User Study Report: Evaluating the Agro-Food CO_2 Emissions Dashboard

Dashboard Evaluated:
Agro-Food CO_2 Emissions Dashboard

1. Introduction

It is critical to comprehend the impact of agro-food systems on CO_2 emissions in order to make sound policy decisions and create public awareness. To facilitate this, I have designed an interactive dashboard that plots emission data by country, year, and sector. This study aims to evaluate the efficacy of the dashboard in helping users navigate and interpret the data effectively and accurately.

2. Study Goal

The general objective of this user study was to assess whether the dashboard assists users in effectively analyzing agro-food related CO_2 emissions by years and countries, and identify usability issues, if any, that can prevent such analysis.

3. Participants

I recruited three participants representing the dashboard's target audience:

- Participant 1 (P1): 23-year-old female, Environmental Science student, medium familiarity with data visualization.
- Participant 2 (P2): 31-year-old male, Food Sciences student, low familiarity with data visualization.
- Participant 3 (P3): 25-year-old female, Environmental Change and Global Sustainability, high familiarity with data visualization.

4. Methodology

4.1 Study Design

The study was conducted face-to-face, and in each session it lasted about 30–35 minutes. Participants used a 15-inch laptop to interact with the dashboard. The study adopted a systematic strategy:

1. Briefing: A one-minute briefing was given to the users which gave context to the objectives of the dashboard and the data shown.
2. Exploration: 5–7 minutes were given to participants to explore the dashboard and ask any questions.
3. Tasks: Participants performed focused tasks created to test the functionality of the dashboard.
4. Think-Aloud Protocol: Participants out-loud as they went through tasks to gain insight into their thought process in decision-making.
5. Post-Task Interview: Participants responded to questions about their experience and gave feedback.

4.2 Tasks

Participants were asked to complete the following tasks:

- Task 1: Identify the top three nations with the largest total emissions in 2018 according to the map and filters.
- Task 2: Compare the trends in emissions of any two countries over the years from the line chart.
- Task 3: Determine which sub-sectors (e.g., Agriculture, Households) released the most in a specific region and year from the stacked bar chart.

4.3 Interview Questions

Post-task interviews included questions such as:

- Was the dashboard easy to understand and navigate?
- Did the charts help you answer the questions clearly?
- Was the interactivity helpful or confusing?
- Did you notice any missing features?
- Do you have suggestions for improvement?

5. Findings

5.1 Major Feedback

- Tooltip Utility: P3 found the tooltips helpful for understanding data points.
- Multi-Country Comparison: P1 suggested enabling the selection of multiple countries simultaneously in the line chart.
- Reset Functionality: P3 recommended adding a "Reset Filters" button for easier navigation.

5.2 Minor Feedback

- Color Palette: P1 suggested adopting a color-blind friendly palette.
- Axis Labels: P2 recommended explicitly labeling Y-axis units.
- Country Names: P3 observed that some country names were abbreviated or cut off on the map.

6. Discussion

The recommendations adhere to conventional information visualization principles. Heer and Shneiderman (2012) emphasize the importance of interactive dynamics, such as filtering and coordinated views, to facilitate effective user exploration. The need for more readable labels and legends is consistent with the requirement for intuitive data representation.

Brehmer and Munzner (2013) offer a multi-level typology of visualization tasks, stressing the importance of supporting high-level analytical tasks in addition to low-level data retrieval. Considering the fact I tried to add the filters so that it becomes easier for my target audience to navigate.

Lam et al. (2012) introduce seven scenarios to assess information visualization, ranging from user experience to performance. The responses of the participants offer insightful points about the usability of the dashboard and where it needs to improve, according to these assessment scenarios.

7. Proposed Improvements

Based on the findings from the study, we intend to make the following improvements:

- Enable Multi-Selection: Modify the line chart so that users can select and compare multiple countries at the same time.
- Add Reset Functionality: Introduce a "Reset Filters" button to streamline the user experience.
- Embrace Color-Blindness Friendly Colors: Redesign the dashboard color palette to better serve color-blind people.
- Clarify Labels: Ensure all labels and axes are labeled with appropriate units clearly.
- Maximize Map Labels: Make map settings display full country names, rather than abbreviations.

8. Reflection

Conducting this user study was an informative and pivotal phase in the iterative design of the Agro-Food CO_2 Emissions Dashboard. Engagement with real users of the dashboard target audience allowed me to step out of assumptions that I had accumulated throughout the design process and observe how users with varying levels of familiarity interacted with the tool. This not only validated many of the interaction patterns that I had established but also revealed subtle usability problems that were not immediately evident.

One of the most enlightening moments was observing how even very experienced users, like P3, cued a desire for additional navigational support like a "Reset Filters" button which I had underestimated in importance. Similarly, P1's difficulty in comparing multiple countries indicated the limitations of the current line chart, affirming Heer and Shneiderman's (2012) assertion that good interactive features seamlessly integrated are not added values, but necessities for analytic tools. Additionally, remarks on color use and label legibility highlighted the need for accessibility, reminding me that visualizations must accommodate diverse user needs, including those with perceptual disabilities.

The think-aloud method, though new to me, proved to be a very powerful approach in understanding users' mental models and decision-making. It shed light on the cognitive process used by users in interpreting information and allowed an understanding of where users' expectations failed the system's performance. Such findings are extremely relevant to Lam et al.'s (2012) evaluation contexts, particularly those relating to user experience and usability.

In retrospect on the approach, I am glad that blending qualitative feedback with structured tasks helped fully assess dashboard performance. The collaboration of task achievement, observation, and post-task interviews allowed for both actionable findings and strategic advice for future growth. In addition, the well-received nature of features like the tooltip and filtering functions led me to believe that some of my design choices were in alignment with

task typology recommendations from Brehmer and Munzner (2013), namely supporting exploratory and comparative analysis.

In future versions, I will test the updated dashboard with more users and a greater diversity, including both new and experienced users, and perhaps through remote usability software to allow scaling of feedback gathering. At the end of this research, it was reaffirmed that user-centered design is not an isolated stage but an ongoing dialogue with the user, and this version is a significant step towards bringing the dashboard up to real-world usability levels.

9. References

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