Strategic Challenge 2022

Phase 1 instructions

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The Nature Conservancy

Your case manager has sent you a project kickoff e-mail

From: Marina Ferrari
To: The Nature Conservancy case team
Subject: **[New Project] Climate impact mitigation project**

Hello team, hope all is well.

The Nature Conservancy's (TNC) strategy director has contacted us because she is very impressed with our climate change practice materials and projects. She has requested our assistance to design a set of **strategic initiatives to mitigate the climate impact of Brazilian agriculture and livestock** in the Amazon region (specifically in the state of Pará), maintaining this sector's growth.

I have divided the whole project into **workstreams**, following Bain's framework to design a Strategic Plan. You will find in the slide attached the framework containing the key questions we want to answer for each workstream.

I have also consolidated below the **specific goals and expected insights for each of our workstreams** so that you can have a sense of how we are going to accomplish the project's overall objective. I will assign a specific piece of analysis for you within one of the workstreams once I validate the workplan with our Bain Partner.

- **Workstream 1 (Case for Change & Ambition):** We'd like to understand and quantify the impact that agriculture and livestock have had in the Amazon region and calculate the potential of our project to reduce equivalent carbon emissions in the state of Pará.

- **Workstream 2 (Where to Play):** The goal of this workstream is to define which regions and product types should be the focus of TNC – ideally these are areas with high demand from the agribusiness sector and with deteriorating environmental conditions.

- **Workstream 3 (How to Win):** On this workstream we must map the most important levers to mitigate the environmental impact of agribusiness, helping TNC to accomplish the project's ambition.

- **Workstream 4 (Implementation roadmap & Enablers):** Based on the previous insights, this workstream will create the set of strategic initiatives that TNC will perform to execute the plan and track its results. We will also map the enablers required to ensure a successful implementation of the plan.

Best,
Marina

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Strategic Plan Framework & Key questions

Case for change

- Why do we need to **mitigate the environmental impact** of agriculture and livestock in the Amazon region of Brazil?

- Which **problem statement** are we trying to **solve**?

Ambition

- What is the **ambition of the plan in Pará**, in terms of **equivalent carbon emissions reduction**?
  - How to deliver the forecasted demand for agriculture and livestock while minimizing equivalent carbon emissions?

- In what **time frame** should the project capture this ambition?

Where to play

- Which combinations of **region + agribusiness product** should be prioritized? These are priority areas to invest
  - Which regions are most likely to **increase the area devoted to agriculture and livestock**?
  - Which regions have the **highest deforestation rate**?
  - Which regions have the **lowest productivity**?
  - Which products (types of crops and livestock) have the **highest environmental footprint**?

How to win

- What are the **ways to mitigate the environmental impact** of agriculture and livestock in Brazil?

Implementation roadmap

- What is the **implementation roadmap** of the strategic plan?

- Which set of initiatives are **global** (applied to all regions & products) vs **specific** (applied to a specific region, product and/or rural property size)?

- How does each initiative contribute to **reach the project's ambition**?

- How to **monitor the effectiveness** of the proposed plan? What are the project's success indicators (KPIs)?

Enablers

- What are the **most relevant enablers** to ensure a **successful implementation** of the strategic initiatives?

You received your first project assignment from your manager

From: Marina Ferrari
To: The Nature Conservancy case team
Subject: **Phase 1 assignment**

Hello again team!

I hope you had the chance to go through the case introduction e-mail to have a general overview of our new project.

I would like to request your assistance with the "Where to Play" workstream. As I mentioned, the goal of this workstream is to assess which are the priority areas (in terms of both region and product type) to invest TNC's resources. These areas should be the most affected by the expansion of agribusiness, in terms of environmental impact.

To perform this analysis, we plan to investigate 4 different criteria:
1. **Expected land area:** our hypothesis is that regions with higher expected demand for agribusiness should be prioritized in order to ensure that the demand is delivered while minimizing environmental impact
2. **Deforestation rate:** areas with higher deforestation rate are more likely to harm the environment and should be protected
3. **Productivity:** regions with lower productivity demand more area to deliver the same amount of product output, which could set more pressure to open new areas over native forests
4. **Product ranking (environmental footprint):** some products (types of crops and livestock) consume more natural resources and emit more greenhouse gases than others – therefore those with higher environmental footprint should be prioritized in our plan as well

I ask for your help on the **1st criteria**: **your goal is to create a model that predicts the land area** destinated to the plantation of main agricultural crops and to pastures for livestock, in the state of Pará. With this important input, we will have a better sense on where to focus next.

I already aligned this topic with Research & Data Services (RDS) and they were able to gather some data that can help us. Danilo from the Advanced Analytics Group (AAG) has worked with these databases before, please speak to him so that he can explain to you a bit better about the databases and if you can leverage any analysis that he has already done.

Time is short so I strongly recommend that you **divide the work**.
Thanks a lot, team, and good luck!

Best,
Marina

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A colleague from the Advanced Analytics Group has experience with the necessary databases and can support you

From: Danilo Carvalho
To: The Nature Conservancy case team – workstream prediction model
Subject: **[New Project] Agriculture databases**

Hello guys,

We have a database file named **historical-database.csv.** It contains the timeseries with known values up to 2017. The data table is as follows:

year	city_code	product_type	product	destinated_area
2008-01-01	07ed828db19fe8ca	temporary	Rice	120
1978-01-01	70a4c62beba3c168	temporary	Cassava	NaN
1992-01-01	eac302b92f87d9ca	permanent	Cocoa	818
1997-01-01	18e37d24ff8517ef	pasture	Livestock	63459,43032
2000-01-01	77c880feff17c521	pasture	Livestock	165786,4346

Column **year**: the year of this data row. Column **city_code**: the city code of this data row (within the state of Pará). Column **product_type:** kind of agribusiness product of this row (permanent crops, temporary crops, or livestock). Column **product:** the specific product of this row. Column **destinated_area**: the area destined to the cultivation or production of this product, in this municipality, this year, in hectares.

Your model should be able to predict the area destined for each product and city, for the years of 2018 and 2019. Please also **write 1-2 paragraphs with the main insights and your interpretation of the model's results**.

I also attached a **technical documentation** to support you in this analysis. It explains how you can submit your results to AAG and how we evaluate your model.

Best,
Danilo

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A G E N D A

Case introduction

Phase 1 assignment

Technical documentation

There is a set of guidelines for the Phase 1 analysis (1/3)

| Pre-submission | Submission | Evaluation |
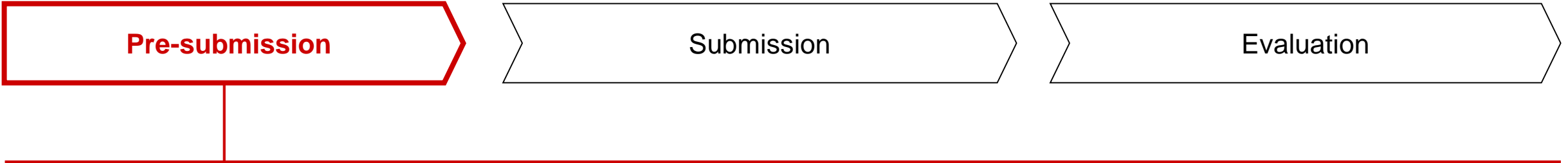
- Groups of participants are going to receive the databases and will be able to work on building their models from then on. We suggest that candidates use the years 2016 and 2017 as a test data to create their models.

- Periodically, candidates will be able to submit the results obtained in their test databases (years 2016 and 2017). The organization of the Desafio Estratégico will calculate the performance of each group and provide an updated ranking of the competition. **This ranking refers only to test data and aims to place the groups of participants in terms of their performance against other competitors.**

- At the end of the first phase period, each group must submit the predicted values for the years 2018 and 2019. These values will be used to calculate the final performance. **Only the result of the final performance, calculated on the forecasts for the years 2018 and 2019, will be used for the final ranking – one of the criteria considered to define those approved for the second phase.**

There is a set of guidelines for the Phase 1 analysis (2/3)

Pre-submission | **Submission** | Evaluation

Final Submission format

- The results submission must be made in a csv file, containing the same columns as the historical-database.csv file. The content of the destinated_area column must be the values calculated by the forecast model developed by the participants for the reference years (2016 and 2017 in the test and 2018 and 2019 in the final submission).

| year	city_code	product_type	product	destinated_area
2016-01-01	07ed828db19fe8ca	temporary	Rice	
2016-01-01	70a4c62beba3c168	temporary	Cassava	
2017-01-01	eac302b92f87d9ca	permanent	Cocoa	
2017-01-01	18e37d24ff8517ef	pasture	Livestock	
2017-01-01	77c880feff17c521	pasture	Livestock	

- In addition, the team should submit the file(s) that contains all the code used to create the model. The code files can be scripts or notebooks in Python or R languages, or even Excel files where the model was developed.

- Please also include a short summary (1-2 paragraphs) with your insights & interpretation of the model's results (word or ppt format).

Additional guidelines

- To ensure reproducibility, we suggest that random seeds be set manually. Thus, running the code on a different computer than the one that generated the model will not present different results. We recommend that participants test their codes on more than one computer to ensure that the results are identical before the final submission.

- To ensure understanding and evaluation of the code, as well as the rationale behind the development of the model, we suggest that participants insert comments throughout the code, describing what is being implemented in each section, what is the purpose of this implementation, any premises used and, mainly, what are the reasons for the parameter choices.

- We also recommend that data analysis steps prior to model creation (visualization, filters, distribution analysis, etc.) be kept in the code and their results be commented. In this way, the Desafio Estratégico team can in fact guarantee that the results were obtained through the correct application of data science techniques.

There is a set of guidelines for the Phase 1 analysis (3/3)

Pre-submission	Submission	**Evaluation**
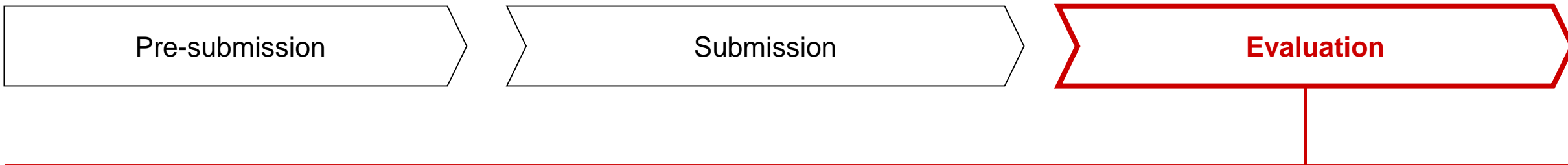
Only 10 groups with the best performance will be selected for the next phase. There are **two main evaluation criteria**:

1. **WMAPE average results**

   - Groups with better WMAPE average results of permanent crops, temporary crops and pasture will have their models evaluated and reproduced by the Desafio Estratégico team. Those who present the same result submitted in the execution of the code by the Desafio Estratégico team and that have justified all the parameter choices will receive higher score on this criteria.

   - Therefore, it is important to highlight that all results must be reproducible and understandable by the Desafio Estratégico Team.

   - The performance metric will be WMAPE (Weighted Mean Absolute Percentage Error). A WMAPE result will be calculated for each product type (temporary, permanent and pasture) and the final result of the group will be the average of these three WMAPE values. WMAPE is calculated by the following formula:

$$ \textbf{WMAPE} = \frac{\sum_{t=1}^{n} |A_t - F_t|}{\sum_{t=1}^{n} |A_t|} $$

   - where A is the vector that contains the known actual values and F is the vector that contains the predictions made by the participants.

   - We emphasize that the numerator of the formula refers to the sum of the modules of the differences between the real value and the predicted value, hence errors of the same magnitude, but with inverse signs, do not cancel each other.

2. **Approach used to develop the model**

   - The groups with strong WMAPE average results will also have their models evaluated in terms of complexity level, use of innovative data science techniques and quality of the comments and data analysis/evaluation steps used to develop the model. Teams that demonstrate innovative ideas and/or significant dedication to develop the solution will receive higher score on this criteria.

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