BIODIVERSITY

FINAL REPORT | *CLIENT : KORU IMPACT SOLUTIONS*

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EXECUTIVE SUMMARY

The following report will :

- Simplify impact measurements for Koru Impact Solutions.
- Focus on the biodiversity metrics for the comprehensive assessment.
- Increase the understanding of biodiversity impact for informed investment decisions.

Some of the challenges we have faced were :

- Aligning with Koru's objectives and expectations.
- Managing diverse datasets.
- Identifying and finding additional data sources.
- Developing a universal metric.
- Meeting project timelines.
- Communicating well with Koru Impact Solutions stakeholders.
- Maintaining Quality and Accuracy of our work.

Some of the key findings we have found is :

- Biodiversity affects health via nutrition through soil quality, the amount of pesticides used and the amount of pests within the area
- The higher the diversity score, the lower the risk of the country's biodiversity.

Our recommendations would be to :

- Diversify data.
- Collaborate with other companies that have data on biodiversity.

OVERVIEW OF THE PROBLEM

Biodiversity is the amount of life on this Earth. (Lévêque, C., & Mounolou,) This includes animals, humans, bacteria and plants. Biodiversity has an important role in maintaining the health and stability of our ecosystems. This is done through services such as nutrient cycling, climate regulation, pest control, and pollination. Also, it supports human well-being by providing clean water, food and other essentials (Dasgupta, P.). Pollution, habitat destruction, overexploitation of natural resources, climate change and many other factors have caused substantial damage, leading to unprecedented biodiversity declines worldwide. This could cause potential risks to water availability, quality of life, food security and human societies.

The objective of Koru Impact Solutions' mission is such that the environmental consequences of financial investments can be easily determined. This is done by creating an API that can take a fund and automatically calculate its impact on sustainability metrics. Our team has been assigned a set of data of which we have been tasked with researching. We will have to evaluate its quality (if it has issues, biases, how well it was collected, etc.), process and clean the data, then analyse it to determine insights into the metrics related to our topic which is biodiversity. The following report is for Koru Solutions to see how their investments impact the environment through our assigned element — biodiversity.

In this report we will be showing the following :

- **Executive Summary**
  - What this report will show.
  - What challenges we have encountered.
  - Some of the key insights we have found.
  - Overview of the recommendations.
- **Overview Of The Problem.**
  - What is biodiversity?
  - Outline of the report.
- **Insights**
  - Evaluation of the assigned datasets
  - Regressions Analysis
  - Margin of Error
  - Biodiversity Score
  - Four Lens - Quantitative
  - Four Lens - Quantitative
- **Recommendations & Next Steps**
  - Recommendations
  - What we would have done differently.
- **Reference list**
  - External sources used through the project.

INSIGHTS

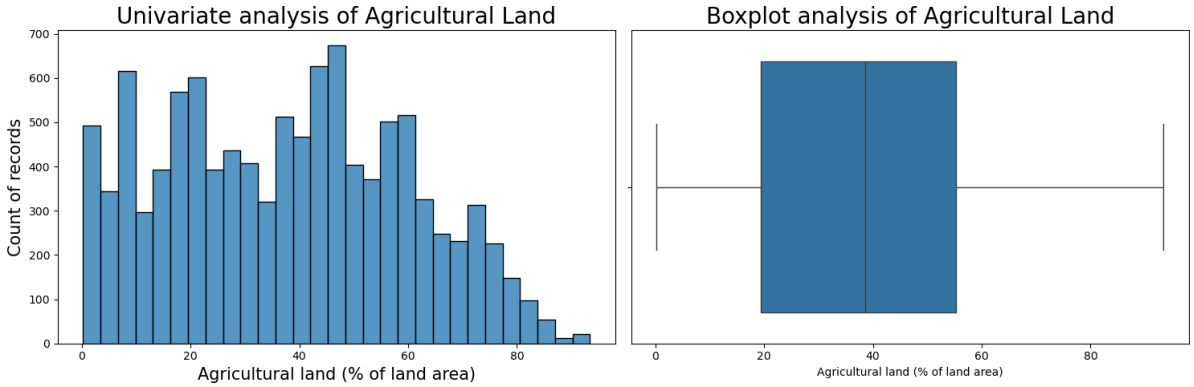
Koru Impact Solutions has provided us with crucial data. This data provides us with data on the amount of land utilised for farming, the number of forests being cleared for farming, the potential for air pollution, and the effects farming has on various plant and animal species worldwide. Also, it provides information on crop growth, such as wheat, which is helpful for improving methods of farming. Biodiversity is the main topic of this piece. Because it maintains the strength and health of our environment, biodiversity is crucial. We can observe how farming is linked to the destruction of many different species of animals and plants thanks to the information provided by Koru Impact Solutions.

The following datasets have been provided by Koru Impact Solutions :

- Agricultural Land
    - Amount of land used for agriculture in various countries. (1960-2021)
- Forest Area
    - Percentage of land covered by forests in various nations. (1990-2021)
- GHG Emissions
    - Greenhouse gas emissions per kilogram of food product. (2010)
- C02 Emissions
    - CO2 emissions per food product in various countries. (2013)
- Tree Cover Loss
    - Reduction of forests areas in hectares. (2002-2021)
- Wheat Yields
    - Yield of wheat crops in tonnes for many countries. (dates vary wildly)
- Living Planet Index
    - (1970-2018)
- Global Living Planet Index (this dataset we received was the same as the living planet index with a few extra columns therefore we did not use this going forward).

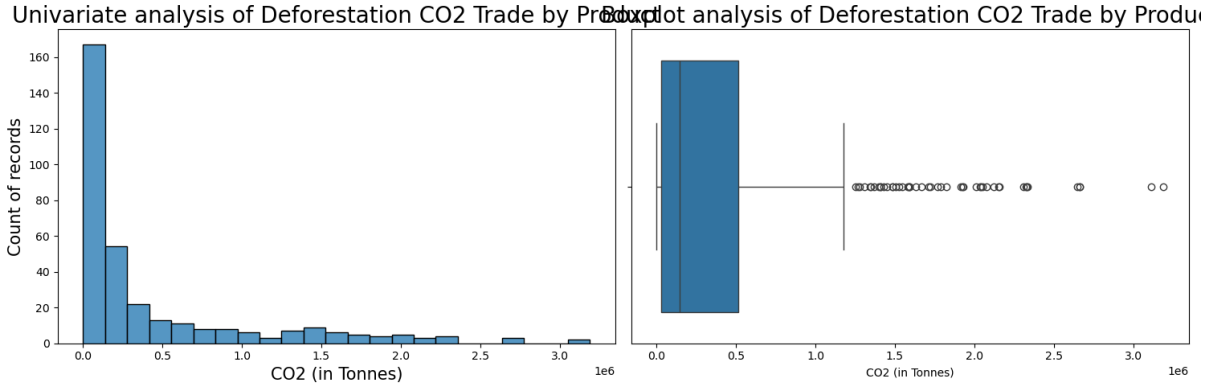
All of these datasets have specific links with biodiversity.

AGRICULTURAL LAND

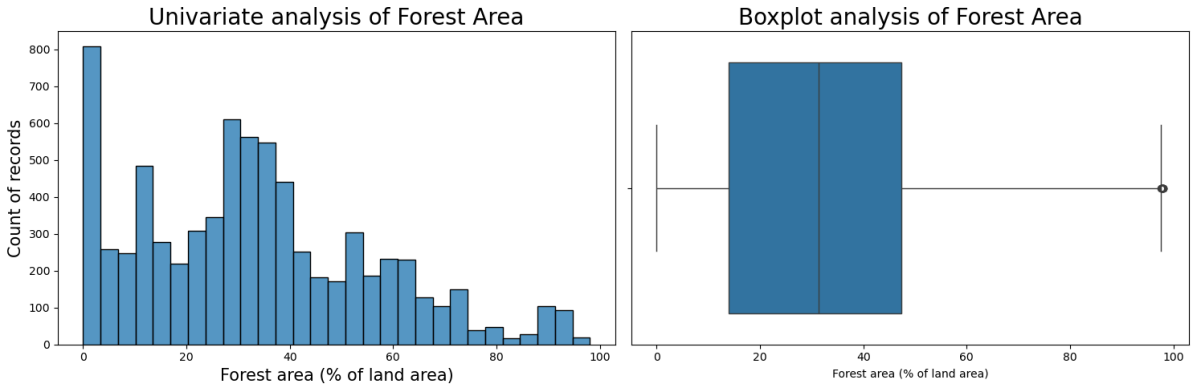


Above shows a univariate analysis and a boxplot of the dataset.

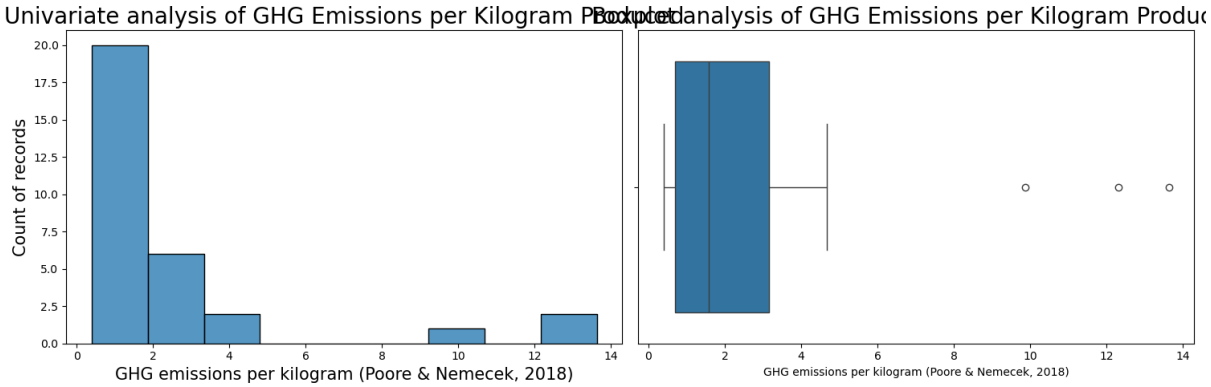
DEFORESTATION CO2 BY PRODUCT



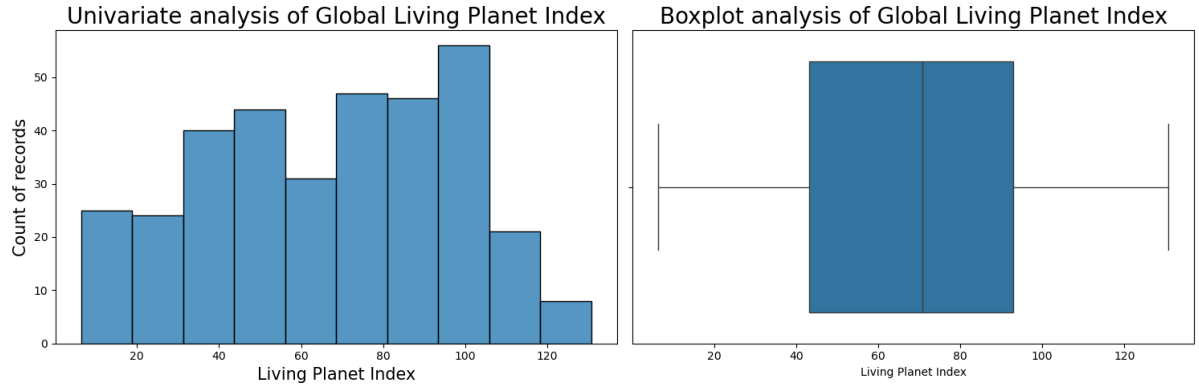
FOREST AREA



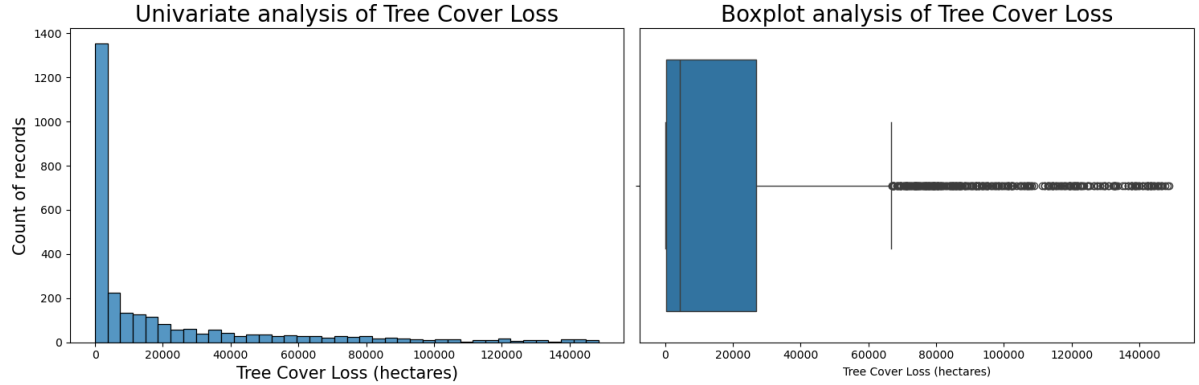
GHG EMISSIONS



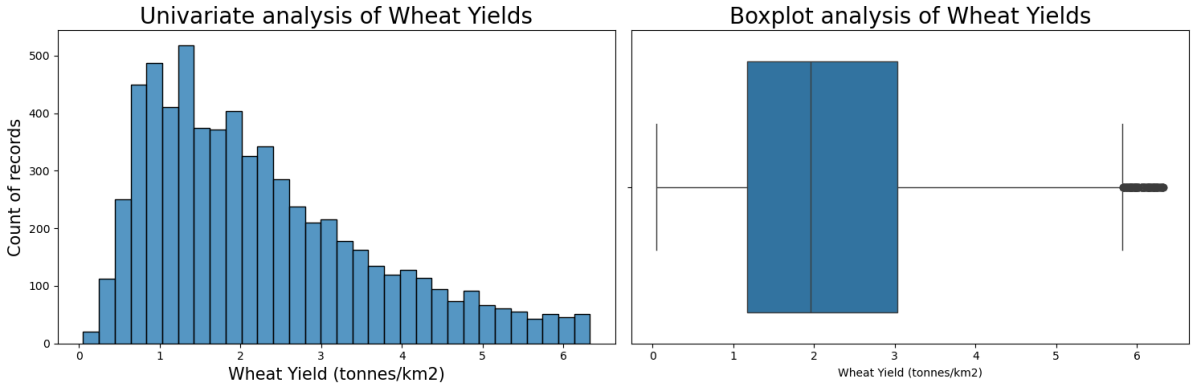
GLOBAL LIVING PLANET



TREE COVER LOSS



WHEAT YIELDS



REGRESSION ANALYSIS

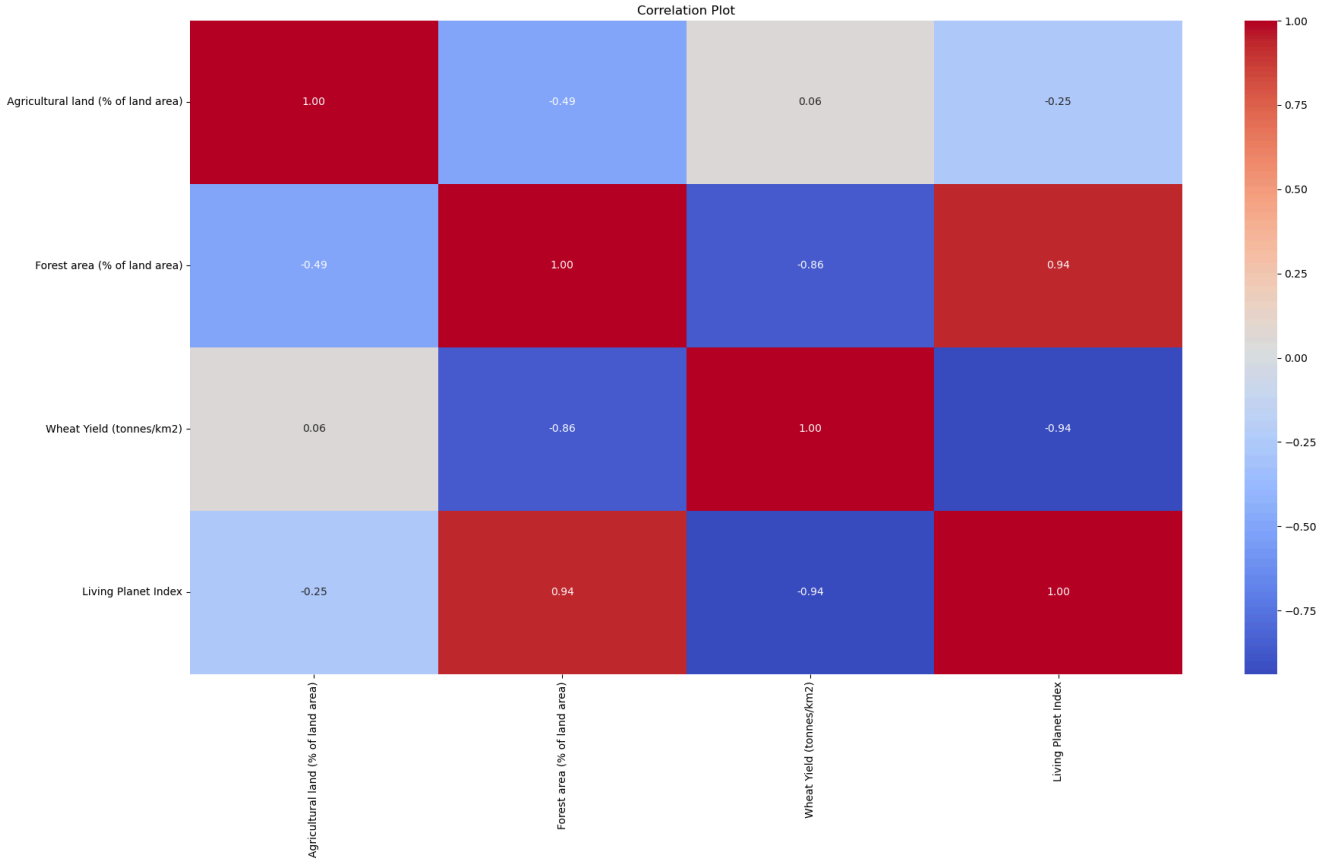
From the 7 datasets that we have been working with, we only used 4 for the regressions analysis. This is because the data GHG Emissions and CO2 Emissions had data for only a year. The tree cover loss dataset had data that spread across 8 years and the results were not that fascinating.

The metrics that we have used four our statistical regression model is :

- Agricultural Land (independent variable)
- Forest Area (dependent variable)
- Wheat Yields (dependent variable)
- Living Planet Index (dependent variable)

```
                            OLS Regression Results
==============================================================================
Dep. Variable:     Living Planet Index   R-squared:                       0.938
Model:                             OLS   Adj. R-squared:                  0.930
Method:                  Least Squares   F-statistic:                     125.6
Date:                 Tue, 26 Mar 2024   Prob (F-statistic):           3.35e-15
Time:                         01:28:20   Log-Likelihood:                -68.046
No. Observations:                   29   AIC:                             144.1
Df Residuals:                       25   BIC:                             149.6
Df Model:                            3
Covariance Type:             nonrobust
=========================================================================================================
                                    coef    std err          t      P>|t|      [0.025      0.975]
---------------------------------------------------------------------------------------------------------
const                           -187.3967    191.742     -0.977      0.338    -582.298     207.504
Agricultural land (% of land area)   -1.3534      2.047     -0.661      0.515      -5.570       2.863
Forest area (% of land area)         10.9765      3.559      3.084      0.005       3.646      18.307
Wheat Yield (tonnes/km2)            -32.0721      5.175     -6.197      0.000     -42.731     -21.413
==============================================================================
Omnibus:                        0.160   Durbin-Watson:                   1.770
Prob(Omnibus):                  0.923   Jarque-Bera (JB):                0.354
Skew:                           0.117   Prob(JB):                        0.838
Kurtosis:                       2.512   Cond. No.                     1.93e+04
==============================================================================
```

MODELLING AND DATA PREPARATION



This is a correlational matrix of the finalised data. This shows the relationship of all the datasets in regards to biodiversity. It shows that the Living Planet Index is very positively correlated to Forest Area while being negatively correlated to Agricultural Land and Wheat Yields.

MARGIN OF ERROR

	Error Margins	In Percentage
AGRICULTURAL LAND	37.74 +- 0.418	1.11 %
DEFORESTATION	437417.47 +- 68682.34	15.7 %
FOREST AREA	33.08 +- 0.519	1.57 %
LIVING PLANET INDEX	67.38 +- 3.239	4.81 %
TREE COVER LOSS	20910.55 +- 1207.988	5.78 %
WHEAT YIELDS	2.26 +- 0.034	1.49 %
GHG EMISSIONS	2.66 +- 1.175	44.14 %

BIODIVERSITY SCORE

The following is the formula we have found :
Biodiversity Score $= -187.3967 - 1.3534x_1 + 10.9765x_2 - 32.0721x_3$

- Where :
  - x_1 is the value for Agricultural land (% of land area)
  - x_2 is the value for Forest area (% of land area)
  - x_3 is the value for Wheat Yield (tonnes/km2)

- This score that we have can be used to compare two different countries.
- Higher scores shows that the country has more forest area and lower wheat yield and agricultural land.
- Therefore the higher the diversity score, the lower the risk of the country on biodiversity.

FOUR LENS

An overview of how biodiversity impacts us through four lenses:

HEALTH -

- Biodiversity affects health via nutrition through soil quality, the amount of pesticides used and the amount of pests within the area. (WHO)

- Biodiversity is important as it keeps the traditional medical plants available.
    - Traditional medicines are estimated to be used by 60% of the world's population.(WHO)

- Infectious diseases are increased due to lack of biodiversity as a result of urbanisation. (WHO)

SOCIAL -

- 45% of people in the UK saw improvements of mental health due to being in nature. (MHF)

- This increases the risk of trans-species transmission of diseases, and the potential for infectious agents to cross-over to human populations. (Bupa)

- Decreasing biodiversity by destroying habitats would increase the rate of wildlife–human contacts. (Bupa)

ENVIRONMENT -

- The amount of pesticides used and the amount of pests within the area.(WHO)

- Food insecurity due to habitat destruction and biodiversity.
    - It is anticipated that, by 2050 the world will be home to 10 billion inhabitants, meaning an extra 3 billion more mouths to feed since 2010. Biodiversity supports agriculture. (Bupa)

- Biodiversity also supports economic opportunities and leisure activities that contribute to overall well being. (WHO)

CARBON INTENSITY -

- Biodiversity is important to ecosystem services and impacts the climate;
- Marine biodiversity is also affected by the levels of carbon and the acidification of the water. (WHO)

- Biodiversity is a fundamental pillar for oceans and forests which absorb more than half of all carbon emissions.(WHO)

A	B	C	D	E	H	K	N	Q
WORLD					CARBON	ENVIRONMENT	SOCIETY	HEALTH
	AGRICULTURAL LAND %	FOREST AREA %	WHEAT YIELD	**BIODIVERSITY SCORE**	WHEAT CO2 IMPACT	RED LIST SCORE IMPACT	FOOD IMPACT	PM2.5 Impact
2001	37.53586019	31.96488769	2.7417	**24.73278001**	-21.82	26.57	40.00	11.61
2002	37.47500405	31.92517773	2.7551	**23.9495002**	-21.07	24.12	36.10	18.71
2003	37.33186008	31.88317137	2.6513999	**27.00802839**	-29.35	22.41	28.82	19.43
2004	36.97053504	31.80694126	2.9426	**17.32090717**	-21.54	39.37	6.49	32.59
2005	37.02644679	31.76606492	2.8286998	**20.44957565**	-34.79	32.75	13.89	18.56
2006	37.03744216	31.72734467	2.8904	**18.03082668**	-34.47	32.68	19.51	13.34
2007	36.97291801	31.68757733	2.8155	**20.08384779**	-37.56	21.20	6.80	34.44
2008	36.85593543	31.65162673	3.0626	**11.92254435**	-11.13	28.37	-17.35	43.15
2009	36.81078171	31.61217853	3.0356998	**12.41339807**	-24.41	26.45	-40.67	-8.47
2010	36.80543401	31.57177176	2.9721	**14.01688997**	-15.60	4.44	-14.80	-65.16
2011	36.94991875	31.53696347	3.1639	**7.28784233**	36.00	-11.68	19.27	33.05
2012	36.867753	31.47231384	3.0916998	**9.005030822**	-6.34	-19.03	-20.19	54.44
2013	36.79023248	31.43820022	3.2472	**3.748281005**	30.28	-25.91	-33.27	-10.54
2014	36.78905099	31.40380692	3.3162	**1.159387061**	26.99	-22.78	-19.83	-30.41
2015	36.62049552	31.36838645	3.3216999	**0.8223239191**	20.27	-20.76	-32.53	26.44
2016	36.58701415	31.34091596	3.4150999	**-2.429426423**	32.19	-27.33	-39.71	-0.78
2017	36.83400084	31.28999701	3.5379999	**-7.264271175**	42.79	-31.54	-10.09	-15.58
2018	36.73845807	31.25263574	3.4243999	**-3.901668955**	30.16	-34.40	-19.91	-15.54
2019	36.76264776	31.21375455	3.5424	**-8.14569768**	28.09	-27.88	-11.71	-32.31
2020	36.73092029	31.17690459	3.4738998	**-6.310296095**	22.58	-29.30	-13.39	-34.72

This diagram above shows our attempt at quantifying each of the four lenses through our Biodiversity score, giving a percentage to each of Lenses based on how much of the main score affects them.
The red in this diagram shows that these values were used as the basis to create the data for Carbon and Society lenses (as the datasets used had data for only one year)

RECOMMENDATIONS

Our recommendation to Koru would be to diversify their data. We feel as though the data that you have provided to us had a lot of limitations with the variables. For example, some of the datasets only consisted of one year while another dataset included products instead. This did mean we could not use these datasets as much to show any analysis. Finding datasets that are regularly updated could help a lot.
Another thing you could do would be to collaborate with other companies that have datasets about biodiversity which could allow the company to grow as well.

NEXT STEPS

One thing we would have done differently would be to put more focus on the datasets given to us rather than finding the external datasets. We found that we had spent too much time finding other datasets and leaving the data that we had aside until we had found those said datasets. We should have fully analysed the data that we had and seen what the correlation plots were telling us. With that we could have found datasets that linked more closely to what we were seeing. It would have made this a lot easier and we would have not lost a lot of time.

One thing we think Koru should approach differently is the data they have given us for biodiversity. The data that we have received was quite complex to work with as through the

analysis of the data, we were seeing trends that did not make sense. For example, biodiversity is increasing due to deforestation.

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