General information			
Project code	BVU-L-001		
Project name	Bamboo Village Uganda BV		
Location	Uganda, Gayaza		
Area	10	ha	
Duration	65	years	estimated permanence of removal and storage (converted to 100)
Holding pool	20%		freed up when measurements confirm projection pathways
Project emissions	80,76	tCO2e	Life cycle assessed emissions over 20 years link
Out of scope	Construction stored carbon		Certificates for harvest to be modeled and issued separately
Per hectare			
Baseline TEC	389	tCO2/ha	Above Ground, Below Ground and Soil Organic Carbon, following CDM AR-ACM0003
Reference capacity	1.131	tCO2/ha	INBAR (2018), range confirmed from Abebe et al (2021) and others
Storage potential	742	tCO2/ha	Projection -/- baseline
Per project			
Projected storage	7.422	tCO2	storage potential per ha x area
LCA emissions	81	tCO2	project related emissions
Net storage potential	7.341	tCO2	project storage -/- emissions over 20 years
Removal credits issued			
Credits first 12 years	2.863	credits	12/20 x net storage potential x permanence factor (duration / 100)
Holding Pool	573	credits	20% of the first 12 years
Credits issued dd	2.290	credits	80% of the first 12 years

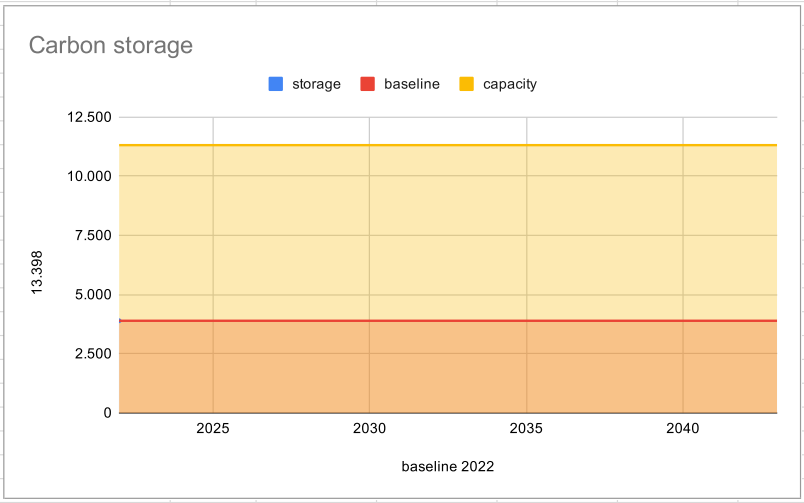
Field Code	Field name	Size (ha)	Owner	Ownership contract	Notes		
001	bamboo	10	Twinobuhungiro /	yes	20 year starting from 4tJa date of August 2022.		
002-R	reference						

#	Field code	Field	Year	Date	Sample depth	SOC/AGB	Carbon (g/kg)	AGB (tCO2/ha)	Sample/report nr.	Notes
001	001	bamboo	2023	10-5-2023	30	SOC	13,5		2411	Chagga
003	001	bamboo	2023	10-5-2023	30	SOC	14,5		2412	Kasanja
005	001	bamboo	2023	10-5-2023	30	SOC	20,5		2413	Next to the river
006	001	bamboo	2023	10-5-2023	30	SOC	15,5		2414	Bush Area
007	001	bamboo	2023	10-5-2023	30	SOC	16,5		2415	Namugabe
008	001	bamboo	2010	1-1-2010	-	AGB	-	176	ESA baseline	ESA agb data
009	001	bamboo	2017	1-1-2017	-	AGB	-	33	ESA baseline	ESA agb data
010	001	bamboo	2018	1-1-2018	-	AGB	-	39	ESA baseline	ESA agb data
011	001	bamboo	2019	1-1-2019	-	AGB	-	182	ESA baseline	ESA agb data
012	001	bamboo	2020	1-1-2020	-	AGB	-	231	ESA baseline	ESA agb data

Year	Above Ground Biomass (Mg/ha)	Carbon (Mg/ha)	CO2 Equivalent (Mg/ha)
2010 ✅	95.750	47.875	175.542
2017 ✅	18.250	9.125	33.458
2018 ✅	21.000	10.500	38.500
2019 ✅	99.500	49.750	182.417
2020 ✅	126.000	63.000	231.000

Sources															
value	**source**	**URL**	Notes												
CEDA aboveground biomass carbon	https://climatee	https://datacedaa	2010-2020 data												
SOC	A critical review of the conventional SOC to SOM conversion factor (Geoderma,Volume 156, Issues 3–4, 15 May 2010, Pages 75-83)														
Density	Wageningen Ur	https://edepot.wu	We've added these soil density levels to the calculation factors tab												
Reference data for capacity															
Reference description	Metastudy of different sources, mainly Yuen et al (2017)														
SOC (soil)	464,40	tCO2e/ha	References												
AGB and BGB (plant biomass)	666,77	tCO2e/ha	References												
TEC	1.131,17	tCO2e/ha													
Bamboo															
value	**CO2/ha**		**range low**	**range high**	**range avg**	**unit**	**source**	**URL**	Notes						
Inda aboveground biomass carbon			15,360	27,79	21,575	tC/ha/y	Devi et al 2021	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7803772/							
AGB stock Ethiopia Oxytenanthera aby	305,07		83,200	83,2	83,200	tC/ha	Abebe et al 2021	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8447768/							
SOC stock Ethiopia Oxytenanthera aby	256,67		70,000	70	70,000	tC/ha	Abebe et al 2021	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8447768/							
AGB + SOC stock	561,73														
Guadua Aculatea in Nicuragua							Ecoplanet Bambo	https://www.redd	1375 ha, 20yr, annual credits expected 40815, so 30 /ha/y CO2e						
SOC average bamboo forest	495,00		70,000	200	135,000	tC/ha	Yuen et al (2017)	https://www.inbar.int/resources/inbar_publications/carbon-off-setting-with-bamboo/							
TEC Guadua and Moso	594,00		156,000	168	162,000	tC/ha	King, Van der Lu	https://www.inbar.int/wp-content/uploads/2021/03/Mar-2021_Integration-of-Bamboo-Forestry-into-Carbon-Markets-2.pdf							
TEC Total Ecosystem Carbon stock	891,00		94,000	392	243,000	tC/ha	King, Van der Lu	https://www.inbar.int/wp-content/uploads/2021/03/Mar-2021_Integration-of-Bamboo-Forestry-into-Carbon-Markets-2.pdf							
Average Guada-Moso and others	**742,50**														
Moso total carbon stock china (TEC)	380,11		87,830	119,5	103,665	tC/ha	Xu et al 2018	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0193024							
								https://forest.kerala.gov.in/images/gwarm/17bmbopacs.pdf							

Carbon Calculation for		**BVU-L-001**								
Surface	10	ha	Fields tab							
Capacity Reference TEC	1.131,17	TEC tCO2e/ha	References tab							
	2023		**2026**		**2029**		**2032**		**2035**	
Measurement average	16,10	SOC g/kg	#DIV/0!	SOC g/kg	#DIV/0!	SOC g/kg	#DIV/0!	SOC g/kg	#DIV/0!	SOC g/kg
Sample depth	30	cm	#DIV/0!	cm	#DIV/0!	cm	#DIV/0!	cm	#DIV/0!	cm
Calculation depth	30	cm	30	cm	30	cm	30	cm	30	cm
Soil density	1,45	g/cm3	#DIV/0!	g/cm3	#DIV/0!	g/cm3	#DIV/0!	g/cm3	#DIV/0!	g/cm3
SOC (soil carbon) / ha	257	tCO2e/ha	#DIV/0!	tCO2e/ha	#DIV/0!	tCO2e/ha	#DIV/0!	tCO2e/ha	#DIV/0!	tCO2e/ha
AGB (above ground) / ha	132,18	tCO2e/ha	#DIV/0!	tCO2e/ha	#DIV/0!	tCO2e/ha	#DIV/0!	tCO2e/ha	#DIV/0!	tCO2e/ha
Storage current	3.890	tCO2e	#DIV/0!	tCO2e	#DIV/0!	tCO2e	#DIV/0!	tCO2e	#DIV/0!	tCO2e
Storage capacity	11.312	tCO2e	54.749	tCO2e	54.749	tCO2e	54.749	tCO2e	54.749	tCO2e



from C to CO2	3,666666667		
soil density	% organic matter	% organic carbor	soil density
1,59	0,5	0,25	1,59
1,52	1,5	0,75	1,52
1,45	2,5	1,25	1,45
1,39	3,5	1,75	1,39
1,34	4,5	2,25	1,34
1,29	5,5	2,75	1,29
1,24	6,5	3,25	1,24
1,18	7,5	3,75	1,18
1,13	8,5	4,25	1,13
1,09	9,5	4,75	1,09
1,05	10,5	5,25	1,05
1,01	11,5	5,75	1,01
0,96	12,5	6,25	0,96
0,93	13,5	6,75	0,93
0,9	14,5	7,25	0,9
0,87	15,5	7,75	0,87
0,84	16,5	8,25	0,84
0,81	17,5	8,75	0,81
0,79	18,5	9,25	0,79
0,77	19,5	9,75	0,77
0,75	20,5	10,25	0,75
0,73	21,5	10,75	0,73
0,71	22,5	11,25	0,71
0,7	23,5	11,75	0,7
0,69	24,5	12,25	0,69
0,67	25,5	12,75	0,67
0,65	27	13,5	0,65
0,62	29	14,5	0,62
0,6	31	15,5	0,6
0,58	33	16,5	0,58
0,56	35	17,5	0,56
0,54	37	18,5	0,54
0,52	39	19,5	0,52
0,5	41	20,5	0,5
0,49	43	21,5	0,49
0,47	45	22,5	0,47
0,46	47	23,5	0,46
0,44	49	24,5	0,44

Source: Soil carbon measurement results May 2023

Soil Organic Matter (SOM) [%] with Loss-on-ignition method (LOI)

			SOM%	SOM (g/kg)	SOC%	
Sample 1	2414	bush area	3,1	31	1,8	
Sample 1	2413	Next to the river	4,1	41	2,38	
Sample 2	2415	namugabhe	3,3	33	1,91	
Sample 3	2411	chagga	2,8	28	1,62	
Sample 4	2412	Kasanja	2,9	29	1,68	
		Average	3,24	32,4	1,88	**Baseline soil carbon**
					0,018792	

Assumptions and Source
Organic matter c https://www.soilquality.org.au/factsheets/organic-carbon
Soil density assu https://www.agric.wa.gov.au/measuring-and-assessing-soils/what-soil-organic-carbon#:~:text=About%2058%25%20of%20the%20mass,derived%20from%20100%2F58).&text=This%20conversion%20factor%20can%20vary,of%20SOM%20for%20most%20purposes.
Conversion C in CO2 with 44/12 (= ratio of molecular weight)

Soil carbon capacity calculation based on literature and baseline me

	Field [ha]	SOC [%]	ample depth [cm	oil density [g/cm3	Field tCO2	tCO2/ha	tC/ha	Source
Baseline (S/2023	10	1,88	30	1,3	2687,3	**268,7**	**73,3**	Soil carbon measurement results May 2023
Capacity (1)	10	3,46%	30	1,3	4950	495	135	*Yuen et al. (2017), Average of 70 species from 184 studies [Max 200, min 70]*
Capacity (2)	10	3,03%	30	1,3	4338,4	433,8	118,3	See calculation below
Average Capacit	10	**3,25%**	30	1,3	4644,2	**464,4**	**126,7**	Average soil carbon capacity

Calculation of soil carbon capacity of different used

Overview used bamboo species		Participation per area	Modelled/ Assumed as	**Participation per area**	**Potential tC/ha**	
Bambusa bambos	Clumping	84%	*Bambusa balcooa & polymorpha & vulgaris*	16%	100,5	*Yuen et al. (2017), Dendrocalamus asper assumed as average of Dendrocalamus barbatus & latiflorus (p.118)*
Dendrocalamus Asper	Clumping	16%	*Dendrocalamus barbatus & D. latiflorus*		65,4	*Toriyal et. al (2013), Bambusa bambos assumed as Bambusa balcooa (p.105 Mean 2011)*
		100%			13	*Yuen et al. (2017), Bambusa bambos assumed as Bambusa polymorpha (p.118)*
					25	*Yuen et al. (2017), Bambusa bambos assumed as Bambusa vulgaris (p.118)*
				84%	34,5	Average Bambusa bambos (assumed)
				100%	**45**	**Average soil carbon capacity (incl. different species and their participation % per area)**

Uptake of the previous system - Above Ground Biomass before [Source: ESA data, Average of 2010, &

Year	round Biomass [	Carbon [Mg/ha]	Equivalent [Mg/ha]
2010	95,75	47,875	175,542
2017	18,25	9,125	33,458
2018	21	10,5	38,5
2019	99,5	49,75	182,417
2020	126	63	231
			132,183

Assumptions and used numbers:

Conversion C in CO2 with 44/12 (= ratio of molecula

Carbon content in biomass 50%

Number of clumps per hectare: 500 (20% more than literature standard)

Overview of the CO2 storage potential in above- and below-ground

Bamboo species	**incl. culms, branch**	**total (incl. rhizon**	**stored carbon [t**	**stored CO2 [t CO**	*Corrected clumps*	*Source*
Bambusa bambo	168,7	6,2	174,9	641,45		*Shanmughavel et al. (2001)*
	143,3	12,2	148,9	545,97		*Yuen et al. (2017)*
	144	22,5	166,5	610,42		*Nath et al. (2009) - Shanmughavel (1996)*
	121	19,5	140,5	515,06		*Sohel et al. (2015)/Nath et al. (2009) - Kumar et al. (2005)*
Average	**144,26**	**15,09**	**157,7**	**578,22**		
Dendrocalamus	108,1	23,6	131,7	482,8		*Yuen et al. (2017)*
	86,7	20	106,7	391,3		*Hermis et al. (2014)*
Average	**97,4**	**21,8**	**119,2**	**437**		
TOTAL	**136,8**	**16,16**	**151,54**	**555,64**	**666,768**	

Estimation of carbon stored in below ground biomas

		BGC		
	icipation per area	a	b	
Bambusa bambo	84%	0,3714	0,8256	*Yuen et al. (2017), p.123 (e) Bambusa sp. & G. angustafolia*
Dendrocalamus	16%	0,7367	0,74	*Yuen et al. (2017), p.123 (d) Dendrocalamus sp. & Gigantochloa sp.*
	100%	**0,6378**	**0,8628**	*Yuen et al. (2017), p.123 (a) all species/groups*

Assumptions and used numbers:		
Conversion C in CO2 with 44/12 (= ratio of molecular weight)		
Carbon content in biomass 50%		
Yearly extraction rate (starting after 5 years)	20%	*Bambu Batu (https://bambubatu.com/harvesting-bamboo-when-why*
Ratio biomass of culms of total above-ground biomass	85%	*Shanmughavel et al. (2001)*
Production efficiency	90%	*Assumption provided by industry p*
Lifespan of product [years]	25	*Moso bamboo (https://blog.moso-bamboo.com/5-things-you-need-to-know-about-the*
		Guadua Bamboo (https://www.guaduabamboo.com/blog/durability-
CO2 storage potential in durable product pool (of harvested bamboo)		
Plant density [plants/ha]	500	
Average ABG [t C/ha]	164,1	*20% more culms (500 plants/ha in*
Culm [t BM/ha]	279	*85% of ABG stored in culms*
Yearly harvest [t BM/ha*year]	**55,8**	*20% yearly harvest rate*
*Yearly harvested culms [culms/ha*year]*	5580	*Assumed weight 10 kg/culm*
	11,2	*culms/plant*year*
Biomass storage potential in durable product pool	1255	t biomass/ha
CO2 storage potential in durable product pool	**2302**	t CO2/ha

Participation per area [%]		
Clumping	*Bambusa bambos*	84%
Clumping	*Dracalamus Asper*	16%
		100%

Source: Lugt, Vogtländer - The environmental impact of industrial bamboo products

Overview of assessed categories - on plant level (1/2)	
Starting material	
Description	Cuttings from mother plant
Average weight per starting material [gr]	0,16
Transport distance (Kiboga - Namanve) [km]	15
Transport vehicle	Pick-up truck, petrol
Process - extraction of starting material from motherplants	by hand
Defined as cut-off: impact of cuttings itself	
Soil	
Description	Common Ugandan ground, non-treated (1 Black soil : 1 Sand soil : 5 Loam soil)
Average weight per soil plug [kg]	0,9
Transport distance (Natabulirwa - Namanve) [km]	2
Transport vehicle	Small truck, 3.5-7.5 tons, EURO 3
Process - soil extraction	by hand
Defined as cut-off: impact of land use change due soil extraction from the ground; impact of soil itself	
Nursery materials - Pots	
Description	Polyethylene (PE) grow bags
Average weight per PE pot [gr]	6,11
Transport distance (Kampala - Namanve) [km]	17
Transport vehicle	Pick-up truck, petrol
Nursery materials - Pots	
Description	1 cutting per pot
Process - planting (nursery)	by hand
Growth loss	25%
Defined as cut-off: water usage	
Transport to field	
Description	Polyethylene (PE) grow bags
Average weight of Young plant [kg]	1,45
Transport distance (Namanve - field) [km]	200
Transport vehicle	Medium truck, 7.5-16 tons, EURO 3
Cultivation	
Total growing plants	5000
Growth loss	20%
Process - planting (field)	by hand

Carbon Footprint assessment		
On plant level		
Category	**CF in kg CO2-eq.**	***Remarks***
Starting material	2,09E-06	*incl. 25% loss*
Soil	0,0012	*incl. 25% loss*
Material (Pots)	0,024	*incl. 25% loss*
Transport to field	0,065	-
Per young plant	**0,09**	**-**
Per plant in field	**0,108**	*Incl. 20% loss*
All plants in field	**540,1**	*5000 plants/10 ha*
Activities of 20 years		
Category	**CF in kg CO2-eq.**	***Remarks***
All plants in field	540,1	-
Planting	496,3	*Forth and back*
Maintenance - fertiliser usage	9841	*Only forth*
Maintenance - soil measurement	633,1	*Forth and back*
Maintenance - travelling	69250,6	*Forth and back*
Total CF of 20 years	**80760,9**	*kg CO2-eq*
Total CF of 20 years	**80,76**	*t CO2-eq.*

Overview of assessed categories - activities of 20 years (2/2)	
Planting	
Description	transportation of workers
Transport distance (Kampala area - field) [km]	200
Transport vehicle	Large car, Diesel, EURO 3
Occurring amount (in 20 years)	3
Maintenance - fertiliser usage	
Amount used [kg/ha]	247,11
Field area [ha]	10
Transport distance (Kampala - field) [km]	160
Transport vehicle	Small truck, 3.5-7.5 tons, EURO 3
Occurring amount (in 20 years)	20
Maintenance - soil measurement	
Transport distance (Kampala - field) [km]	160
Transport vehicle	Large car, Diesel, EURO 4
Occurring amount (in 20 years)	5
Maintenance - travelling	
Description	Business trips from Netherlands to Uganda
Transport distance (Amsterdam - Kampala) [km]	6335
Transport vehicle	plane (long haul)
Occurring amount (in 20 years)	30
Description	Visiting field
Transport distance (Kampala - field) [km]	160
Transport vehicle	Large car, Diesel, EURO 4
Occurring amount (in 20 years)	253