Do Investors Care About Biodiversity?

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ESG and Sustainable Finance

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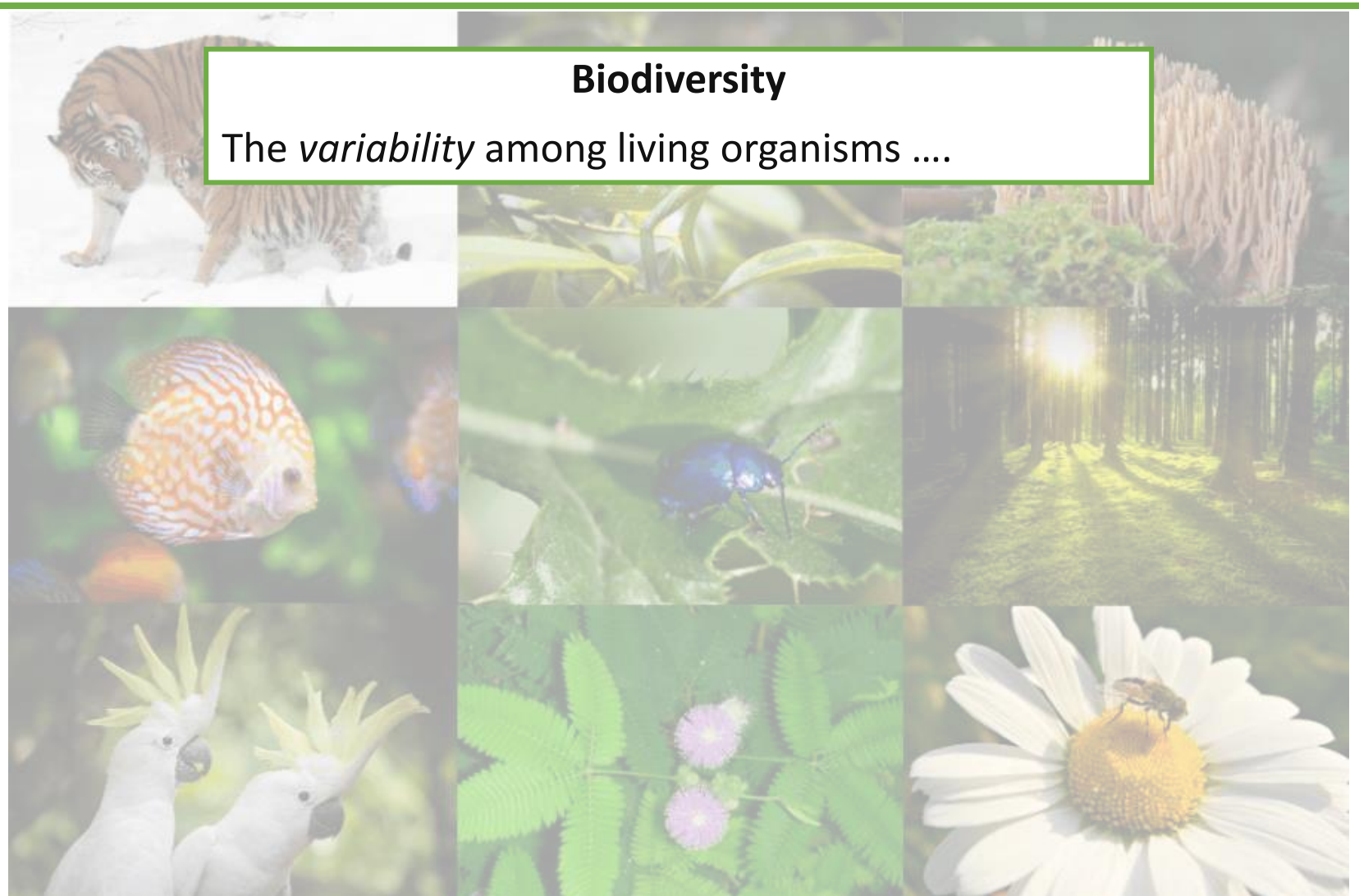
Biodiversity -> Ecosystem services



Biodiversity

The *variability* among living organisms ….

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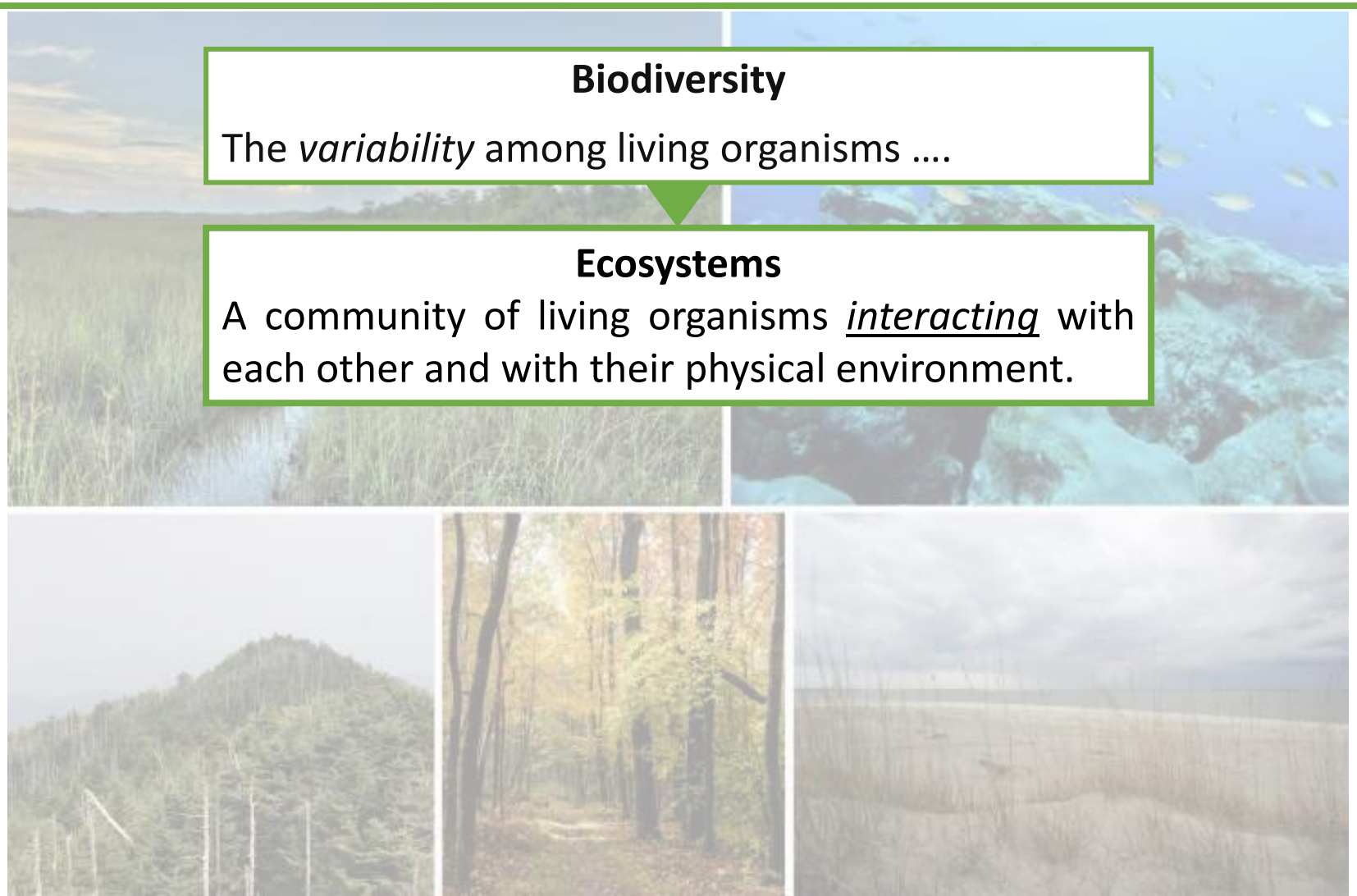

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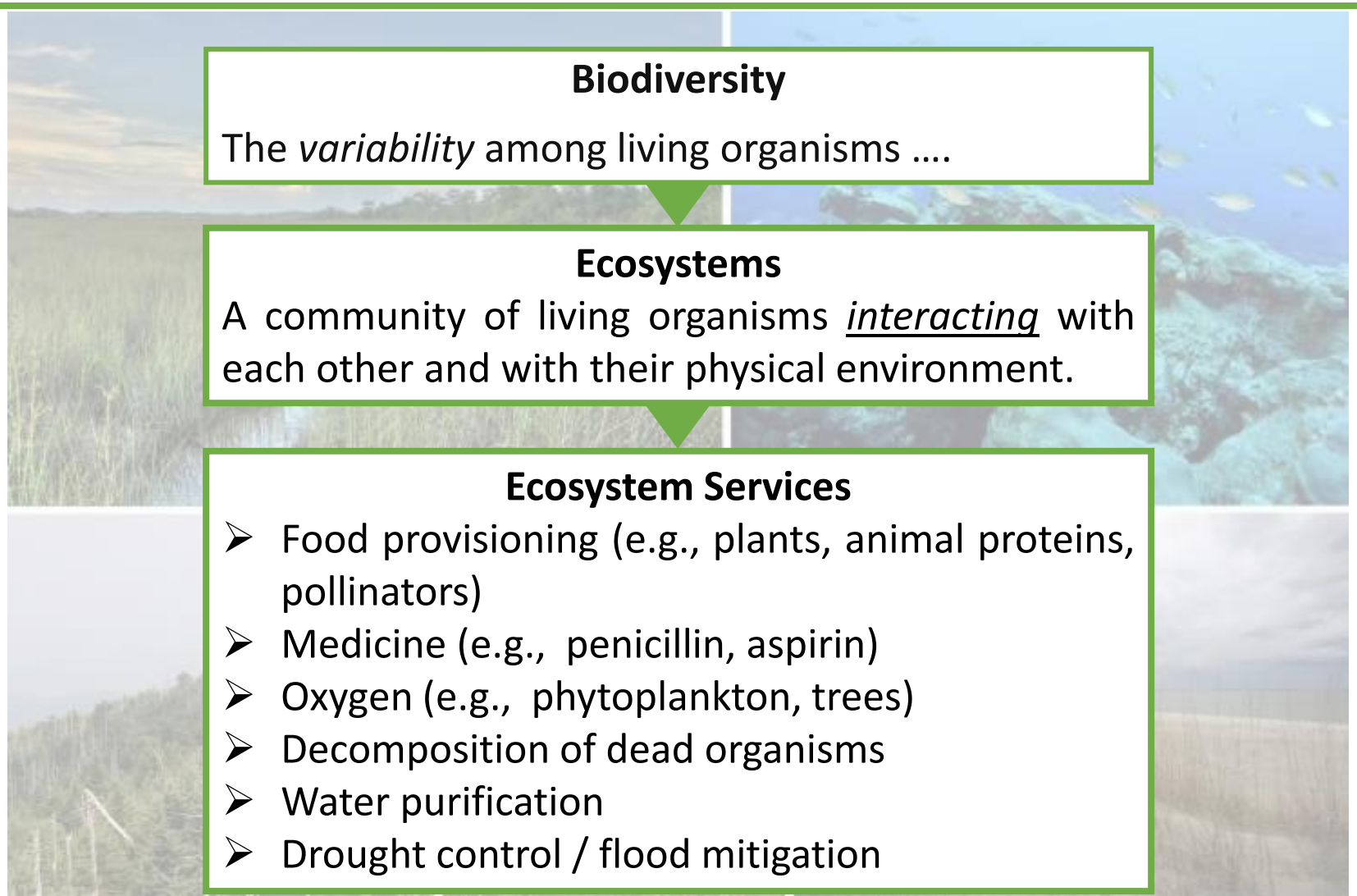
Ecosystems

A community of living organisms *interacting* with each other and with their physical environment.

Biodiversity -> Ecosystem services



Biodiversity

The *variability* among living organisms ….

Ecosystems

A community of living organisms *interacting* with each other and with their physical environment.

Ecosystem Services

- Food provisioning (e.g., plants, animal proteins, pollinators)
- Medicine (e.g., penicillin, aspirin)
- Oxygen (e.g., phytoplankton, trees)
- Decomposition of dead organisms
- Water purification
- Drought control / flood mitigation

Biodiversity loss

Massive

Unprecedented speed

Between 1970 - 2018, 69% loss of monitored wildlife

“Sixth mass extinction”

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Human Activities

- Reshaped natural habitats (farmland, obtain natural resources). Fragmentation due to infrastructures.
- Sea and land use (primarily for large-scale food production). Deforestation.
- Overexploitation (overfishing, overhunting and overharvesting) for food, medicines, timber.
- Climate change. Growing impact.
- Pollution... Fertilizers, pesticides, plastic.
- Water use (dams, irrigation).
- Invasive alien species. Trade & Travel.
- Increasing human pop.; per capita consumption.

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Less stable and resilient ecosystems.
Less effective ecosystems services.

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Biodiversity loss –> Policy momentum

*Typical **negative environmental externality**. Triggered a strong policy reaction in 2021.*

Kunming Declaration (Oct. 2021):
>100 countries committed to developing, adopting, and implementing an effective global framework to put biodiversity on a path to recovery by 2030 at the latest.

Montreal Agreement (Dec. 2022) to protect 30% of the planet's lands, coastal areas, and inland waters by the end of the decade.

Biodiversity loss –> Biodiversity momentum

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Montreal Agreement (Dec. 2022) to protect 30% of the planet's lands, coastal areas, and inland waters by the end of the decade.

Launch of the Task Force on Nature-Related Disclosure (Jun. 2021):
Seeks to develop and deliver a risk management and disclosure framework for organizations to report and act on evolving nature-related risks.

Emergence of a biodiversity transition risk ?

Post COP15

Increased investor awareness about the loss of biodiversity.

Biodiversity boom:

- Press coverage
- Earnings calls
- Funds
- Investors coalitions (NA100, FBF)
- NGFS
- Biodiv. credit market

Increased investor uncertainty about future biodiversity regulations or litigation.

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Transition Risk

Leads investors to require a risk premium for holding stocks of companies with a large biodiversity footprint (*Pastor and Veronesi, 2012*).

Consistent with investors demanding a compensation for exposure to carbon (Bolton and Kacperczyk 2021, 2023) or pollution (Hsu, Li, and Tsou 2023) risks.

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We seek to test this…

CBF: Corporate Biodiversity Footprint

- Impact/footprint measure. ***Extent to which ecosystems affected by a firm's activities have been degraded from their pristine natural state***.
- Corporate Biodiversity Footprint (CBF) expressed in **MSA.km2**: *Loss in Mean Original Species Abundance over an area.*
- *A CBF score of -100 MSA.km2 corresponds to a reduction of original biodiversity of 100% over an area of 100 km2 or of 10% over an area of 1,000 km2.*
- Yearly. From 2018. Large sample of international companies.
- Scope 1 to 3 [*land use*, *air pollution*, *water pollution*, *GHG*].

Iceberg Data Lab
Enabling Sustainable Goals

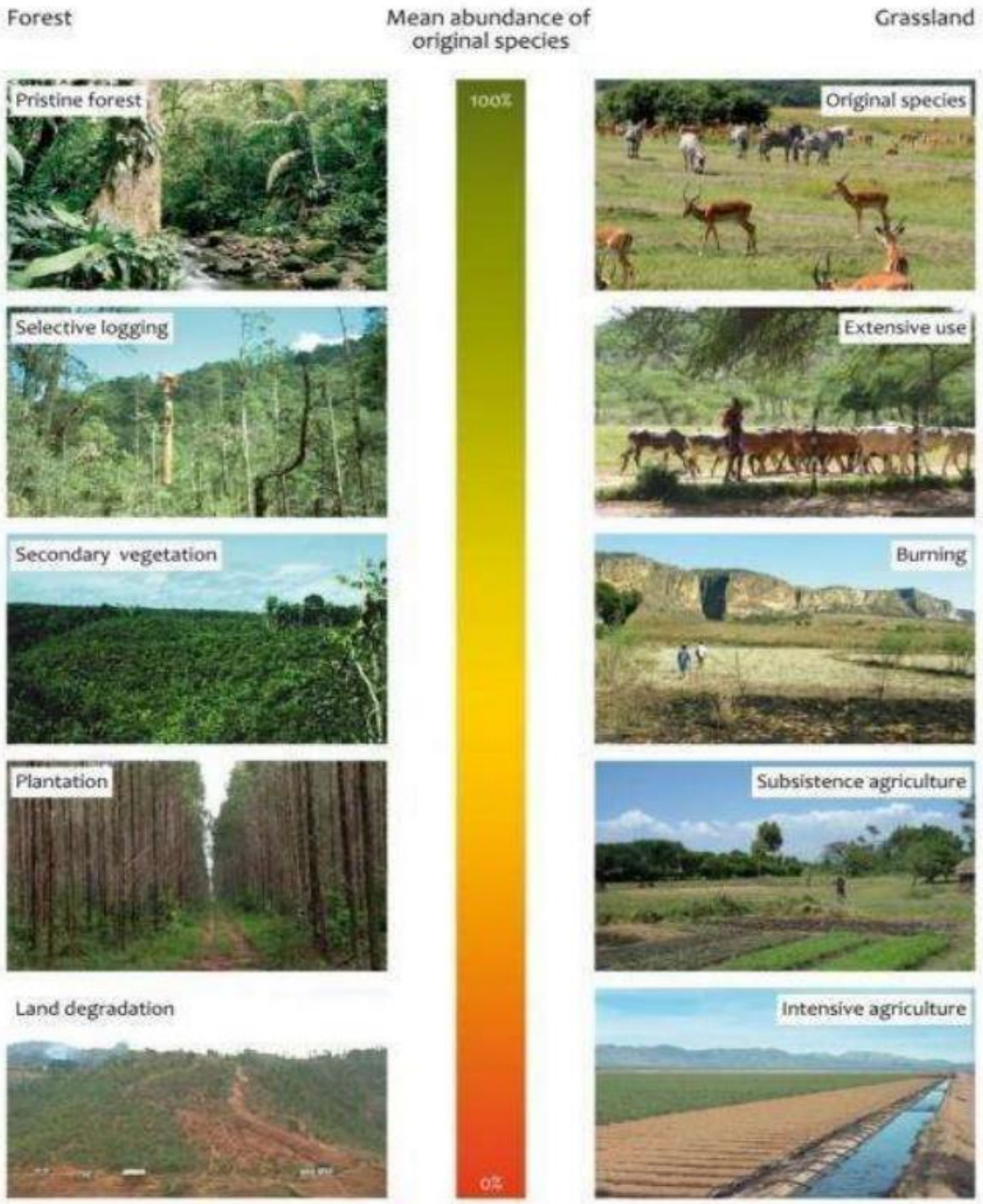


Figure 2: Photographic illustration of MSA variation for forest and grassland ecosystems (GLOBIO, 2019).

CBF: Corporate Biodiversity Footprint

Iceberg Data Lab

Enabling Sustainable Goals

CBF: Corporate Biodiversity Footprint

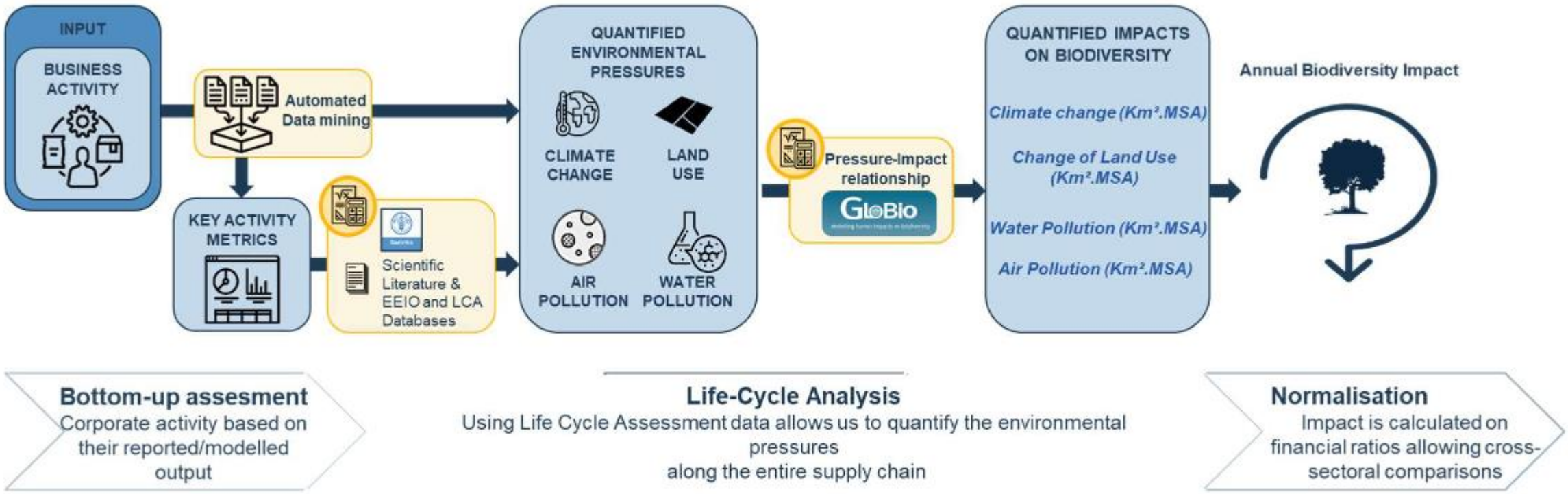
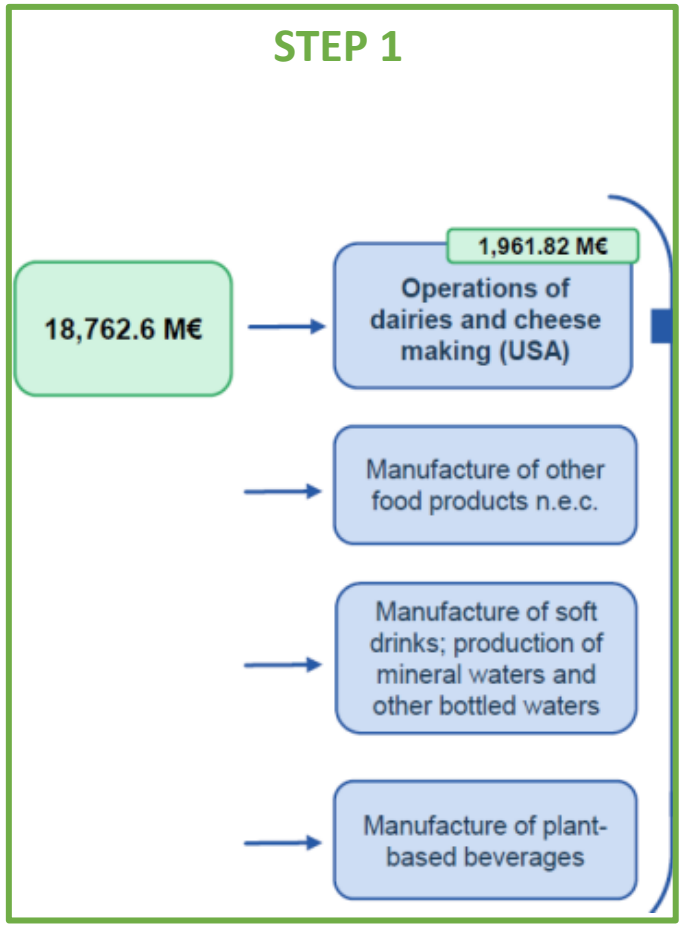


Figure 3: Illustration of the global approach and modelling process of IDL's biodiversity accounting methodology.

CBF: Corporate Biodiversity Footprint

Danone 2021



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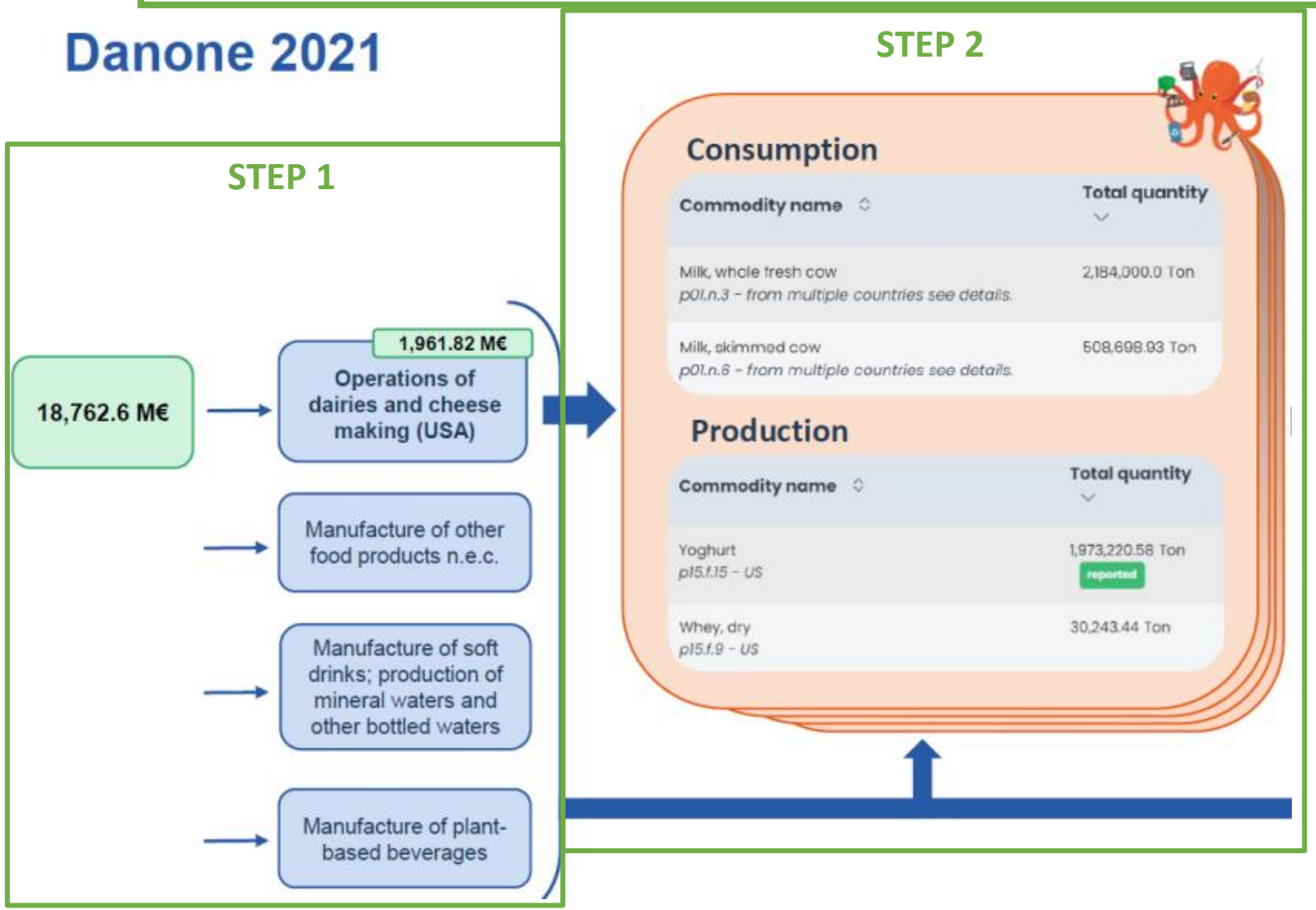

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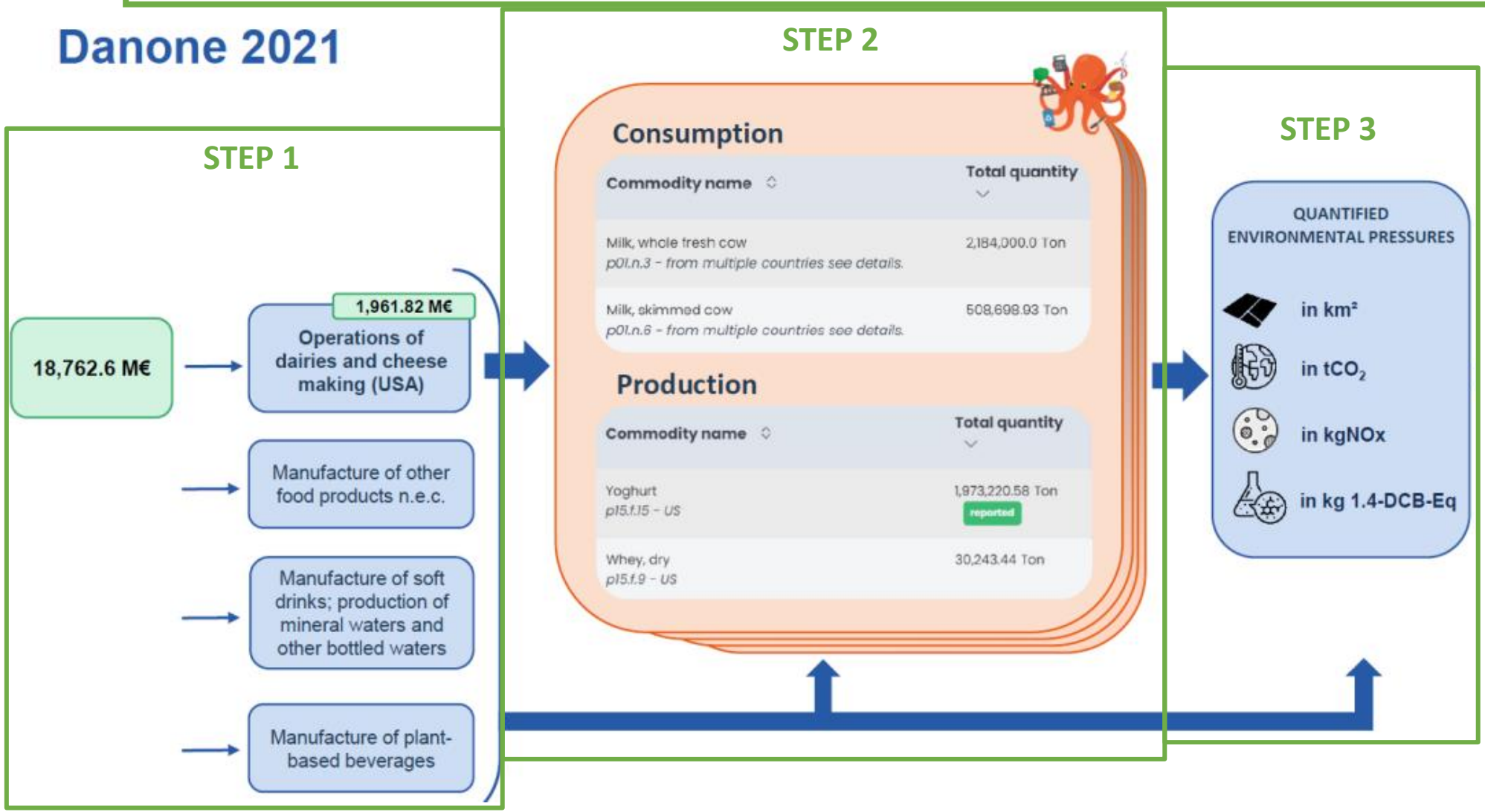

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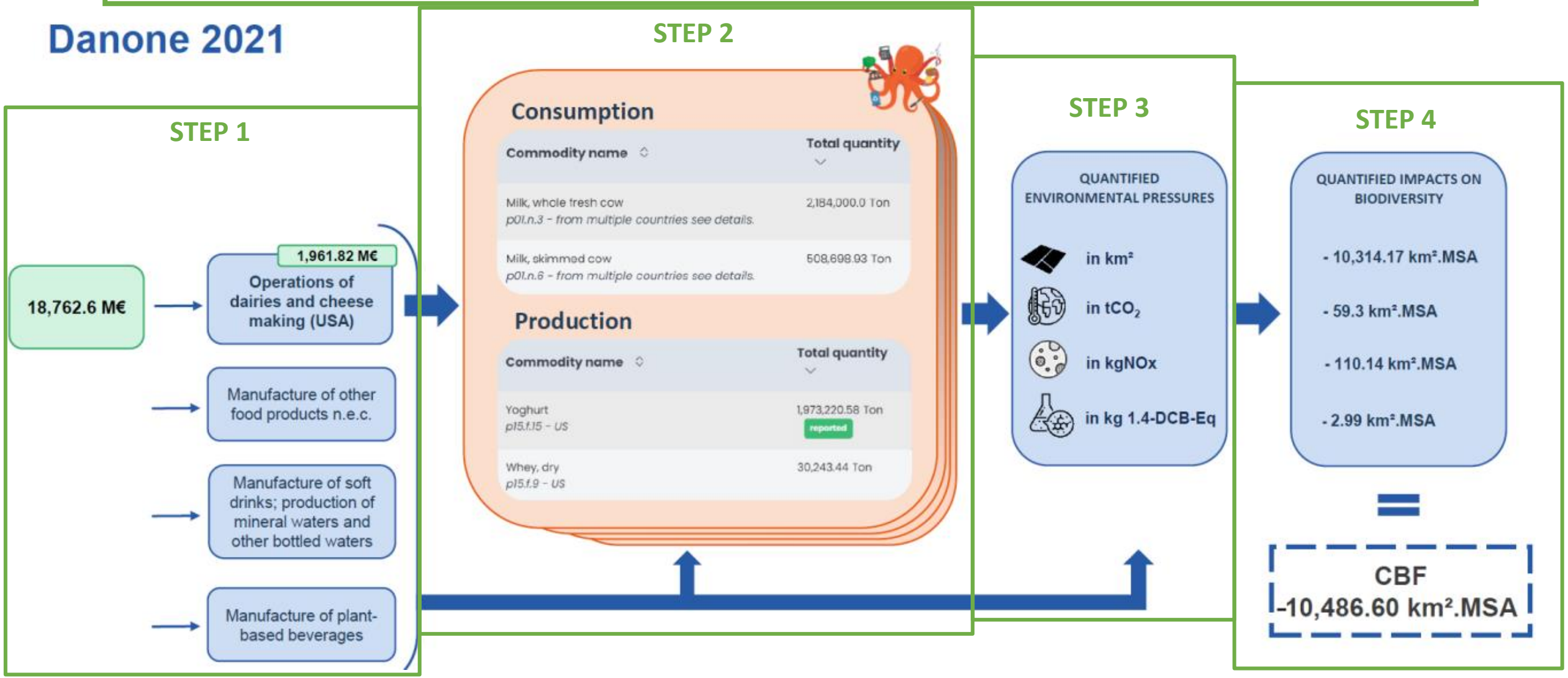


Sample

#Firm-month obs.	#Listed firms	#Countries
89k+ over 2019-2022	**2,106**	**34**

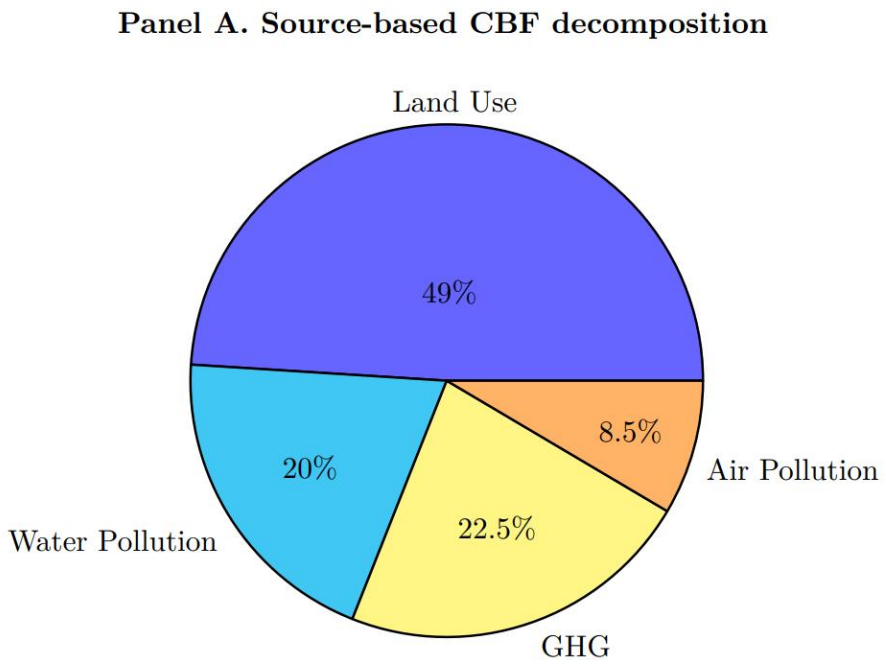
Sample

Descriptive statistics

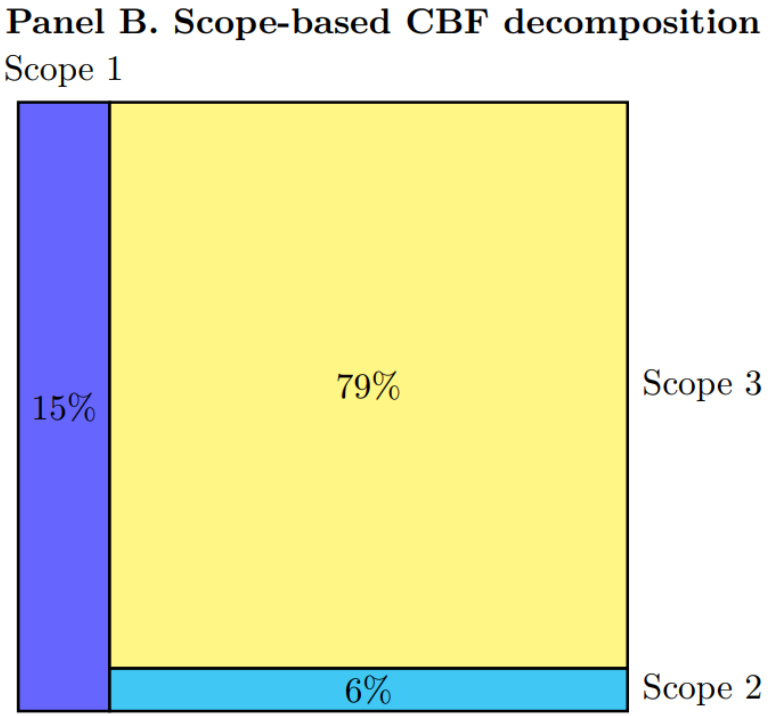
Variables	#Obs.	Mean	S.D.	Min	25%	50%	75%	Max
Ln(CBF)	89,132	4.79	3.11	-9.25	3.17	5.28	7.01	13.78
Ln(CBF GHG)	89,132	2.27	2.97	-12.33	0.24	2.51	4.42	10.08
Ln(CBF land use)	88,820	3.60	3.56	-15.88	1.75	4.10	6.06	13.77
Ln(CBF water pollution)	89,132	1.37	4.27	-15.53	-1.15	2.21	4.40	11.34
Ln(CBF air pollution)	89,132	1.47	3.29	-13.47	-0.39	1.96	3.71	9.12
Ln(CBF scope 1)	89,012	0.88	3.82	-12.69	-2.03	0.98	3.81	13.77
Ln(CBF scope 2)	88,856	-4.54	5.51	-30.77	-8.70	-3.18	-0.15	6.57
Ln(CBF scope 3)	89,120	4.36	3.45	-11.26	2.78	5.01	6.78	12.11
Ln(CBF/Total assets)	89,132	-4.34	2.73	-11.28	-5.50	-3.86	-2.45	0.10
Ln(CBF/Sales)	89,108	-3.75	2.61	-10.21	-4.88	-3.17	-1.90	0.30

Sample

Distribution by Source



Distribution by Scope



Scope 3 is dominant : large international firms either assemble and distribute products or provide services, implying that they usually do not have direct impacts on their environments (examples include retailers, banks, or tech firms): Upstream (e.g., providers of farming land or extracting raw materials) or downstream (e.g., usage of products and services by clients, financing activities by banks) activities. Firms with large scope 1 footprints tend to operate in the paper and forest business or in metals and mining, that is, with business models that have a much larger direct effect on the local biodiversity.

CBF Validation

Top Industries

Retail & Wholesale
Paper & Forest
Food

TNFD

Taskforce on Nature-related Financial Disclosures

Recognized

Biodiversity funds & inst. investors

HSBC World Biodiversity Screened Equity ETF
Ossiam Food for Biodiversity ETF
AXA IM ACT Biodiversity Equity ETF …
BNP Paribas, Robeco, Mirova …

Other biodiversity metrics

Biodiversity disclosure score (31%)

REFINITIV

MSCI Biodiversity and land use exposure score (37%)

MSCI

Nature Action 100

Institutional investor initiative ($27 trillion in assets)

100 firms across eight sectors to engage with in order to tackle biodiversity and nature loss.

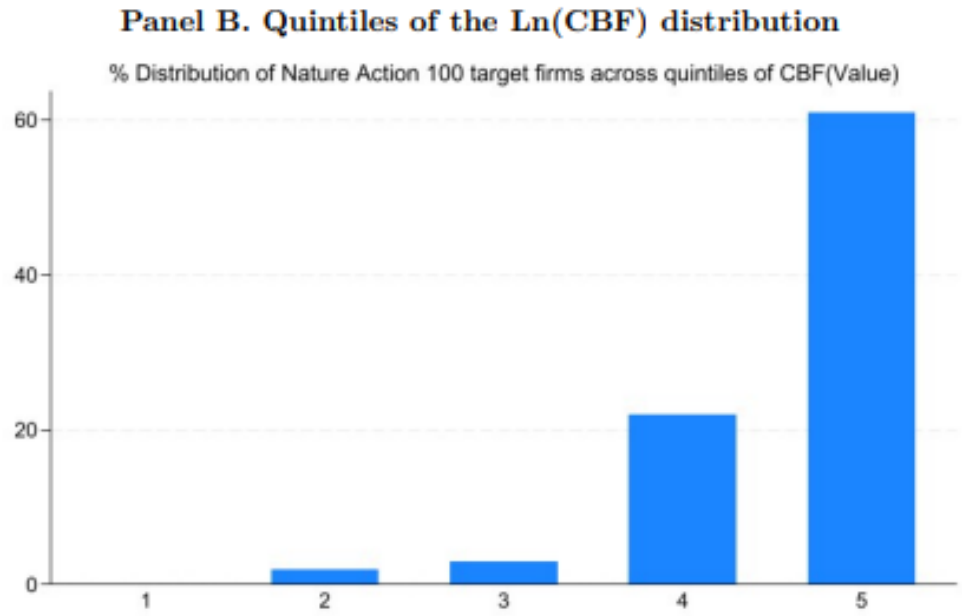


Table 4. Corporate biodiversity footprint and stock returns

This table reports regressions relating monthly stock returns to Ln(CBF). The sample period in Columns 1–2 includes monthly returns over the full sample period from January 2019 to December 2022. The sample period in Columns 3–4 includes monthly returns from January 2019 to September 2021 (the COP15 in Kunming started in October 2021) and in Columns 5–6 monthly returns from October 2021 to December 2022. Ln(CBF) is measured as of the end of the previous year. The accounting-based right-hand variables are measured as of the last fiscal year. Market capitalization, volatility, and momentum are measured as of the end of the previous month. CBF is the corporate biodiversity footprint and reflects the biodiversity loss caused by the firm's annual activities. Standard errors are clustered at the year-month and firm level. Intercepts are not reported. *, **, and *** represent significance levels of 0.10, 0.05, and 0.01, respectively. Appendix A provides variable definitions.

	Monthly return (%)					
	Whole period		Pre-Kunming period		Post-Kunming period	
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(CBF)	0.003	-0.000	-0.036	-0.036	0.061**	0.057**
	(0.019)	(0.018)	(0.022)	(0.022)	(0.026)	(0.026)
Ln(Total assets)	0.211	0.158	0.143	0.112	0.336	0.290
	(0.171)	(0.164)	(0.192)	(0.187)	(0.329)	(0.313)
Ln(Market cap)	-0.468***	-0.393***	-0.426**	-0.382**	-0.372	-0.305
	(0.153)	(0.143)	(0.187)	(0.178)	(0.252)	(0.238)
Book-to-market	-0.086	-0.043	-0.072	-0.047	-0.057	-0.043
	(0.159)	(0.158)	(0.196)	(0.189)	(0.285)	(0.289)
Leverage	0.353	0.372	0.630	0.701	-0.524	-0.496
	(0.351)	(0.347)	(0.438)	(0.435)	(0.562)	(0.576)
Capex/Total assets	1.933	2.265	6.695***	6.459***	-6.763*	-5.955
	(2.200)	(2.089)	(2.100)	(2.070)	(3.518)	(3.411)
PPE/Total assets	0.327	0.353	-0.319	-0.270	1.624*	1.569*
	(0.401)	(0.414)	(0.425)	(0.427)	(0.760)	(0.747)
ROA	2.216	2.014	0.979	0.969	5.534	5.109
	(1.864)	(1.724)	(1.712)	(1.584)	(3.493)	(3.457)
Asset growth	-0.408	-0.300	0.221	0.167	-1.491**	-1.343**
	(0.336)	(0.316)	(0.334)	(0.320)	(0.566)	(0.552)
Sales growth	-0.038	-0.218	0.047	0.398	0.101	-0.403
	(0.480)	(0.374)	(0.676)	(0.509)	(0.476)	(0.340)
Volatility	5.433	5.012	14.644**	13.513*	-2.692	-2.214
	(5.096)	(5.077)	(7.126)	(7.115)	(6.226)	(6.473)
Momentum	4.407	3.134	-1.459	-0.438	-3.682	-1.515
	(5.382)	(4.770)	(6.418)	(5.913)	(8.548)	(7.804)
Wald test (p-value): Column 3 vs. 5			0.019			
Wald test (p-value): Column 4 vs. 6					0.036	
Year-month fixed effects	Yes	No	Yes	No	Yes	No
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No
Industry×year-month fixed effects	No	Yes	No	Yes	No	Yes
#Obs.	89,132	89,132	58,218	58,218	30,914	30,914
R^2	0.251	0.320	0.245	0.309	0.255	0.324

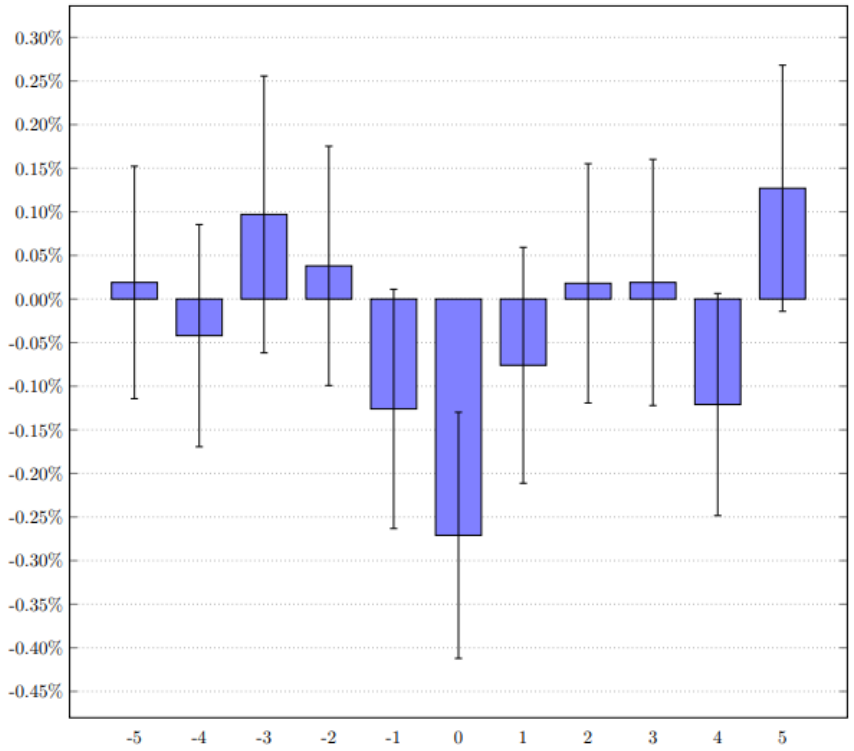
Realized monthly returns

- No significant association over 2019-2022.
- Positive association with monthly realized returns in the post-Kunming period (October 2021 to December 2022).
- A one-standard-deviation increase in Ln(CBF) is associated with an additional monthly return of 18.5 basis points, or a 2.2% annualized increase.
- Consistent with the emergence of a biodiversity footprint premium (a compensation for the transition risk) post Kunming Declaration.

Event study - Kunming Declaration

Figure 5: Kunming Declaration: Return differences between large- and small-CBF firms

This figure reports daily mean stock return differences around the Kunming Declaration between large- and small-CBF firms. It covers the event window [-5,+5]. The day of the Kunming Declaration (event date) is t=0. Returns are adjusted for the mean daily return of the country and the mean daily return of the industry. Large-CBF (small-CBF) firms have a CBF value that is above (below) the median as of end 2020. We also report 95% confidence interval. CBF is the corporate biodiversity footprint and reflects the biodiversity loss caused by the firm's annual activities.



- Market reaction to the announcement of the Kunming Declaration (13th of October 2023; t =0).
- We expect investors to revise downward their valuation of large-CBF stocks post Kunming declaration.
- First, compare abnormal returns of large-CBF firms vs the ones of small-CBF firms.
- Significant negative market reaction at *t=0*.
- No marked parallel trend or reversal.

Event study - Kunming Declaration

Table 6. Stock price reactions to Kunming Declaration

This table reports regressions documenting the stock price reactions to the Kunming Declaration, with the focal date of the event being October 13, 2021. We report results for firms with large versus small CBF values. The event window consists of the [-3,2]-day window around the focal date. The market reaction is computed as the within-firm difference in daily returns between the three trading days before versus after the event. Large CBF equals one for firms with a CBF value above the median (as of the beginning of the year), and zero otherwise. CBF is the corporate biodiversity footprint and reflects the biodiversity loss caused by the firm's annual activities. Post equals one in the three days after the event (days t=0 to t=+2), with day t=0 being the event date. Abnormal returns are returns in excess of their domestic stock market index returns (using MSCI domestic indices). Standard errors are clustered at the country level. Intercepts are not reported. *, **, and *** represent significance levels of 0.10, 0.05, and 0.01, respectively. Appendix A provides variable definitions.

	Daily return (%)				Abnormal daily return (%)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Large CBF × Post	-0.381***	-0.372***	-0.189**		-0.295***	-0.380***	-0.209**	
	(0.064)	(0.057)	(0.084)		(0.073)	(0.055)	(0.078)	
Large CBF × t = -2				0.040				-0.043
				(0.213)				(0.204)
Large CBF × t = -1				-0.504*				-0.361
				(0.278)				(0.277)
Large CBF × t = 0				-0.671***				-0.590**
				(0.218)				(0.226)
Large CBF × t = +1				-0.642***				-0.461**
				(0.193)				(0.196)
Large CBF × t = +2				-0.301*				-0.241
				(0.164)				(0.166)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day fixed effects	Yes	No	No	Yes	Yes	No	No	Yes
Country×day fixed effects	No	Yes	No	No	No	Yes	No	No
Industry×day fixed effects	No	No	Yes	No	No	No	Yes	No
#Obs.	12,301	12,301	12,301	12,301	12,301	12,301	12,301	12,301
R^2	0.240	0.332	0.298	0.243	0.192	0.256	0.245	0.194

- DiD [-3,2] with firm and day FE.
- In the three days following the declaration, relative to the three days before, large-CBF firms experienced a cumulative stock price decline of 1.14%, relative to small-CBF firms.
- Consistent with investors starting to discount more heavily the cash flows of high-biodiversity-footprint companies because of a transition risk.
- Similar market reaction around the launch of the TNFD .

Robustness checks

Intensity instead of raw CBF	Controlling for CO_2 Emissions	Controlling for Climate Risk Exposure	MSCI Biodiv. Score
✓	✓	✓	✓
Restricting to ACWI universe	Alternative clustering of SE	Country of stock exchange	Dropping countries
✓	✓	✓	✓

Alternative interpretations

Expected cash flows are revised updward (e.g., Atilgan et al. 2023).

Unlikely to be driven by unexpected shifts in investor preferences after the Kunming Declaration (e.g., Pastor et al. 2020, 2021).

We perfom additional analyses to better identify a discount rate channel…

Alternative interpretations

- ICC better at detecting expected return-risk tradeoffs (e.g., Pastor et al. 2008; Cenedese et al. 2023).Post Kunming, a one-standard-deviation increase in Ln(CBF) is associated with a monthly ICC increase of 0.057% (0.94% annualized).

- Biodiversity footprint association with stock returns **significantly larger in countries with low levels of biodiversity protection.**
- Where the regulatory *uncertainty* and the *expected* stringency of future regulation to protect biodiversity should be the highest.

- Both corroborate a discount rate (expected return) channel.

Conclusion

- Still little research on biodiversity in finance (Karolyi and Tobin-de la Puente (2023), Flammer et al. (2023), Giglio et al. (2023), Hoepner et al. (2023), Starks (2023), Coqueret and Giroux (2023), Xin et al. (2023)).

- First step toward understanding the interplay between finance and biodiversity: introducing a measure of the corporate biodiversity footprint & exploring whether it is priced by investors.

- We (will) provide publicly the CBF measure at the industry-country level.

Thank you for your attention!

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AFA 2024

ESG and Sustainable Finance

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