Dataset on Costs and Benefits of Agroforestry in Africa

Users Guide

1. Introduction

Land degradation is a major contributor to poverty and hunger in many parts of the African continent. Climate change will further exacerbate both degradation and social vulnerability to degradation. Addressing land degradation through large-scale adoption of agroforestry solutions can strongly contribute to sustainable development in Africa, especially when considering the increasing demand for biomass resources and the projected implications of climate change. However, the adoption of these climate smart agroforestry solutions is, despite their availability, relatively low due to various structural bottlenecks. An economic assessment of costs and benefits of agroforestry can help promote climate smart agroforestry solutions, expand the knowledge about them, and facilitate decision-making and policy action. Weighing the costs and benefits against each other enables a promotion of the most worthwhile policy choices contributing to social welfare and safeguarding the environment. The Center for Development Research (ZEF) of the University of Bonn and the Centre de Suivi Écologique in Senegal have compiled a dataset to capture the economic value of ecosystem services generated by agroforestry systems in Africa.[1] This dataset represents the first extensive compilation of costs and benefits of agroforestry systems in Africa and contributes to close the information gap of economic profitability of this practice. The dataset is based on a systematic literature review (SLR) as well as focus group discussions conducted in selected countries across Africa. This work builds on previous ZEF research on the economics of ecosystem restoration in the Sahel by MIRZABAEV et al. (2021).

2. Methodology

2.1 Data collection through Systematic Literature Review and Focus Group Discussions

The Systematic Literature Review (SLR) followed a defined review protocol with predetermined selection criteria. The review was carried out using the Scopus database. To include grey literature, a second review was conducted with Google. The publication period for both Scopus and Google search was set to 2000-2022. The keywords for the SLR are displayed in Table 1 and contained the constant "agroforestry", as well as terms referring to monetary values and country contexts. Additional economic data from the WOCAT SLM database (https://qcat.wocat.net/en/wocat/) was included to expand the findings. Only publications in English were considered. A total number of 750 papers was compiled. After a content review, 65 papers containing monetary values on agroforestry were retained. In addition, 33 sources on costs of agroforestry in Africa originated from the ECON-WOCAT dataset (https://qcat.wocat.net/en/wocat/), while 9 sources were collected from the grey literature review. Focus group discussions (FGD), conducted by the Centre de Suivi Écologique (CSE) and International Centre of Insect Physiology and Ecology (ICIPE) in Senegal and Kenya in 2022, added further 102 supplementary value sources. In total, the 209 sources delivered 490 data points

[1] Mirzabaev A., Rothenberger P., Diouf A.A., Baumüller H., Mbow C. and von Braun J. (2025) Dataset on Costs and Benefits of Agroforestry in Africa. Bonndata. https://doi.org/10.60507/FK2/KJR2HW.

providing monetary information on costs and benefits of agroforestry systems in various locations in Africa (Table 2).

Table 1: List of keywords used for SLR.

Agroforestry, AND economic AND costs, AND benefits, AND Africa
agroforestry, AND economic AND costs, AND benefits, AND [African country name]
agroforestry, AND income, AND Africa
agroforestry, AND income, AND [African country name]
agroforestry, AND economic, AND Africa
agroforestry, AND economic, AND [African country name]
agroforestry, AND costs, AND Africa
agroforestry, AND costs, AND [African country name]

Table 2: Compiled data from SLR and FGDs.

Scopus results		750	
Scopus results after content review	***Yes*** ***65***		***No*** *685*
Grey Literature		9	
Additional Data entries WOCAT		33	
FGDS Senegal		68	
FGDs Kenya		34	
Total of Sources		**209**	
Amount of Data points		**490**	

2.2 Data Harmonization

Data provided in the literature was presented in different currencies and expressed at different times, hence, a harmonization of values had to be carried out. For this purpose, two approaches can be considered. First, values will be transformed into USD and following accounting for inflation will be based on USD inflation rates. Second, inflation accounting will be performed on the local currency to bring all values to the same year and subsequently values will be converted to USD. TURNER et al. (2019) recommends inflating the local currencies for non-tradable goods and services. Since most of the values recorded remain in the regional market, such as e.g., crops and timber, or are non-tradable goods like labour, the second approach was chosen. For this purpose, the World Bank's inflation and GDP deflator indicator for each country was used. Local currencies value in 2020 was then converted to USD using average exchange rates for 2020. Data harmonization resulted in all values being expressed in USD 2020.

3. Structure of the Dataset

The dataset is composed of 164 variables. Descriptive variables indicate details such as source, country and specific location, tree/crop species, sapling survival rate and spacing between trees. The economic factors like inflation deflation and exchange rate are listed. The actual economic values are then divided into costs and benefits. The total costs are separated into maintenance costs and establishment costs. While establishment costs refer to the costs incurred for the initial adoption of

the technology, maintenance costs express the annually recurring costs for the upkeep of the technology. Total, establishment and maintenance costs as well as total benefits are given in USD 2020, the individual value categories are expressed in the currencies used in the original sources for traceability. The cost variables mainly refer to inputs and labour, while the benefits include variables such as income, yield, tree fruits, and sale of tree products. Variables labelled with “currency”, “curr” or “unit” display the currency and/or measurement unit of values. All variables are explained in Table 3.

Table 3: List of variables with explanations.

Variable	Description
Country	Country
refyear	Year in that data is expressed in the original source
inflationdef	Inflation deflation rate
exrate	exchange rate
totalusd2020	total costs in USD 2020
establishcost2020usd	Establishment costs in USD 2020
maincosts2020usd	Miantenance costs in USD 2020
benefitsusd2020	Benefits in USD 2020
EcC_seedlings	Costs for seedlings
EcC_saplings	Costs for saplings
EcC_seeds	Costs for seeds
EcC_harvest	Costs for harvesting
EcC_maint_plant	Costs for plant maintenance
EcC_production	Costs for production
EcC_inputs_max	Maximum costs for inputs
EcC_Transplanting	Costs for transplanting
EcC_labour_max	Maximum costs for labour
EcC_maint_labour	Costs for maintenance labour
EcC_fertilizer	Costs for fertilizer
EcC_maint_fertilizer	Maintenance costs for fertillizer
EcC_land	Costs for land
EcC_agrochemicals	Costs for agrochemicals
EcC_pest_contr	Costs for pest control
EcC_packaging	Costs for packaging
EcC_equipment	Costs for equipment
EcC_maint_equipment	Maintenance costs for equipment
EcC_construction	Costs for construction
EcC_maint_construction	Maintenance costs for construction
EcC_pest_contr_maintenance	Maintenance costs for pest control
EcC_Transport	Costs for transport
EcC_other	Other costs (not specified)
EcC_maint_other	Other maintenance costs (not specified)
costsestablish	Establishment costs expressed in curreny used in original source
costsmainte	Maintenance costs expressed in curreny used in original source
EcC_total_max	Total costs expressed in currency used in original source
EcB_income_max	Benefits in income
EcB_total_max	Total benefits expressed in curreny used in original source
EcB_yieldcrops	Benefits from yield and crops
EcB_livestock	Benefits from livestock

EcB_sap_production	Benefits from sapling production
EcB_tree	Benefits from trees; not further specified in original source. Can be income, sale or consumption of tree products, etc.
EcB_AFTPSNTFP_sale_max	Maximum benefits from sale of agroforestry tree products and non timber forest products
EcB_wood	Benefits from wood, timber
EcB_charcoal	Benefits from charcoal
EcB_fruit	Benefits from tree fruits
EcB_fodder	Benefits from fodder generation
EcB_org_matter	Benefits from production of organic matter
EcB_tree_sale	Benefits from sale of whole trees (timber)
EcB_sapling_sale	Benefits from sale of saplings
EcB_food_max	Benefits from food generation
EcB_tools	Benefits from generation of tools out of trees
EcB_pest_control	Benefits from pest control function of agroforestry systems
EcB_carbon_sequ_max	Benefits from carbon sequestration from agroforestry systems
EcB_CO2_equiv_biomass_max	Benefits of CO_2 equivalent of the rate of biomass carbon accumulation
EcB_climate_regulation	Benefits from climate regulation function of agroforestry systems
EcB_disturbance_regul	Benefits from disturbance regulation function of agroforestry systems
EcB_water_regul	Benefits from water regulation function of agroforestry systems
EcB_water_treatment	Benefits from water treatment function of agroforestry systems
EcB_water_supply	Benefits from water supply function of agroforestry systems
EcB_Erosion_control	Benefits from erosion control function of agroforestry systems
EcB_Soil_formation	Benefits from soil formation function of agroforestry systems
EcB_nutrient_cycling	Benefits from improved nutrient cycling due tree component in agroforestry system
EcB_raw_materials	Benefits from provisioning of raw materials
EcB_genetic_resources	Benefits from provisioning/conserving of genetic resources by reducing extinction and crop genetic resource loss
EcB_medical	Benefits from providing natural medicines
EcB_recreation	Benefits from recreation potential from agroforestry systems
EcB_aesthetics	Benefits from aesthetics of agroforestry systems
EcB_cultural	Benefits from cultural value
EcB_Gas_regulation	Benefits from regulation of gases
EcB_air_regulation	Benefits from air purification function of agroforestry systems
EcB_Pollination	Benefits from supporting service of pollination
EcB_habitat_refugia	Benefits from provisoning of habitat
EcB_bushmeat	Benefits from bushmeat
EcB_Employment_tax_income	Benefits occurring from employment and tax income
EcB_other	Other benefits (not specified)
costs_saved	Saved costs in pest control due to implementation of agroforestry systems.
reference_value	Reference value describes detail about time of data expression or currency
comment	comment
remark	Shows from which year the values are, if the original source

	has observed an agroforestry system over several years
Agrofor_practice	Agroforestry practice analysed in source
Type	cropped, pastoral or mixed system
Source	Source
Location	Specific location (village, region, state, etc.)
Coordinates	Coordinates
Unique_location	Detail about uniqueness of location
tree_species	tree species
non_tree_species	non tree species (mostly crops)
sapling_surv_rates	sapling survival rates
shade_index	shade index based on eight variables: number of trees, number of tree species, tree density, number of herbs, number of herb species, average tree height, percent shade cover, and percent herb cover. 0= least diverse shade; 1= most diverse shade.
tree_density	Tree density
spacing_btw_trees	Spacing between trees

4. Key Descriptive Statistics of the Dataset

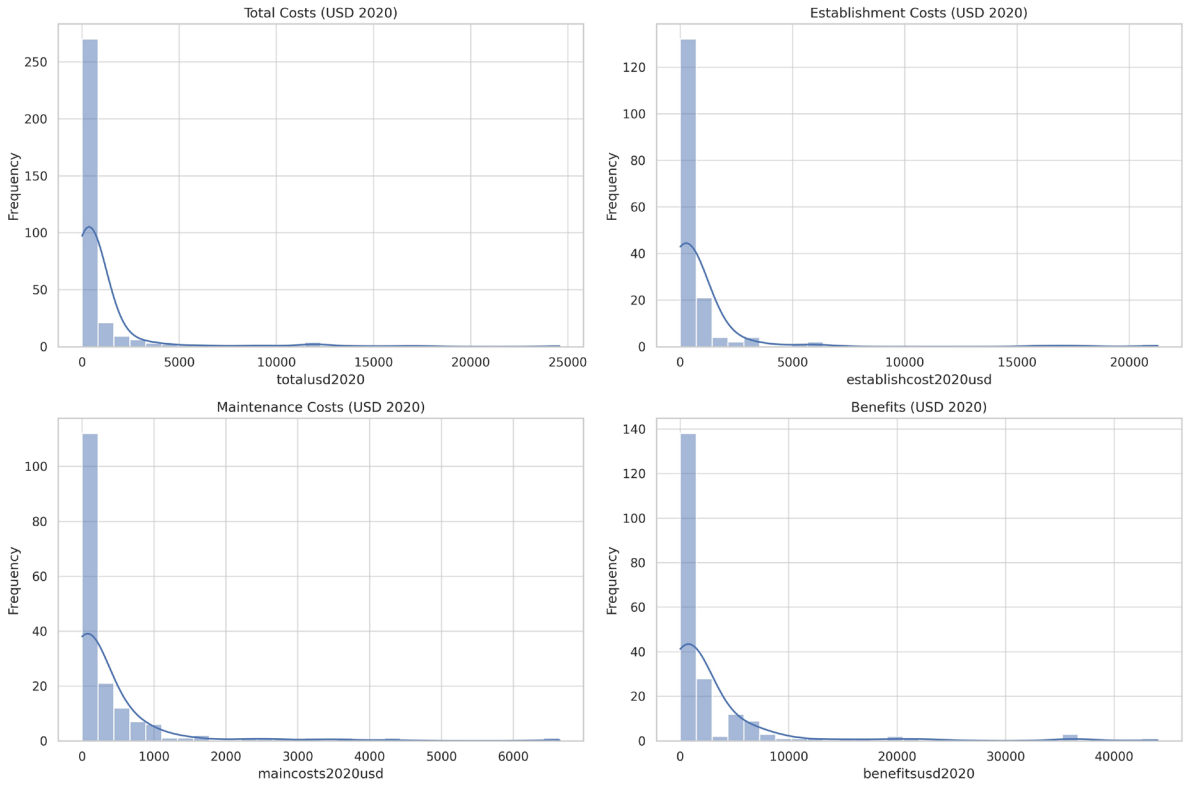

Figure 1. Distribution of key variables

Table 4. Descriptive statistics of key variables

Statistical Measure	Total Costs (USD 2020)	Establishment Costs (USD 2020)	Maintenance Costs (USD 2020)	Benefits (USD 2020)
Mean	1,081	832	345	2,799
Median	372	192	31	780
Minimum	0.02	0	0	0

Statistical Measure	Total Costs (USD 2020)	Establishment Costs (USD 2020)	Maintenance Costs (USD 2020)	Benefits (USD 2020)
Maximum	24,572	21,272	6,642	44,025

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