)	Measured Whole Plot Yield	0.67	t ha ⁻¹
LER	Land Equivalent Ratio (Millet only)	1.40	

Take-home message

- We confirmed here *Faidherbia* is a large fertility islet to improve crop yield
- But what is new actually ?
 - ✓ using drones to upscale yield and biomass from small plot to the whole stand
 - ✓ Estimating LER without real sole crop controls
 - ✓ Possibility to estimate yield and LER in other plots, with just one drone flight
- Next steps ? Dis-entangle the “*Faidherbia* effect”: microclimate, livestock, soil fertility, SOM, soil humidity, hydraulic redistributions, P, pests, termites, plot history...??
- We need help and “*Faidherbia*-flux” is open to your collaboration !!!

Djèredjef Senegal!!!



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eco & soils



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