Benefits of landscape restoration,
with a focus on African dryland biomes.

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Abstract

African drylands are degrading rapidly. Justdiggit develops land restoration programs by applying water harvesting, reforestation and climate resilient agriculture techniques at scale. Our programs result in a wide array of bankable and non-bankable benefits, closely aligned with the Sustainable Development Goals and with huge positive socio-economic impacts, besides addressing climate change and biodiversity loss, two of the major challenges of our time. This whitepaper explains the mechanisms behind the benefits of landscape restoration and provides insights in the scale at which these benefits can be achieved.

Introduction

Degradation of ecosystems poses a tremendous threat to human well-being, as a UNEP study suggests that ecosystem services are possibly worth more than the world's combined Gross National Incomes (UNEP, 2010). On the ground, land degradation leaves communities that rely on the land in peril, threatening their livelihoods.

Addressing land degradation in African drylands is of particular importance:

- In drylands the demands of human communities have been much higher than the capacity of ecosystems to sustainably deliver, resulting in the rapid depletion of these resources, more so than in other biomes (FAO, 2015).
- Drylands cover a large portion of the earth's surface and are home to a substantial amount of the world population.
- The African continent is the most affected in terms of soil erosion (ELD, 2015b), placing even greater importance on African drylands in fighting land degradation. Moreover, Africa is often thought to be the region most vulnerable to climate change and variability (Haile, 2005).

Quick facts

- **60 percent** of all services provided by ecosystems are under threat (UNEP, 2010);
- **2 billion hectares** of arable land are degraded (MEA, 2005);
- **25 %** of the global food production may be lost during the 21st century because of the combined effect of land degradation, climate change, water scarcity, and invasive pests (UNEP, 2009a);
- Drylands cover **41%** of the earth's land surface and are home to over **2 billion people** (FAO, 2015);
- Benefits of restoring drylands generally outweigh costs by a factor of up to **1:35**.

Justdiggit has developed several intervention strategies suitable for African dryland biomes (biomes are the world's major ecological communities, classified according to the predominant vegetation and characterized by adaptations of organisms to that particular environment, such as woodlands, grasslands and temperate forest (Campbell, 1996)). Justdiggit is currently active in Morocco, Kenya and Tanzania.

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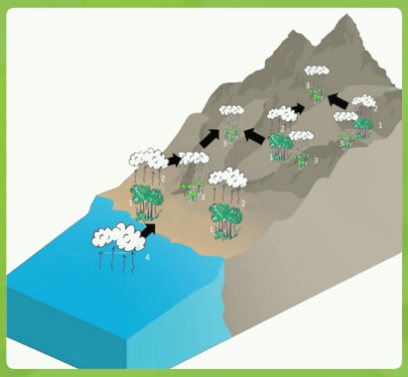
The promise of Justdiggit

Restoring degraded lands can be an effective solution for climate adaptation and mitigation. First of all, it mitigates climate change by sequestering CO_2 in vegetation and soils. Secondly, increased vegetation improves the hydrological cycle and lowers local temperatures, making it an effective adaptation strategy. The promise of the Justdiggit approach however proceeds beyond these local effects: by creating a network of strategic project locations within a hydrological corridor where our re-greening techniques are applied, adjacent areas also benefit from increased cloud cover and rainfall, ultimately resulting in regional and global climate impacts (see graph).

Landscape restoration projects, as proposed by Justdiggit, do not only serve as an effective way to address climate change, but result in a much wider set of benefits. In fact, land restoration contributes significantly to achieving the United Nations Sustainable Development Goals (UNCCD, 2016), as explained below.

Interventions at the scale of the hydrological corridor



1. **Local interventions** through water harvesting and conservation methods, in ten strategically chosen areas of 3 000 hectares, optimize water infiltration and enable vegetation to return;
2. Better soil conditions and improved vegetation results in **evapotranspiration**;
3. **Secondary climate**: as project areas start to interact adjacent regions also benefit from increased cloud cover, rainfall and local cooling;
4. **Regional climate effect**: local atmospheric changes resulting in more evenly distributed rain throughout the adjacent region.

Landscape restoration as an effective way to achieve the Sustainable Development Goals

Restoration of dryland landscapes reduces poverty and generates employment, specifically benefitting the extreme poor[1,2,3,4].

Sustainable Land Management increases yields, decreases undernourishment, and prevents malnutrition[1,5,6,7,8].

Healthy landscapes increase physical and mental health and human well-being and provide with medicinal resources[1,6,9].

Biodiversity loss can negatively impact access to education, while increasing income through landscape restoration increases access to education[1,6,10].

Ecosystem performance is not gender-neutral, restoring landscapes and climate change adaptation can help reduce gender inequalities[1,9,11].

Restoring degraded landscapes contributes to increased water infiltration, storage, quality and availability[1,12,13,14].

The transition towards renewable energy relies to an extent on functioning ecosystems, especially for the world's poor[1].

Investment into landscapes results into direct and indirect jobs, and wider economic growth through multiplier effects[1,15,16,17].

No effect.

As failing ecosystems often hit the poor the hardest, restoring landscapes benefits the bottom 40 per cent of the global population[4].

The world's growing and urbanizing population depends on resilient rural areas and communities, while exerting additional pressure on landscapes[1,6,10].

Restoring productivity through Sustainable Land Management is integral to responsible and sustainable food production[1,18].

Landscape restoration contributes to both climate change mitigation and adaptation, capturing CO_2 and increasing climate resilience[1,19,20,21].

Restoring degraded drylands can reduce soil-erosion induced eutrophication of lakes and oceans and reverse below water biodiversity loss[22,23].

Life on land is the basis of our human existence. Landscape restoration contributes to increased biodiversity and ecosystem services[24].

Combatting desertification through restoration of drylands addresses one of the major drivers of migration and conflict[5,25].

Landscape restoration requires multi-stakeholder engagement and therefore fosters new partnerships[26].

Restoration of degraded landscapes contributes significantly to the delivery of many of the Sustainable Development Goals[1].

Wide set of benefits

Table I shows a whole range of quantified benefits of landscape restoration for relevant dryland biomes and agricultural systems, as observed in meta-research and case-studies. These numbers highlight the potential of restoration projects. Take for example the potential for carbon sequestration: up to 140 Gigatons of CO_2e by 2030, which is more than ten times the current global Emissions Gap (UNEP, 2015). Or the 200 million jobs that are estimated to result from investing in an agricultural sector that fully adopts Sustainable Land Management (ILO, 2012). Water harvesting can increase the safe abstraction rate of aquifers.Local temperture potentially decrease by 0.8 °C through increased vegetation. And not to forget the increase in biodiversity that results from landscape restoration.

Various studies have demonstrated that landscape restoration not only delivers all these benefits, but against costs that are easily outweighed by the benefits (De Groot et al, 2013; UNEP 2015), while creating more jobs per dollar invested than for example the oil and gas industry (BenDor, 2015). Cost-benefit ratio's of ecosystem restoration can be as high as 1:35 for grasslands and 1:31 for woodlands, while remaining positive for all other biomes (De Groot et al., 2013).

In addition, landscape restoration could also be used as an entry point to address other social goals, such as improving gender equality (Broeckhoven, 2015) or increasing access to finance (Chokkalingam, 2005).

Table I: Multiple benefits of landscape restoration in numbers for selected dryland biomes (global)

	Overall	Biome specific numbers (if available)	Temperate Forest	Woodlands	Grasslands	Agriculture
Cost-benefit ratio	1:2.2 - 1:35[27]		1:3 - 1:22[27]	1:4 - 1:32[27]	1:4 - 1:35[27]	n/d
Climate						
Rainfall	up to 30%[31]		30%[31]	n/d	n/d	n/d
Temperature	0.5-0.8 °C lower[21]		n/a	0.5-0.8 °C lower[21]	0.5-0.8 °C lower[21]	0.5-0.8 °C lower[21]
Carbon Sequestration	+140 GT CO_2e[3]		up to 320 t C/ha[32]	up to 262 t C/ha[32]	up to 296 t C/ha[32]	+62%[28]
Agriculture						
Yields	+79% crop yield increase[14], future potential of 1.4 trillion USD[18]		n/a	n/a	n/a	+280 million tons of cereal crops[7] +2.3 billion tons of total crops[18]
Soil quality	62.4 billion USD / year[7],		n/a	n/a	n/a	prevent 53 kg/ha/year nutrient loss[7]
Economy						
Income	35 -40 billion USD / year[2]		n/d	n/d	n/d	n/d
Employment	200 million jobs by 2050[15]		> 3 million jobs[3]	n/d	n/d	n/d
Water						
Water availability	n/d		n/d	up to 13 % higher safe abstraction rate[30]	up to 13 % higher safe abstraction rate[30]	water productivity increase of 15 - 256%[14] water use down by 70- 90%[33]
Infiltration	up to 3 fold		n/d	up to 3x[13]	up to 3x[13]	up to 3x[13]
Biodiversity						
Species richness	+44[24] - 68[28] %		+44[24]	+44[24]	+44[24]	+68[28] %
Biomass	n/d		+ 21,211 Mt of biomass[34]	up to 8x tree biomass accumulation [29]	n/d	n/d

n/d = no data available; n/a = not applicable.

Table II: Potential for landscape restoration in monetary values for selected biomes in selected countries

	Morocco			Kenya			Tanzania		
	Temperate Forest	Wood-lands	Grasslands	Temperate Forest	Wood-lands	Grasslands	Temperate Forest	Wood-lands	Grasslands
Size (ha)	1.100	23.200	119.800	41.200	159.500	321.600	453.000	113.100	411.800
Current average GLADIS biophysical state	72%	26%	22%	66%	45%	45%	52%	38%	38%
Potential added value									
per ha per year USD	846	1.180	2.250	1.027	876	1.568	1.437	983	1.765
total per year (in million USD 2007)	0.9	27.4	269.6	42.3	139.7	504.3	651.1	111.1	727.0

Monetary values of ecosystem services

Using the Global Land Degradation Information System (GLADIS) we have assessed the current biophysical state of the land on potential locations in Morocco, Kenya and Tanzania to determine the current land degradation status. We then combined the degradation status of the land with the potential value of ecosystem services provided by these lands, as calculated by De Groot et al. (2012) and Costanza et al. (2014) at a global level. The results, as presented in Table II, provide with insight in the potential added value for landscape restoration in the countries Justdiggit is currently working.

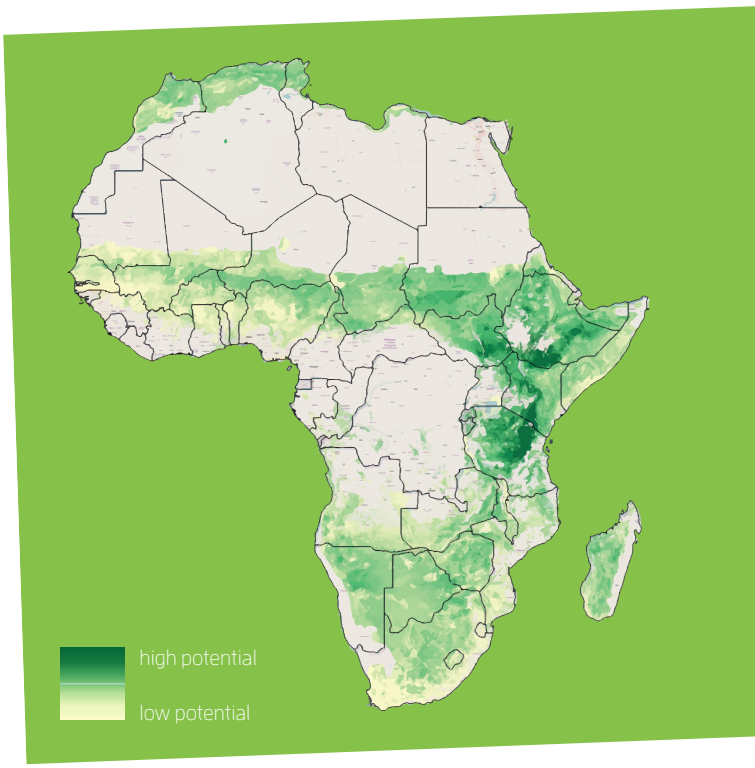
Ecosystem services include provisioning (e.g. food), regulating (e.g. climate regulation, pollination), supporting/habitat (e.g. maintenance of genetic diversity) and cultural services (e.g. recreation, spiritual experiences) (see Appendix I). The monetary values of ecosystem services are calculated using different valuation techniques, including so-called non-market values or shadow prices. Shadow prices highlight values that are not fully internalized in our economic system, or in the wrong place (e.g. damage costs of degradation are added to GDP) or are not accounted for at all and future generations will have to pay the price.

The values presented in Table II are calculated assuming the ecosystems will function at a fully sustainable level after restoration. Table II shows that land restoration provides considerable value through the increased delivery of ecosystem services. In the case of Tanzania, the combined value for the services provided by three biomes compares to 3,2% of their 2016 gross domestic product. Furthermore, the one-off intervention costs of Jusstdigit are well below the annual recurring monetary values that are provided by the restored ecosystems.

Potential for Africa

To demonstrate the potential of our approach, Justdiggit has performed a mapping analysis of the potential for our interventions across Africa, as presented in the map on the right (please consult our memo "Hydrological corridor potential map of Africa" for technical details about the mapping analysis).

The mapping analysis reveals the tremendous opportunity for projects across Africa.



Opportunities

The results of this quick scan show the enormous benefits of landscape restoration in African drylands and the potential for the development of business cases to bring our water harvesting and soil conservation projects to scale. Main initial drivers behind the business case could benefit from increased agricultural yields and carbon sequestration. Other project finance could come from governments or international development organisations pursuing public goals, such as addressing climate change, achieving land degradation neutrality or delivering the Sustainable Development Goals.

Financial instruments for land restoration are currently being developed, such as the Green Climate Fund or the Land Degradation Neutrality Fund, and are in need of investment-ready projects.Justdiggit is able to fast-track a pipeline of on-the-ground projects, by combining concept-of-proof with pre-existing aggregation points through their network of local implementation partners.

Justdiggit presents goverments, businesses, (impact) investors and international funds an incredible opportunity to combat climate change and restore productive landscapes, while at the same time achieving a wide range of other social, economic and environmental benefits.

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Appendix I: Summary of monetary values for selected dryland biomes (De Groot, 2012)

Ecosystem service All vallues in USD 2007 per ha per year		Temperate forest	Woodlands	Grasslands
Provisioning services		671	253	1 305
1	Food	299	52	1 192
2	Water	191		60
3	Raw materials	181	170	53
4	Genetic resources			
5	Medicine resources			1
6	Ornamental resources		32	
Regulating services		491	51	159
7	Air quality regulation			
8	Climate regulation	152	7	40
9	Disturbance moderation			
10	Regulation of water flows			
11	Waste treatment	7		75
12	Erosion prevention	5	13	44
13	Pollination	93		
14	Nutrient cycling		31	
15	Biological control	235		
Habitat services		862	1 277	1 214
16	Nursery services		1 273	
17	Genetic diversity	862	3	1 214
Cultural services		990	7	193
18	Esthetic information			167
19	Recreation	989	7	26
20	Inspiration			
21	Spritual experience			
22	Cognitive development	1		
Total economic value		3 013	1 588	2 871