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The Great Green Wall, a bulwark against food insecurity? Evidence from Nigeria

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Context

Desertification in Sub-Saharan Africa:

- ▶ Pressure exerted by human activities
- ▶ Aggravated by climate fluctuations
- ▶ Both phenomena generated land degradation
- ▶ Harmful consequences on local livelihoods: food insecurity, water shortage, poverty, health issues and conflicts.

Context

Desertification in Sub-Saharan Africa:

- ▶ Pressure exerted by human activities
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- ▶ Both phenomena generated land degradation
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The Great Green Wall, an environmental restoration program:

- ▶ Eleven countries committed to the creation of the Great Green Wall in 2007
- ▶ A goal of 8,000 km wall of vegetation from West to East
- ▶ Mosaic of interventions to address the needs of local populations

Research Question

- ▶ Has the Great Green Wall led to an improvement of standards of living for local population?
- ▶ *Focus on Nigerian Case*
 - ▶ African country with the highest deforestation level between 2000 and 2013
 - ▶ The country with the largest population along the Great Green Wall



At the crossroads of two streams of literature

Causal impact of environmental areas/forests on livelihoods

- ▶ Direct channels (medium / long run): addressing basic needs (mainly food), improving soil quality, limiting soil erosion, water retention & water flow regulation, biodiversity, changing local micro-climates thus improving agricultural productivity and labor productivity.
- ▶ Indirect channels (short run): creating new income-generating activities and boosting local demand temporarily

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Importance of early life conditions for individual development

- ▶ Long term consequences of malnutrition in early childhood on human capital attainments (height)
- ▶ No literature on how environmental programs could mitigate the deficits during early childhood

Information on Great Green Wall in Nigeria

The project

- ▶ GGW started during late 2013
- ▶ Spread over 11 northern States in Nigeria
- ▶ Two main types of intervention : Vergers communautaires (300ha) et Brise-vent (642km)
- ▶ 20,000 jobs created

Data:

- ▶ Provided by the National Council on the Great Green Wall
- ▶ GPS coordinates of the projects
- ▶ Information on year of implementation & on the type of intervention

Map

Health of Nigerian Children

Fact: 37% of Nigerian children are stunted in 2018.

Data:

- ▶ Nigerian Demographic and Health Survey (DHS)
 - ▶ two pre-treatment waves: 2003 & 2013
 - ▶ one post-treatment wave : 2018
 - ▶ cluster gps coordinates
- ▶ Sample selection
 - ▶ children below 5 years old
 - ▶ restriction to the 11 eleven northern states of Nigeria
 - ▶ rural clusters only
- ▶ Health outcome
 - ▶ Height-for-age standard deviation
 - ▶ Derived from anthropometric measurements

Difference-in-Difference Estimation

$$Y_i = \alpha + \beta POST_i.TREAT_i + \gamma POST_i + \delta TREAT_i + \nu X_i + \theta X_i.POST_i + \epsilon_i \quad (1)$$

- ▶ $TREAT_i = 1$ if the child is less than 20km far from the project
- ▶ $POST_i = 1$ for post-treatment period (2018)
- ▶ X_i : gender/age/education of hh head , religion/marital status/body mass index of the mother, time to the nearest water source, past drought conditions
- ▶ $X_i.POST_i$: time varying effects
- ▶ Standard errors clustered at the municipality level
- ▶ Exclusion of children located between the 'treatment' distance and $2 \times$ 'treatment' distance: 15-30 km far from the project for main specifications.

Difference-in-Difference Estimation: limitations

Identifications issues: Location of projects is not random

- ▶ Propensity Score Reweighting
- ▶ Placebo Checks (2003 - 2013)

Evolution of the outcomes

- ▶ Change in Height-To-Age standard deviation over time: [Graph1](#)

Main results for orchards

Table: DiD regressions on height-to-age for Orchard Treatment

	Orchard Treatment				
	(1)	(2)	(3)	(4)	(5)
<i>Period of Interest : 2013 - 2018</i>					
Post x Treat	0.438*** (0.157)	0.683*** (0.174)	0.717*** (0.175)	0.589*** (0.147)	0.555*** (0.147)
Observations	8,726	7,859	7,856	7,856	7,856
R-squared	0.022	0.025	0.157	0.179	0.181
<i>Placebo Period : 2003 - 2013</i>					
Post x Treat	-0.0763 (0.290)	-0.0763 (0.290)	0.142 (0.203)	-0.277 (0.200)	-0.269 (0.191)
Observations	7,043	7,043	6,864	6,864	6,864
R-squared	0.022	0.022	0.165	0.182	0.185
Individual Controls X_i	Yes	Yes	Yes	Yes	Yes
PS Reweighting	No	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes
Birth Month FE	No	No	Yes	Yes	Yes
Birth Month x Birth Year FE	No	No	Yes	Yes	Yes
State fixed effect	No	No	No	Yes	Yes
$POST_i \times X_i$	No	No	No	No	Yes

→ **A 14 to 19 % health improvement**  11/19

Main results for shelterbelts

Table: DiD regressions on height-to-age for Shelterbelt Treatment

	Shelterbelt Treatment				
	(1)	(2)	(3)	(4)	(5)
<i>Period of Interest : 2013 - 2018</i>					
Post x Treat	0.717** (0.348)	0.862** (0.378)	0.902*** (0.328)	0.537 (0.364)	0.514 (0.355)
Observations	10,027	6,699	6,698	6,698	6,698
R-squared	0.021	0.020	0.148	0.153	0.155
<i>Placebo Period : 2003 - 2013</i>					
Post x Treat	-0.295 (0.471)	-0.295 (0.471)	0.214 (0.311)	-0.251 (0.326)	-0.321 (0.339)
Observations	8,204	8,204	3,718	3,718	3,718
R-squared	0.018	0.018	0.150	0.157	0.158
Individual Controls X_i	Yes	Yes	Yes	Yes	Yes
PS Reweighting	No	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes
Birth Month FE	No	No	Yes	Yes	Yes
Birth Month x Birth Year FE	No	No	Yes	Yes	Yes
State fixed effect	No	No	No	Yes	Yes
$POST_i \times X_i$	No	No	No	No	Yes

→ A 23 to 29 % health improvement

Main results for all treatments

Table: TOTAL PROJECTS 15 KM

	Total Treatment				
	(1)	(2)	(3)	(4)	(5)
<i>Period of Interest : 2013 - 2018</i>					
Post x Treat	0.365** (0.143)	0.615*** (0.177)	0.644*** (0.175)	0.504*** (0.142)	0.469*** (0.141)
Observations	8,828	7,972	7,970	7,970	7,970
R-squared	0.021	0.024	0.159	0.181	0.184
<i>Placebo Period : 2003 - 2013</i>					
Post x Treat	0.0872 (0.292)	0.0872 (0.292)	0.326 (0.208)	-0.179 (0.199)	-0.180 (0.194)
Observations	7,051	7,051	6,873	6,873	6,873
R-squared	0.021	0.021	0.163	0.181	0.183
Individual Controls X_i	Yes	Yes	Yes	Yes	Yes
PS Reweighting	No	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes
Birth Month FE	No	No	Yes	Yes	Yes
Birth Month x Birth Year FE	No	No	Yes	Yes	Yes
State fixed effect	No	No	No	Yes	Yes
$POST_i \times X_i$	No	No	No	No	Yes

→ A 23 to 29 % health improvement

Main results for orchards/shelterbelts/boreholes, 15km

Table: orchards/shelterbelts/boreholes

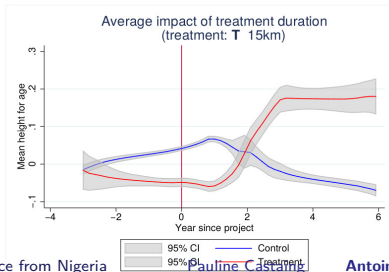
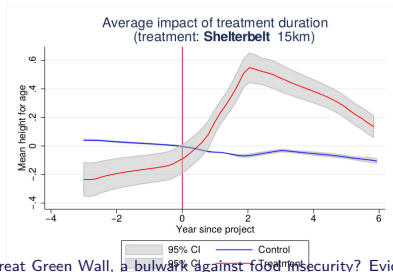
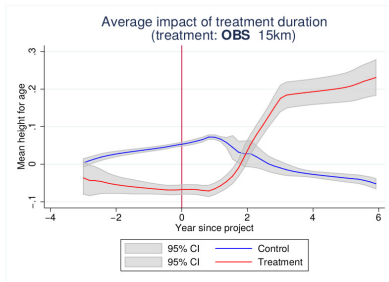
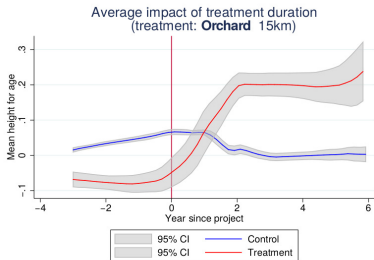
	Orchard/Borehole/Shelterbelt Treatment				
	(1)	(2)	(3)	(4)	(5)
<i>Period of Interest : 2013 - 2018</i>					
Post x Treat	0.407*** (0.149)	0.638*** (0.176)	0.675*** (0.175)	0.524*** (0.141)	0.489*** (0.140)
Observations	8,812	7,956	7,954	7,954	7,954
R-squared	0.021	0.023	0.157	0.179	0.181
<i>Placebo Period : 2003 - 2013</i>					
Post x Treat	0.0407 (0.287)	0.0407 (0.287)	0.298 (0.206)	-0.196 (0.198)	-0.183 (0.194)
Observations	7,093	7,093	6,915	6,915	6,915
R-squared	0.021	0.021	0.161	0.177	0.179
Individual Controls X_i	Yes	Yes	Yes	Yes	Yes
PS Reweighting	No	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes
Birth Month FE	No	No	Yes	Yes	Yes
Birth Month x Birth Year FE	No	No	Yes	Yes	Yes
State fixed effect	No	No	No	Yes	Yes
$POST_i \times X_i$	No	No	No	No	Yes

→ A 23 to 29 % health improvement

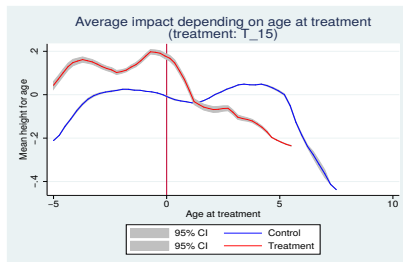
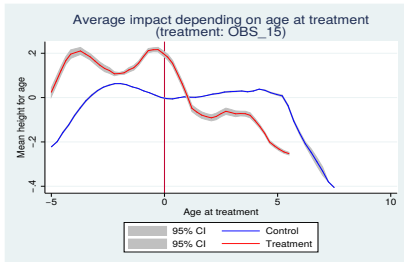
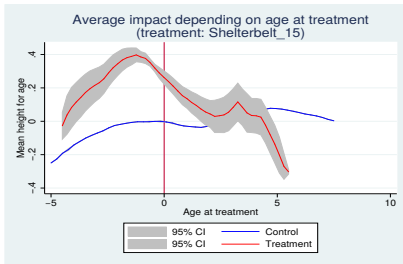
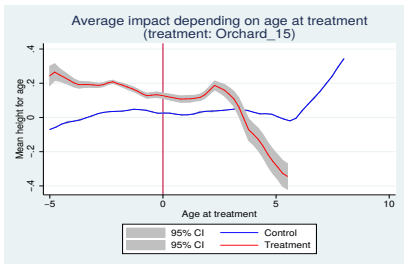
Alternative Specifications

- ▶ Fake treatments (other health outcome): fever, diarrhea, cough ✓
- ▶ Testing short run (weight) health outcome ×
- ▶ Different distance (main identification strategy): 10 and 20km. ✓
- ▶ Controlling for climate zones (rainfall: ishojets) ✓
- ▶ Controlling for migration ✓
- ▶ Considering specificity of joint projects (boreholes) ✓
- ▶ Introducing 2008 DHS for placebo checks : × → **Placebo**

Heterogeneity of impacts: treatment duration



Heterogeneity of impacts: age at treatment



Conclusion

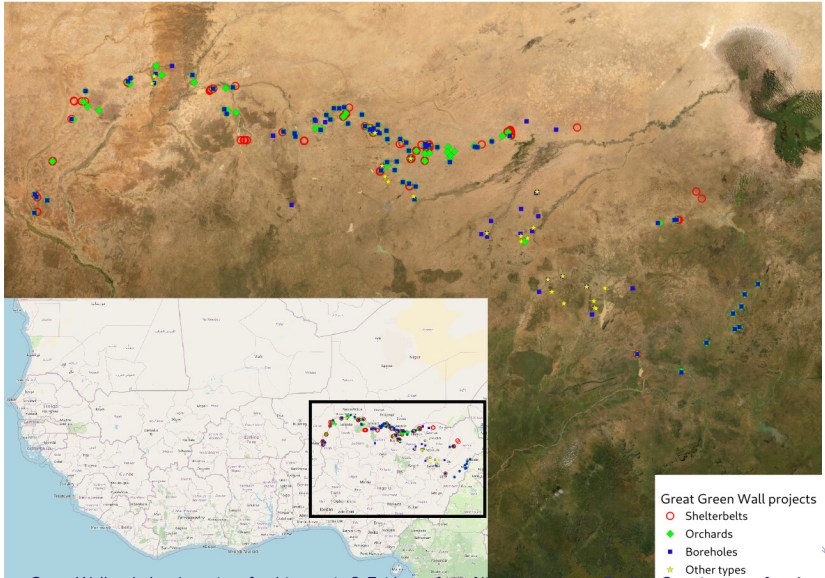
Results

- ▶ Children living next to new orchards benefit from better health conditions (14 to 19%) and food access
- ▶ Children living next to shelterbelts also enjoy better health (23 to 29%) but channel is not identified

Path for future research

- ▶ Extend the analysis to other committed countries
- ▶ On a longer term, further investigate the indirect channels

Back Mapping the GGW projects



Back

GGW projects

Table: Distribution of projects over the 2013-2016 period

	Year of establishment				Total
	2013	2014	2015	2016	
Orchard	8	32	39	4	83
Shelterbelt	45	57	114	0	216
Borehole	0	44	29	1	74
Solar Powered Borehole	10	3	14	0	27
Nursery school	0	1	1	0	2
Orchard / Nursery school	0	11	6	0	17
Borehole / Nursery school	0	3	0	0	3
Woodlot	1	3	14	2	20
Skill Acquisition center	0	0	4	0	4
Total	64	156	221	7	448

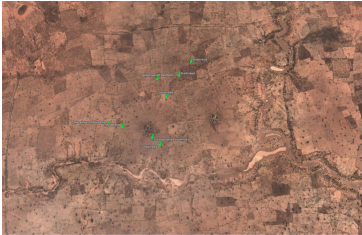
Back **GGW projects**

Table: Project size summary statistics

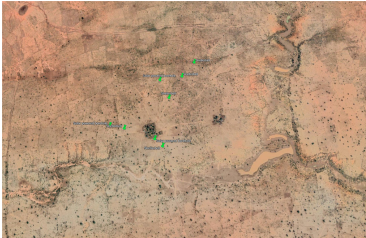
Variable	Mean	Std. Dev.	Min.	Max.	N
Shelterbelts lenght (km)	1.338	0.868	0.65	5	204
Orchards size (ha)	2.829	1.228	1	7	111
Borehole field size (ha)	0.511	0.489	0.022	1	25
Woodlots (ha)	4.25	1.164	1	5	20
Other (size in ha)	0.163	0.448	0.009	2	24

Back

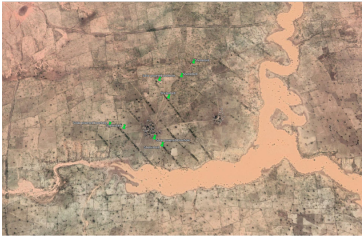
Satellite Views for Shelterbelts and Orchards



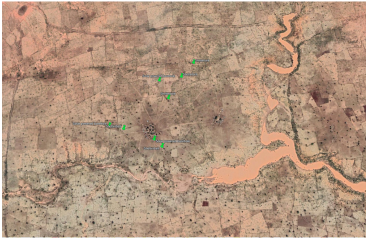
11/2013



01/2017



11/2020



11/2018

Back

Satellite Views for Shelterbelts and Orchards



12/2013



03/2016



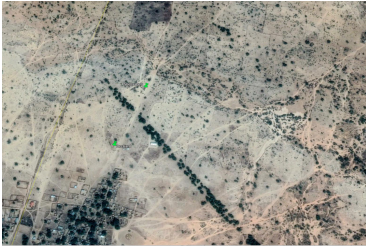
01/2019



04/2018

Back

Satellite Views for Shelterbelts and Orchards



01/2014



10/2016

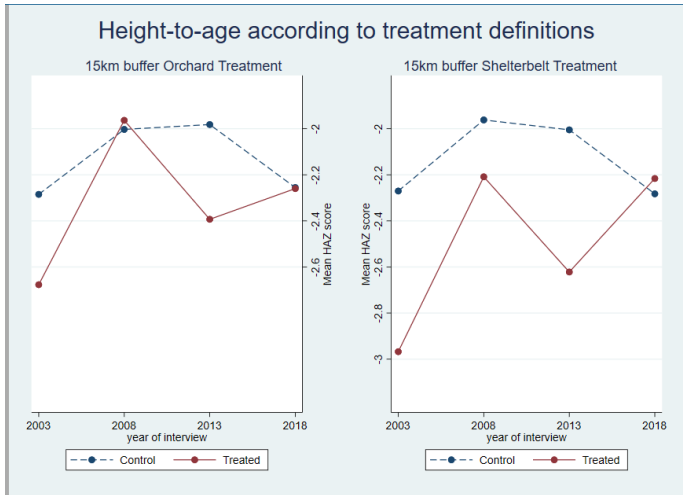


11/2020



09/2018

Parallel trends [Back](#)



[Back](#)

Table: Distribution of observations among treated and control groups in DHS surveys

	10km				15km			
	2013		2018		2013		2018	
	<i>Treated</i> (after 2013)	<i>Control</i>	<i>Treated</i>	<i>Control</i>	<i>Treated</i> (after 2013)	<i>Control</i>	<i>Treated</i>	<i>Control</i>
Orchard	865	9,081	941	8,921	1,441	7,575	1,663	7,498
Total Sample	9,766		9,862		9,016		9,161	
Shelterbelt	197	10,530	326	10,329	447	10,097	472	9,522
Total Sample	10,727		10,665		10,544		9,994	
T								
OBS								