~~Evaluationof~~How does Assisted Natural Regeneration (ANR) ~~impacts on~~improv~~e~~~~ing~~ soil fertility and plantcoverin the Simiri commune in Niger?~~.~~

Aims: This study aimed toassesshow AssistedNaturalRegeneration (ANR)~~impactson~~improves~~ing~~ soil fertility andplant coverusing ~~through~~thephysicochemical~~characterization~~characterisationof soil samples takenfrom ANR fieldsandcontrol fields.

Studydesign: Theexperimental design ismadeupofa vegetationobservationgradient alongan East-Westtransect anda soil sampling gradient alongaNorth-South transect.

PlaceandDurationof Study: This studywas carriedout in the Sahelian zone in the rural communeof Simiri in Nigerbetween MayandJune 2023.

Methodology:

Dataon thediversityof speciespredominant inthe ANR system,the social categoriesof~~ANR~~usersANR land andfarmers'perceptions of ANRwere collectedona sampleof120farmers chosen at randomfrom threevillages in the communeof Simiri.

Results:A sandytexturewas recorded inallthe samples submitted foranalysis,withanoverallacidity or pH of what??.Theproportionsofthemainnutrients(C,N, P, K, Mo,C/N)were relativelyhigher inthefieldsunder ANRpractices compared withthe control fields. With regardtothe dominantwoody species, the results showthatthestandsare mainlybased onCombretumglutinosum,Combretum micranthumandGuera senegalensis. The ability ofwoody speciesto withstand stressful conditions couldactasa bulwark against climatichazards. The strongdominance ofthese species isdue,amongotherthings,totheir regenerative capacity,their rapid spreadand,aboveall,theireconomic interest intheproductionof firewoodand otherecosystem services.

Conclusion: The creation of village committees for the protection and management of trees and other areas of sustainable natural resource managementhas accompanied AssistedNatural Regeneration (ANR)adoption in farmingpractices~~hasoftenbeen accompanied bythe creation of village committees fortheprotectionandmanagementoftreesand otherareas of sustainable natural resourcemanagement~~.Despite mutilation andother illegal felling,the newagroforestryparks increase the resilienceofagriculturalproduction systems to climatic shocksand biotic stresses.

Key words: Woody species, ANR, stand, plant cover,dissemination, Simiri.

Comment [1]: Indicate the pH.

Comment [2]: Please provide proportions of nutrients.

1. INTRODUCTION

The disruptionoftheecologicalbalance in the Sahel ismainly the resultof the recurrentdroughtsthat characterised the climate between1970 and 1980 (Rinaudo,2010).The consequencesofthisdisruption upheaval includedenergy andfood crises,which caused communities toturnto forestareas for fuelwood to stem theenergy crisisand meetthe basicneedsofanever-growingpopulation (Drame*etal*., 2008).Consequentlyasa result,the natural resourcesthat contributetothe livelihoodsofthispopulationare ina stateofadvanced degradation underthe combinedeffectsofhuman actionsand climate change (Lawali*etal*.,2018).In addition, strongdemographicpressureon land has resulted ina sharp reduction in vegetation cover throughoutthe Sahel (Botoni*etal*.,2010).The scarcityoreven disappearanceofplant cover is causing thedesert to advance, reducing soil fertilityand lowering agriculturalproductivity, leading tofood insecurity.Inaddition to thisongoing degradationof natural resources,themajor challenge indeveloping countriesremains, toa large extent, the issuesof povertyand food security(Lawali*etal*., 2018). Integrating multipurpose woody crops into the agricultural production system helps to mitigate deforestation, landdepletionandpoverty among ruralpopulations (Bonkoungou,1998). Faced with environmentaldegradationand strong landpressure, farmers indenselypopulatedareas,particularly in south-centralNiger,have intensifiedtheiragriculturalland supportproduction systems.Theyhavedone soby increasedingthenumber oftreesand shrubs intheir fields,thus creatingnew agroforestryparks,the scale ofwhichin the Zinder, MaradiandTahoua regions isaround5millionhectares (Cotillon*et al*.,2021). However, despite the large-scale disseminationof these systemstechnologies,their adoptionby certain communities remainsslowtimid(Zarafi*et al*.,2002).Numerous studies showthatnatural regeneration managedby farmers has increased crop yieldsfrom31 to350 kg/haandensured food securityfor families,evenduring drought years.However, cereal yields remain lowandwillis not beenoughtofeed arapidlygrowingpopulation(Abasseeetal., 2023). Moreover, ANR increasesthe incomesofall social categories,even themost vulnerable(men, women and youngpeople)of soceity. Pruningtrees inthe fields has alsoreduced the distancestravelledbywomento collect firewood. ANRhasalso increased the availability of fodder for farmers andagro-pastoralists,with ANR households harvesting 30to45 kgof fodderper day(Abasseet *al*.,2023).

Increasingthenumberoftreesand shrubs perhectarehas increased litterproduction. This improves soil structure and allows greater quantities ofwater tobe stored.Theadditionof litteralsohelps to improve soilfertility.Certain species,whichoftendominate regeneration, suchas Piliostigma reticulatum, Guiera senegalensis andCombretumglutinosum, havea positive impact on thecontentof chemical elements (carbon,nitrogenandavailablephosphorus) inthe soil. ANRhasenabled village communities to adapt betterto climate changeandto strengthen their resilience. Indeed,evenwhen harvests fail,farmers can cutdown certaintrees and sell themon themarketasfirewoodor service wood,enablingthem to buy cereals. ANRalso has a positive impact on crop yields,even in years with low rainfall (Abasseet *al*.,2023). Hence,the interestaimofthis study,whichaimstoassessthe positive impactsof ANR onimprovingsoilfertilityandincreasingthe densityofwoody plants incropfields.

2. MATERIALSAND METHODS

2.1 Study area

Comment [3]:
What kind of demographic pressure? Please specify.

Comment [4]:
How has it. Please explain.

Comment [5]:
There is no mention of demographical analysis (DA) in materials and methods section. Please mention DA and the techniques used in arriving at results.

The studywas carried out inthe rural communeof Simiri and coveredthree villages in thearea:Guessé Gaobanda,Guessé Sinsan and Simiri.

The rural commune of Simiri is 80 kmnorthof Niamey inthe Ouallam department.The climate isarid, Sub-Sahelian, withannual rainfall varyingbetween400and 600mm (Saadou, 1990).It is irregularly distributed intime and space.The rainy seasonextendsfrom Juneto September. Theaverage maximum temperature varies from 24°C in Januaryto33°C in April, withatemperature rangeof9°29. The representative toposequenceofthe region is characterisedbya successionoffour major zones typicalof thetropical ferruginous plateauxof the Sahel:thearmoured plateau,the sandy skirt, theglacis and the lowlands (Ambouta*etal*.,1996). Skeletal soilsofthe rigosoland lithosoltypesformed on terminal continental clayey sandstonesarefoundonthe plateaux (Ambouta,1997).The sandy skirt and glacis contain sandytropicalferruginous soilswith little leaching,followedbyalluvial soils in the lowlands.The natural vegetation consistsof shrub steppeon the glacisand shrubstotrees inthe lowlands,whilea contractedformation subjectto severedegradation can be seen onthe plateaux (Boubacar*etal*.,2013).Themainwoody speciesare Guiera senegalensis, Combretummicranthum and Combretum glutinosum. Theherbaceous layer isdominatedby Mitracarpus scaber, Eragrostis tremula and Cenchrusbiflorus.Figure1 below shows thegeographical locationof the Simiri commune.

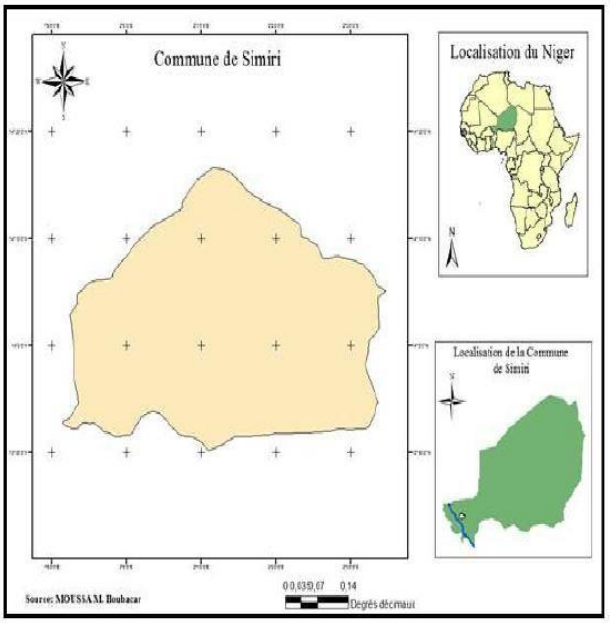


Figure1: Locationmapof therural commune of Simiri (Source:Moussa Boubacar, 2019)

2.2.Documentary research

Thisphaseinvolvedgatheringtherelevant literature documentationneededtoproperly understandthesubjectproperlyand toestablishthe state of knowledge onthesubject.Itwascarriedoutusingevidence sources such as databases(website, scientificjournals and),activity reportsand scientificpublications.

2.3Fieldinvestigation

Comment [6]: What are the geographic coordinates of these villages? Please specify.

Comment [7]: Who do you mean? Use other well-known terminology.

Comment [8]: What is?

Comment [9]: Meaningless. Correct.

Comment [10]: Which subject? Please specify.

Tocollectbothquantitative andqualitativedata,individualinterviewswere conductedwitha sampleof120farmerspractisingANRintheir fields.Thesefarmerswerelocatedinthree villagesintheruralcommuneofSimiri:Guessé Sinsan,GuesséGaobandaandSimiri.The interviewswere conductedusingasemi-structuredquestionnaire.Asystematicinventoryof woodyspecieswascarriedoutin thefieldsinordertoassessthediversityofspeciesusedin ANR.

Figure2: Interviewwith an ANRpractitioner in Guessé(Daouda, 2023)

Comment [11]: Which of the Guesses? Guessé Sinsan or Guessé Gaobanda?

2.4. Soil samplingandanalysis

Atotaloftwelve(12)soilsampleswere takenfromallthreesites,withthreesamplespersite andthreecontrols.ThesoilsamplescollectedwereanalysedattheINRANNiameysoilscience laboratory usingstandard methods(Mathieuand Pieltain,2003).Thephysico-chemical parameters usedtocharacterisethe soil were:granulometrybytheRobinsonpipette method; pH bydeterminationofhydrogenions;cationexchange capacity(CEC) andthe sumof exchangeable bases(S) bythe silver thiourea method;totalnitrogenbythe Kjeldahlmethod; organiccarbonbytheWalkley&Blackmethod; assimilableandtotalphosphorus(P)bythe Bray1 method, electrical conductivity by the conductimetry method, exchange acidity, organic matter andexchangeablebases.The figures3and4belowshowrespectivelythepackedsoil samples and a glimpsen ~~overview~~of afield under ANR practices.

Comment [12]: Which standard methods? Please specify?

Figure3: packed soil samples(Daouda,2023)

Figure4: OverviewofafieldofANRNA (Daouda, 2023)

2.5. Dataanalysisand processing

Thesurveydataweretabulatedandanalysedusing Excel,thensubjectedtodescriptiveanalysis usingSPSSsoftware.The soilanalysisresultswere alsosubjectedtodiscriminantanalysisin order to identify similarities between variablesat different sites.

3.RESULTS

3.1 Breakdownofproducers by sex andage

Figure5 below shows the breakdown ofANARusers by genderand agegroup.

Comment [13]:
Which type? Linear discriminant analysis, normal discriminant analysis, or discriminant function analysis?

Comment [14]:
Results could use more effective graphing to compare and contrast.

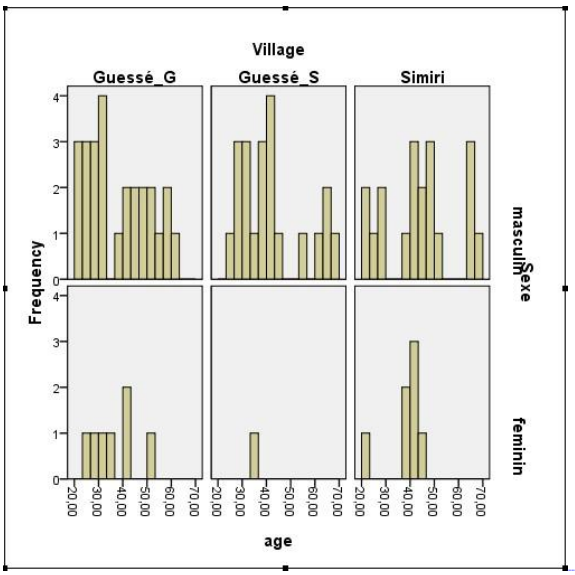


Figure5: Breakdown ofrespondentsby gender and age group

This graph shows that the averageage ofrespondents is 39.97±12.76, with aminimum of 20 and amaximumof 67rRegardless of the sites. ,Wwomen arein theminority in the practiceof on-farm ANR.

3.2. Dispersionofsoilphysicochemicalparametersby site

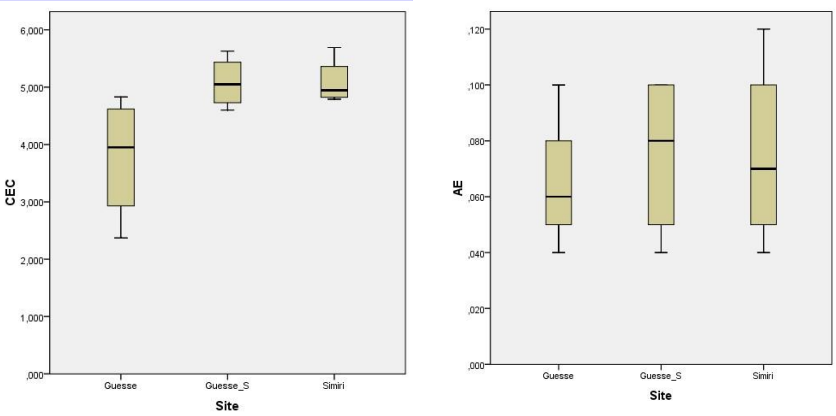


Figure6: Dispersion of CECandexchangeacidity(EA) valuesby site

Thisfigure showsthatthe CECvalues recordedatthe SimiriandGuesséGao-Bandasitesare scatteredaroundtheaverage,unlikethoseobtainedattheGuesséSinsansite, whichare close tothe generalaverage.Onthe other hand,the variationinexchangeacidityvaluesshowsthat theSimiriandGuesséGao-Bandasiteshavevalueswellabovethegeneralaverage,whilethe

Comment [15]: Is age in the thousands or tens? Edit graph accordingly. Better to present data in pie charts.

Comment [16]: Which of the x-axis legends is which? Guessé Sinsan or Guessé Gaobanda. Edit accordingly.

Comment [17]: What is CEC? Use full worded term and acronyms in brackets.

Comment [18]: Which average? Specify.

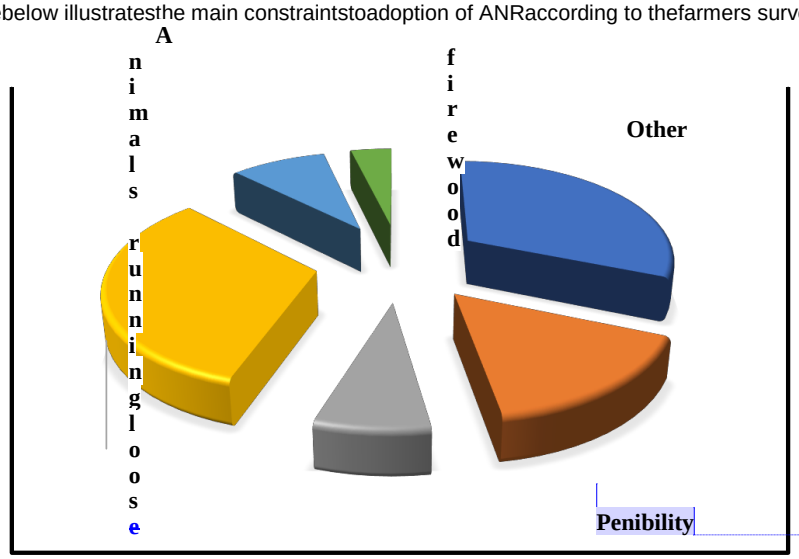
Comment [19]: Which is the general average? Please specify.

Comment [20]: Which? Specify.

GuesséSinsan sitehas valuesbelowtheaverage. Thisindicates afairlyclear dispersionofthis variablebetweensitesandcultivationpracticesatthese sites.Inaddition,lowCECandAE values wereobserved at thecontrol sites that werenot underANRpractices.

3.3 Constraints to adoptionof ANR in the farming environment

Thefigurebelow illustratesthe main constraintstoadoption of ANRaccording to thefarmers surveyed



Conflictsover theuseof

Comment [21]: Which? Specify.

Comment [22]: How do you mean?

Comment [23]: Which? Please specify.

Comment [24]: Which types of cultivation practices. There is no prior mention or discussion of such.

Comment [25]: What were the control sites. These and their coordinates were never mentioned.

Comment [26]: How do you mean by penible? Please use an english word. Please show percentages of each portion of the pie chart for ease of comparison.

No knowledgeof treecare techniques

Defending problem

Figure 7:Constraintsto adoptionofANR

Thefigure showsthat conflictsoverwood harvesting,theproblemof defending fields under ANRand poor knowledgeof young shoot maintenance techniques arethemain constraintsfacedbyfarmers in adopting ANR, withproportionsof32.5%, 31.25%and16.25% respectively.

3.4 Socio-economic impactsofANR

3.4.1.Impactsonhouseholdlivingconditions

Figure8 belowpresentsthe impactsofthe ANRonhousehold living conditions

Comment [27]: This graph is not well represented. The stated values to not correspond to the depicted values.

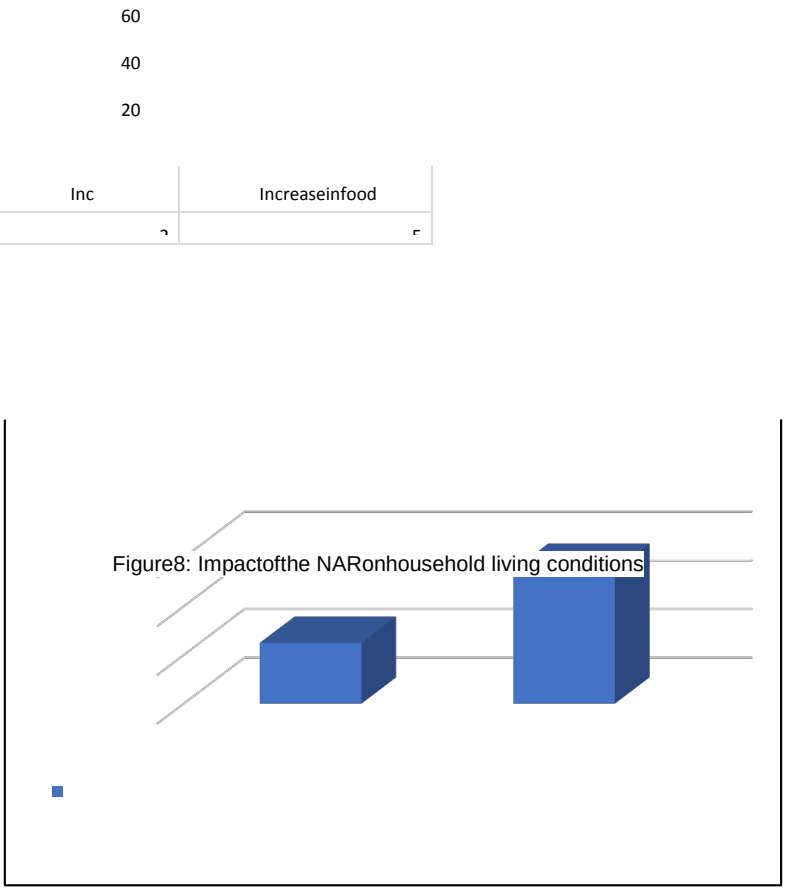


Figure8: Impactofthe NARonhousehold living conditions

Thegraph showsthat68.25%of respondents saidthat theuseof ANR in cropfieldshad increasedtheir food stocks, compared with31.25%who saidthat ithad clearly increased their income, inparticular through thesale of firewood, servicewoodandnon-timber forest products.This income is thenused to reconstitutepartofthefood stock in addition to thatderivedfrom theproductionoffieldswhosefertility is improvedbythesepractices.

3.4.2. Impacts onsoiland climate components

Returnof the wild fauna

Thefigurebelow illustratesthe main advantagesof ANR.

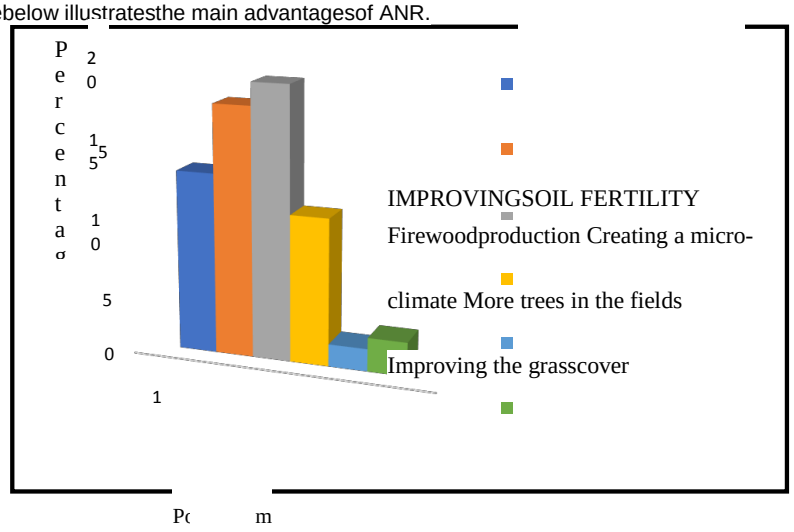


Figure9: Main advantagesof ANR

Thereareseveral advantages tofimplementingANRincroppingsystems.Indeed,the following mainbenefitsemerge fromthis graph: Returnofwild fauna, improved soil fertility,and firewood productionwitha preponderanceof 30%, 27.5% and20% respectively.

3.4.3 ImpactsofANR on soilphysicochemical properties

Comment [28]: With what standard errors are these properties measured?

Table: Physico-chemical characteristicsofthe soil in the fields underpractice

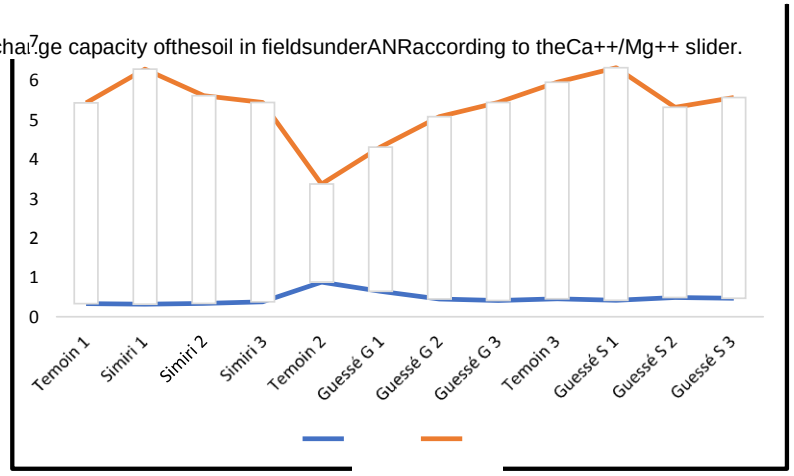
N° La.	Identification	Prof. en cm	pH O	C. E	+	+	+		Tot	CEC	AE	Phosphorepp Assim.	Tot	L	Fer Tot	Carb.	M.O	
2023/1	Simiri Témoin	0-25	5.1	0.01	1.1	3.4	0.16	0.07		4.86	0.0	8.11	0.12			0.26	0.44	
1	Smiri1	0-25	5	0	1	4	0 1	0		5	0	6	0 1			0	0	
1	Simiri2	0-25	5	0	1	3	0 1	0		5	0	5	0 1			0	0	
191	GuesséGao bandaTémoin	0-25	5.46	0.04	1.20	3.34	0.15	0.07		4.83	0.06	2.56	0.13			0.21	0.36	
192	GuesséGao banda1	0-25	5.45	0.05	1.05	1.21	0.04	0.02		2.37	0.04	14.51	0.10			0.18	0.31	
193	GuesséGao banda2	0-25	5.51	0.06	1.25	2.03	0.07	0.03		3.49	0.10	4.61	0.12			0.28	0.49	
194	GuesséGao banda3	0-25	5.38	0.05	1.25	2.89	0.16	0.04		4.41	0.06	8.28	0.10			0.09	0.45	
195	GuesséGao banda	0-25	5.38	0.05	1.25	3.16	0.18	0.07		4.79	0.12	2.99	0.09			0.07	0.12	
196	GuesséSissan Témoin	0-25	5.46	0.05	1.50	3.43	0.18	0.06		5.24	0.06	2.82	0.12			0.08	0.13	
1	GuesséSissan1	0-25	5	0	1	3	0 1	0		5	0	12	0 1			0	0	
1	GuesséSissan2	0-25	5	0	1	2	0 0	0		4	0	7	0 1			0	0	
1	GuesséSissan3	0-25	5	0	1	3	0 1	0		4	0	6	0 1			0	0	

EC:electricalconductivity;CA++:calcium;Mg++:magnesium;Na+:sodium;K+: potassium;CEC:cationexchangecapacity;AE:exchangeacidity;assimilablephosphorus; carb:carbon; Mo: organic matter;C/N:carbontonitrogen.

The soil analysis results showthat thefieldsunderANRNAhavefairly variable characteristics andan acceptable levelof fertility.The pHwasgenerallyacidic inall samples (5.07-5.62), with relatively low levelsoforganicmatter, carbonandtotal nitrogen. Inaddition,thepredominantly sandytextureof the soil samples justifiesthe lowCEC values,which varyaccording to OM content. The slider between calciumandmagnesiumdepends onthe sizeof the CEC.Figure10below illustratesthe variation inthe

Comment [29]:
What is low levels? Define.

cationexchange capacity ofthesoil in fieldsunderANRaccording to theCa++/Mg++ slider.



++ ++

Figure10:Ca /Mg complexandCEC in soil

++ ++

Thisgraph showsthatthe CECofthe soils variesfrom one siteto another,unliketheCa /Mg complex, which shows little variation fromone sitetoanother.In termsof soiltexture,the results showthatallthe

samples arepredominantly sandy,with relatively low clayand silt content.Theproportionsof fineand coarse sandsdominate thetexture ofthese soils.Thefigure showstwo peaks (convexand concave) representing thetwoextreme values fortheCa++/Mg++ complexandthe CECfor allthe samples analysed.

Comment [30]:
Not clear. Restate.

3.4.4 Diversityofwoody species inagroforestryparksunderANR

Thefigurebelow showsthediversityofwoody species in fieldsunder ANRpractices in the Simiri zone.

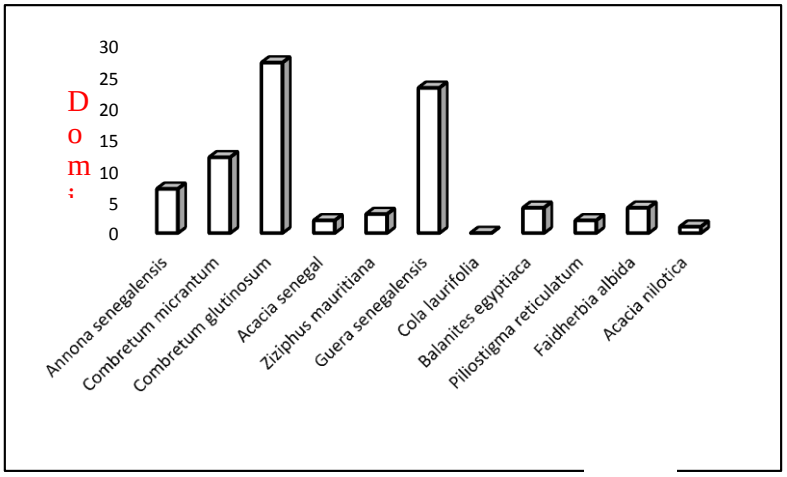


Figure11:Diversity ofwoody speciesused in ANR

This figure shows that severalwoody plant speciesareused in ANR systems.These includeCombretum micrantumand Combretumglutinosum, Guera senegalensis and Annona senegalensis,which are the most predominant species in agroforestryparks in the Simiri zone.

3.5Discussion

Increaseddegradationof cultivated landand other specialecosystems has led tomassive investment in restoration activities inNiger. Forthis reason,the countryhas signedup totheAfricanForest LandscapeRestoration (AFR100) initiative, which aims to restore100 millionhectaresby2030.To honourthis commitment, thereare planstofurtherpromote agroforestrypractices, includingassisted natural regeneration forthe rapid reforestationofagriculturalareas,which wouldill ensuretheproductivity of Niger'sagro-ecosystems. In this study,the results showedagoodperceptionof ANRbytheproducers surveyed,hence the involvement of allsocio-professional strata in theadoptionofthispractice.The farmers surveyed said thattheyhad boosted intensifiedtheiragricultural production system by increasingthe numberoftrees in their fields.This increase doesnot resultfromnewplantingsbut ratherfrom the protectionandmaintenanceof youngtree shootsthatappear spontaneously in thefields, contributing inthe long run to theformationofagroforestryparks with, inparticular, variouscenterscentresof interestfor the communitiesand the landscape.These resultsare in line withthoseofseveral authorswho findthat ANR isagood wayof improvingagricultural production,and combating food insecurity and climate change. Furthermore, these authorsstatethat ANR could bea strategyfor combating food insecuritythroughthe saleand marketing of woodyforestproducts (Sitou*etal*.,2018; Ado etal.,2019). Variouswoody speciesare protectedand maintained in cropfields,providing multipleecosystem services, including soil fertilisation through litterfromdead leaves, climate regulation, carbon sequestration, recreationand runoff reduction. Themostdominant speciesare Guera senegalensis,Combretummicranthum, Combretum glutinosum and Annona senegalensis. These results corroboratethoseof Baggnian etal (2014); Moussaetal (2015);Mamane (2017) andMaâzou (2019), who state thatwoody stands in fields under ANRNAare mostoften dominatedby Combretumglutinosum, Combretum micranthum, Piliostigma reticulatum, Guiera senegalensis,Faidherbia albida and Prosopisafricana. Accordingtotheseauthors,

Comment [31]: Discussion could use some more detail based on scholarly literature, highlighting strongest factor interconnections.

Comment [32]: Is this a policy or law? If not explain.

Comment [33]: Is there any evidence to support this claim? I don't see any socio-professional analysis done.

Comment [34]: Which authors? Please cite.

Comment [35]: Which authors? Please cite.

Comment [36]: Repetition, delete.

Comment [37]: Which authors? Please cite.

the specific contributionofeach species ishighly variable, ranging from what?? up to more than50%ofthetotaltree stand.Improving soil fertilityunderANR~~NA~~ isoneoftheprimaryobjectivesofthis agroforestry practice. Farmers invest in trees mainlytomaintainor improve thefertilityof their soils. ~~and~~Tthe impact of certain specieson chemicalfertilityhasbeen confirmed by several studies (Mansouretal.,2013; Camaraet al.,2017; DanLamso etal.2015a,2015b;Zounonetal.,2020;Traoré, 2012; Bodoet al., 2019). Soil analysis results showed thatthe content of certain nutrients wasmuch higher infields underANR~~NA~~comparedwith controlareasnotunderANR~~NA~~.These includeC (%),N (%), K (meq/100g)andC/N.This suggests that an increase intreedensity is always followedbyan improvement in soilfertility.A study byDan Lamsoetal (2022) showed that ANR isaneffectivefertilitymanagement practicefortropical ferruginous soils cultivated in Niger.The resultsofthehousehold surveys showedthatthepracticeof ANR inthefieldsgeneratesadditional incomeforpractising households inadditiontothe increase in cerealproduction in thefields.This increased income comesfromthe saleof woodandnon-wood forest productsfromthe ANR. Although this incomehas notbeenaccuratelyevaluated inthis study, the producers claim thatthe saleof ANRproducts considerably reduces thepoverty levelof households and, in turn,enables them toobtainfood supplies.Thisprotectsthemfromfood insecurityand increases thedurationoftheirfood stocks.These resultsare in line withthoseof Baggnian (2010),who statesthat theactionoftrees increasesthe durationofagriculturalproduction stockby5to7monthsonaverage, whichcontributes significantlyto food stability.

Themanagementof ANR isoftenaccompaniedbybetter consultationandorganisation within villages in orderto manage the newtree capitaleffectively.

Several constraints limittheuseof ANR in the villages coveredbythe study.Theseare mainly conflicts overwoodharvesting (33%),problemswithdefendingfields under ANR (31%) and lackof knowledge oftechniques formaintaining young shoots (16%). These resultsare similartothoseof Kabirou (2022), whonotesthattranshumantherders,who generally comefrom elsewhere duringthedry season, carry out severepruning,whichmoreoftenthannot compromises the survivalofthetrees. Similarly,the animalsof local livestock farmers,whichare sometimes left to roam,graze onthenew shoots left in the fields.This leads tofrequentphysical conflicts.Inaddition,youngpeople andwomenfrom the villages fraudulently cut downplant species in the fields without consideringthe consequences. Also, woodcuttersfrom several localities cut downtrees clandestinely atground level intheabsenceofthe field owner,often lateat night (Kabirou,2022).Finally,thepartialapplication of theprovisions ofthe forestry codebyruralactorsandthe inadequacyofforestry regulations thattake intoaccountthestatus of regenerated trees in thefieldsare constraining ANR inthe studyarea (Kabirou,2022).The introduction of ANRhasoftenbeenaccompaniedbythe creationof villageorganisations for the protectionandmanagementoftrees.Theseorganisationshave adoptedcommunity regulationsagainst treefelling andtheft, and this new social intervention ~~capital~~helpsto ensurethe sustainability ofthetree capital established inthefields.Thenewagroforestryparks increasethe resistanceofagriculturalproduction systemsto climatic shocksandsequester large quantitiesof carbon.

Conclusion

Atthe endofthis study,the results show that ANR isaneffective agroforestry practice for integrated managementof soil fertility, cropproductivity and the improvementoffarmers' sustainable livelihoods. Given its multiple benefits, itencouragesa clear awarenessandwillingnesson thepartof small-scale

Comment [38]: Which practice? Specify.

Comment [39]: How much of additional income? More scientific to specify.

Comment [40]: Was there any system of poverty classification of households to aid understanding of improvement in their lot?

Comment [41]: This points to weaknesses in the regeneration plan. Was this envisioned in the planning stage. What measures were taken to overcome it? Methods should have been assessed in survey.

Comment [42]: Why so? What plan was put in place to prevent or dissuade this? A robust regeneration plan should have captured this ahead of implementation.

Comment [43]: How were tree fellers involved in the regeneration plan and management to prevent unapproved tree felling?

Comment [44]: Which? Specify.

Comment [45]: Which? Specify.

Comment [46]: How do you mean? No explanation of how knowledge of status might help.

Comment [47]: How do you mean? Regulations are enacted law. Community action or programmes?

farmerstoprotectandmanagewoody species. Theadoption ofthispractice is closely linkedtothe farmers'perception of the causal linkbetween thepresenceofwoody species inhighdensities inthe fields andthe levelof fertilityofthe fields,and betweenthe level offertility ofthe soil and theproductivity ofthe land.Furthermore,the soil and climate conditions (sandy soil, semi-arid climate) are undeniable advantages for the adoptionof ANR inthe villagesof Guesséand Simiri.Thefactthat thispractice is accessibletoall social categories is conducive to itswidespread adoption.In addition, farmersderive significant incomefrom ANRthrough the sale offirewoodand othertreeproducts. Women benefitfrom ANRbecause it increasestheavailability offuel, reducing the distancestheyhavetotravelto collect wood.Italso increases non-timberforestproducts,whichhelpto improve family nutritionandthequality of life.

Comment [48]:
Was there any analysis of farmer perception? Any evidence of the links between farmer perceptions?

Comment [49]:
How do you mean? Do you mean determinants or advantages?

How do you prove this claim? Any evidence backing this conclusion?

Comment [50]:
How do you come to significance? Was there any analysis to discriminate income?

Bibliographical references

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