Scaling up Assisted Natural Regeneration to intensify agroecologically agrosystems productivity

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Background: During the last decades in Sahel, rainfall variability combined to land-use changes in order to supply increasing population (+3%/year) with food has led to a drop in cereal production. As an agroecological intensification technique, the scaling-up of tree assisted natural regeneration (ANR) could protect agrosystems and ensure sustainable crop production in this Sahelian context. This study aims to evaluate agronomic and environmental performances of agroforestry parkland arising from a local community innovations in tree resources management to support their ongoing scaling-up.

Fig. 1 Galma village in Niger in 1970 (left) and in 2003 (right)

Material and methods

Fig. 2 Soil sampling for the determination soil moisture and bulk density at ANR and non-ANR areas.

Study area: Study sites are located in central-south of Maradi region (Niger) (13 ° 41'43.16"N; 07 ° 44'7.33"E; http://satellites.pro/carte_de_Dan_Saga). Average annual rainfall is 600 mm. It is a Multispecific parkland is derived from ~ thirty years of trees ANR practice (Larwanou & Saâdou 2011). Pearl millet is the main cereal grown usually associated with cowpea, sorghum or groundnut.

Experimental design: Woody vegetation monitoring was made using the method of radial transects from village towards the bush. On each transect, plots of 2500 m² (50 m * 50 m) have been delimited and the surveys has been done by systematic sampling**.** Soil moisture and soil bulk density in ANR and non-ANR areas were measured on samples collected during rainy and dry seasons at depths of 0.5, 1.0, 1.5 and 2.0 m. Millet growth and grain yield were measured in 100 m2 (10x10m) plots (50 plots in ANR and 50 non-ANR areas).

Results: Environmental performances

Table 1 Composition of woody vegetation of Dan Saga multi-specific park.

Contexte	Trees average density (pieds ha^{-1})				Dominant species in descending order of density
	1ère aureole	2ème aureole	3ème aureole	Average Density (ind/ha).	
RNA	78	88	103	89.67	*C. glutinosum, P. reticulatum, G. senegalensis* and *F. albida*
Non RNA	23	27	31	27	*C. glutinosum, P. reticulatum, G. senegalensis, F. albida* and *Acacia nilotica*

The two areas have the same composition for dominant woody species but the mean tree density is higher in the ANR than in non-ANR areas. Tree density is lower in fields in the vicinity of the village than those that are far away irrespective to the two areas.

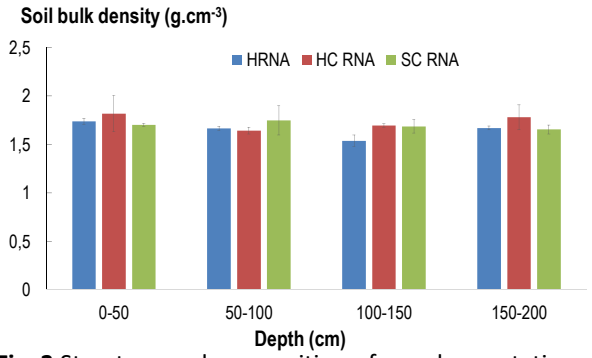
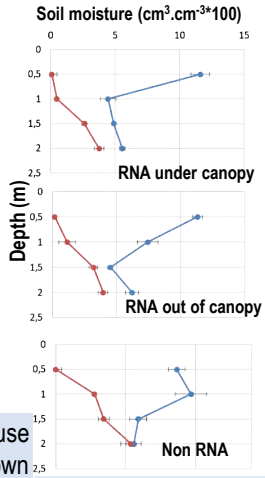


Fig. 3 Structure and composition of woody vegetation of Dan Saga multi-specific park.



The practice of RNA has not improved the soil structure because bulk soil density was within the range (1.0 to 1.6 g.cm-3) known for sandy soils. Soil moisture in uppermost horizons is higher in ANR areas under -and out of canopy than in non-ANR area. However, in deep horizons up to 1.0 m, soil moisture is higher in ANR areas (under and out of canopy) than in non ANR areas.

Fig. 4 Structure and composition of woody vegetation of Dan Saga multi-specific park.

Results: Agronomic performances

Table 2 comparison of agronomic performance parameters in millet in different contexts, under RNA and Hors RNA.

	Contexte			
Agronomic performance parameters	H RNA	S RNA	*F*	*P-value*
Number of hole sown (NPS)	55.76 ± 4.50	56.82 ± 4.98	01.20	0.2756
Number of hole at seedling raising (NPL)	36.46 ± 10.75	47.04 ± 8.60	30.29	0.0000
Number of ears harvested (NER)	134.36 ± 71.35	217.98 ± 91.16	26.60	0.0000
Gross weight of ears (PB)	70.5 ± 31.90	114.34 ± 17.88	74.73	0.0000
Net weight of seeds (PN)	24.28 ± 11.50	42.18 ± 11.64	57.21	0.0000

Beside NPS, results showed a significant improvement in all agronomic performance parameters of millet grown in RNA plots compared to non-RNA plots.

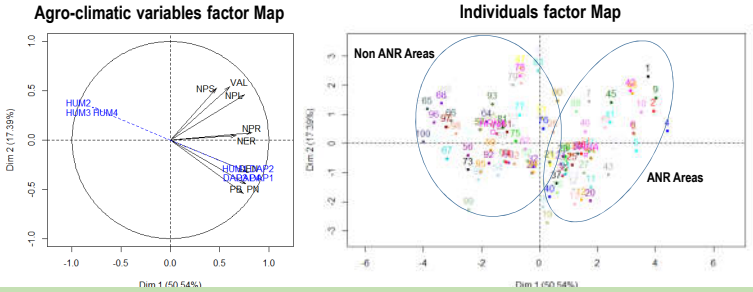


Fig. 3 Principal component analysis performed on agro-climatic parameters. (Left): correlation of variables, axis 1 represents 50.54% and axis 2 represents 17.39%. (Right): projection of the plots on the factorial plane formed by the axis 1 and 2. Two groups were formed through this ACP: ANR areas and non ANR areas

Ref. Jouve et al., 1998, Bois et forêts des tropiques, 31-44; Reij & Botoni, 2009, CILSS ; Larwanou et al., 2011, J Arid Environ, 194–200, doi:10.1016/j.jaridenv.2010.09.016