Please list out changes in the directions of your project if the final project is different from your original proposal (based on your stage 1 proposal submission).

> Our app has kept its original focus in direction, creating an app that allows users to visualize and analyze deforestation data for countries and sub nationals within.

Discuss what you think your application achieved or failed to achieve regarding its usefulness.

> Our application successfully achieved its core goal of presenting deforestation data in a structured and accessible format. Users were able to interact with key metrics and obtain valuable insights into environmental changes across various countries and subnationals within. However, one aspect that we originally intended to implement, the creative component, was left out of the final product. Specifically, we had planned to incorporate an interactive map that would have enhanced both the visualization of data and the overall user experience. A geographic representation would have allowed users to intuitively explore trends across different locations, making the interface more engaging and the data easier to interpret. By omitting this feature, the application missed an opportunity to deliver a more immersive and user-friendly design. Integrating visual tools in the future would be a very useful and insightful improvement.

Discuss if you changed the schema or source of the data for your application

> We used the same data for the entirety of the project.

Discuss what you change to your ER diagram and/or your table implementations. What are some differences between the original design and the final design? Why? What do you think is a more suitable design?

> When users log into the website, we chose not to require an email address. We determined that collecting an email was unnecessary since a username and password were sufficient for authentication purposes. Additionally, email collection is often tied to marketing efforts, which was outside the scope and intent of our application. We also decided to remove the search history feature. Given that users have access to a personalized favorites page, we found a recent search option to be redundant and potentially clutter the user experience. Our focus was on prioritizing features that directly enhance user interaction with the application. Aside from these changes, all of the tables outlined in the UML diagram were successfully implemented.

Discuss what functionalities you added or removed. Why?

Originally, we were going to create an app that gave deforestation data based on a certain input location. This location would then gather data from a user slider control to include everything within the radius. We opted to not implement this feature due to the limitations in the data itself, there is not enough descriptive data to parse areas small enough for this feature to be useful. Instead, we opted to only display subnational data as the area parser. The overall creative component was also not implemented due to time constraints. Although the creative component was feasible, it would have required more time than was available within the project's timeframe.

Explain how you think your advanced database programs complement your application.

The primary goal of this project was to present deforestation and climate change data. Our use of advanced database programs complements the application by enabling the statistical modeling necessary to display environmental metrics for the user. One of our main features allows users to determine whether a country is a net emitter or net absorber of carbon, offering insights into its overall climate impact. Another query focuses specifically on tree cover loss, highlighting the extent of each country's contribution to deforestation and habitat destruction. Additionally, we provided functionality for users to explore subnational data, enabling a closer examination of whether particular regions within a country contribute disproportionately to carbon emissions. Users can also view detailed information regarding deforestation and habitat destruction at the subnational level.

Each team member should describe one technical challenge that the team encountered. This should be sufficiently detailed such that another future team could use this as helpful advice if they were to start a similar project or where to maintain your project.

Jeremy: The original Google Cloud Platform configuration was difficult. First, this was a new system that I had to learn, and the GCP has a lot of features and functionalities that required some additional preparation in order to work in. Future teams should look into watching some background videos on GCP so they understand the basic functionalities with a project that consists of multiple people.

Akhil: I had issues with connecting the frontend and backend on GCP since I couldn't figure out what API links to use to be able to fetch the backend routes (which we created using Flask). I also had trouble viewing the UI through the VM. After extensive research, I found it would be both practically and financially feasible to just run all the code locally and connect to the SQL instance through Python's MySQL module. Future teams should conduct extensive research and watch all the full-stack videos that were uploaded on PrairieLearn as tutorials if they want to run everything on the cloud. They should also start off running all the code locally

to make sure their code is working and to minimize the amount of compute resources they use on GCP, since we used a lot of resources when we set up the code on the VM.

Tyler: I also struggled with the Google Cloud Platform, more specifically the SSH processing. As someone with no prior experience using GCP, I struggled to understand some of the security settings and connectivity issues that arose during the process. Similar to Jeremy's experience, I would strongly recommend that future teams watch demonstration videos or tutorials on GCP setup, especially focusing on how to integrate GCP with external applications. A better understanding early on would have saved significant time and prevented common configuration mistakes.

Chloe: I had difficulty with the users favorites configuration in the backend development. Specifically, setting up the correct database relationships that users could save, retrieve, and manage their favorite entries. I would recommend that future teams plan out the database schema for user specific features like favorites early on.

Are there other things that changed comparing the final application with the original proposal?

For the most part we did not deviate from the initial proposal. Other than the creative component which we did not implement, we stuck to our original project proposal.

Describe future work that you think, other than the interface, that the application can improve on

The application definitely could have included other features that we removed due to time constraints, such as the slider and location data, as well as an interactive map for easy visual access to country data. There also could be a possibility to include a forum for users to discuss deforestation around them, and raise awareness about local issues. On that same topic, there could also be a news page that users could view to learn about global deforestation issues. Finally, we could add an expansion to explore all avenues of climate destruction, maybe including information about coral reefs, or natural prairies and national parks.

Describe the final division of labor and how well you managed teamwork.

For our division of labor, we made sure to discuss what everyones strong suits were and ended up splitting it as such. For all the stages, Tyler was the manager, ensuring that all other group members were on track as well as focusing on the high level ideas of the project, such as

our write-ups or design ideas for our project. For Stages 1-3, everyone in the group was collaborating together on the project proposal, database design, and database implementation. For Stage 4, Chloe was one of our frontend designers as well as a floater, ensuring that if anyone needed assistance she would help them get back on track. Jeremy was the main backend designer, working on designing database queries and creating routes for the frontend to call. Akhil was the main frontend developer, designing the website and using all the routes that were in the backend. Although each of us had our designated roles, we all helped each other when needed and made sure we understood each other's code and progress so we could effectively use it for the other parts of the project.