



Evaluation of the MapBiomass Initiative

(August 2019)

Managers Response

1. Introduction

MapBiomass completed the first three-year cycle in 2018. As part of the process to design and implement the phase two (2019-2022), the project passed through an independent evaluation¹ to assess the data quality, access/impact and governance of the initiative.

MapBiomass team participated in the evaluation process by responding questionnaires and through interviews. The group had no previous access to preliminary or draft reports thus not influencing in any way the content of the report. We received the final report in early September (2019) and it was circulated to all leaders of the co-creator partners of the project.

This document is the response of MapBiomass coordination to the evaluation report. It includes general comments, responses to each of the recommendations of the report and comments to specific parts of the text that need clarification. We do not expect that report will be revised based on our comments, rather we design this response to be published together with the report to transparently complement the views and at the same time present follow up to the recommendations.

2. General Comments

The report reflected very well the stage of the project and brought useful insights for the next phases of the MapBiomass project. In some parts, there were minor misunderstandings that are pointed out in chapter 4 of this document.

Some of the findings of the report, especially those raised in the interviews with people outside of the project, were novel and resulted in thoughtful insights like the perception that handling the download of MapBiomass data is far from easy.

¹ *Evaluation of the MapBiomass Initiative, prepared by Sparovek at all and Commissioned by the Norway's International Climate and Forest Initiative and the Good Energies Foundation (August 2019) – available to download at <http://mapbiomas.org>*

3. Response to the Recommendations

All seven recommendations and eleven suggestions will be reviewed and considered for phase two of the project. Find below the specific comments and first reactions to each recommendation and suggestions.

Recommendation 1: *The MapBiomias initiative needs to move gradually from project-based funding to long-term funding to guarantee the financial sustainability of the initiative and ensure long-term commitment with partners developing MapBiomias products. There is no agreement on how to move in this direction but building agreements with governmental institutions and the private sector in the coming years is recommended.*

Response:

- One of the products of the second phase of the MapBiomias project (2018-2022) is to define a long-term funding strategy. It does not exclude a possibility of continuously be a project-based funding initiative but will be centered in exploring other possibilities that are compatible with the collaborative nature of the project and the production of free and open data and algorithms.

Suggestion 1: *Institutionalize MapBiomias. Institutionalizing MapBiomias would be encouraged to ensure long-term resilience. Institutionalizing could facilitate the establishment of partnerships and fundraising with governmental and private entities. To ensure a balance between providing legal status and maintaining the strengths of a broad collaborative network, we recommend restricting the institutional attributes to those aspects in which improvements are expected, such as fundraising, fund redistribution, public relations, and overall network management.*

Response:

- Institutionalization is one option considered for long term resilience but it not a fate yet. The Climate Observatory, for example, is institutionalizing only 15 years after its creation. Nevertheless, this route has been explored. In 2019 the creation of the institution for the Climate Observatory (named LabOC) could be an option for the institutionalization of MapBiomias. The non-existence of a MapBiomias institution has not caused any constraints in establishing partnerships and cooperation agreements. In fact, it ends up highlighting the role and recognition of the co-creators and partners, where keeping a cohesive network is very important.

Recommendation 2: *The MapBiomias initiative is in the process of expanding to other countries. The initiative has the potential to contribute in the governance of natural resources in these countries; therefore, such expansion should be encouraged. However, the expansion needs to be governed to ensure that the quality, principles, and vision of MapBiomias are consistent across the various regions. Mechanisms for this governing need to be established. To this end, the creation of a MapBiomias Global Steering Committee would be recommended. The committee would provide overall executive direction, technical advice, and support for national and regional teams to develop fundraising strategies.*

Suggestion 2: *Create a MapBiomias Global Steering Committee. A global steering committee could provide the overall executive direction and support national and regional teams in developing fundraising strategies.*

Response:

- This is an excellent point. In the last week of August we have convened the first meeting of the MapBiomias Global Network with the participation of representatives from all MapBiomias initiatives (Chaco, Pan-Amazonia, Pampa, Brazil and Indonesia). During this meeting we started to draft the guidelines of the network to be launched in 2020 including the principles of the network (what takes to form a MapBiomias initiative), network rules (what members are expected to be part of the Network) and governance. A MapBiomias Global Steering Committee will also be formed.

Recommendation 3: *The ultimate goal of MapBiomias is to contribute to sustainable management of natural resources and socio-economic development. The more MapBiomias products are used and the more diverse the user profiles, the greater the likelihood that MapBiomias products will trigger new applications that can lead to significant impacts on the ground. Therefore, it is crucial for MapBiomias to have a well-defined strategy for reaching new users. Such a strategy should continuously search for innovative ways to attract new users from different backgrounds by facilitating access to data and strengthening communication with potential users.*

Suggestion 3: *Inspire the next generation of professionals. We recommend that MapBiomias strengthens communication with educators, providing inspiring material that can support education on subjects related to land-use planning and natural resource management.*

Response:

- Another good contribution. Through the partner organization LAPIG/UFG an extension program with universities and schools is being developed and will be accelerated in 2020. Also Solved (another partner) is developing a series of training videos and materials related to MapBiomias datasets and its methodologies. In addition, several members of MapBiomias represent education institutions and/or are professors in universities in Brazil. MapBiomias team is also giving talks and courses in Brazilian public universities and regional and national scientific events. The MapBiomias Award, which it is in your second edition, has been part of a strategy to engage more students and professionals in using the MapBiomias datasets and tools. In 2020 we intend to go further including a potential to develop a MapBiomias Education Program.

Suggestion 4: *Facilitate integration with other platforms: Development and maintenance of a functional application programming interface (API) to facilitate integration with other initiatives and speed up development of automated applications using MapBiomias data.*

Response:

- The expansions of interfaces are now in process. A Plugin to use MapBiomias data direct in QGIS was developed and is now available (thanks to a volunteer contribution from a user from IBAMA). Also, a Web-service was developed and made available to read data on demand for Collection 4 and MapBiomias Alert.

Suggestion 5: *Implement a custom download interface. We would suggest the implementation of a custom download system that follows a three-step user interface for downloading MapBiomias data. In the first step, users choose the geographic regions by i) selecting predefined regions, such as biome, special regions, state, and municipality, ii) uploading a polygon in shapefile or kml format, or iii) drawing a polygon. In the second step, users should be given the option to choose which dataset they need. Finally, in the last step, users will check and confirm the order and insert an email address to which the link for downloading the datasets will be sent. The order will be queued and processed within the MapBiomias server or Google Cloud, and made available for download for a short period of time.*

Response:

- This feature was implemented using a toolkit at Google Earth Engine that allows downloading MapBiomass Collection data for any given geography. It is not as suggested but has attended the demand very well. It was also produced by Solved a tutorial video available on the internet to teach general users how to use the toolkit and download the dataset.

Recommendation 4: *The number of MapBiomass users is increasing; moreover, so is the number of supporters, who share the initiative's vision and who are willing to contribute to it. That said, users can make an invaluable contribution toward improving the quality of MapBiomass data. We recommend the creation of simple mechanisms to collect feedback from users of MapBiomass in a systematic and automated manner. This feedback should be validated and used to feed machine learning algorithms to improve coming MapBiomass collections.*

Suggestion 6: *Bring user feedback collection to the next level: Development of applications that enables user feedback regarding inconsistencies in land-use and landcover classification to be collected. Such a system should enable users to identify inconsistencies and report errors for the various years in the time series. Such information should then be validated by developers from regions in which the inconsistencies have been identified, and then feed machine learning algorithms to prevent repetition.*

Response:

- We already have the MapBiomass Forum to collect contributions and questions from the users but it is not enough. We also have workshops with experts to comment and give inputs of each collection we launched. A mechanism dedicated specifically to collect feedback on the maps itself is a good idea and will be developed.

Recommendation 5: *The core vision of MapBiomass is to provide free access to reliable LUC/LCC information. Although this objective has been accomplished to a large extent, the improvement in quality must be a continuous process. There is much new ground to be broken in enabling the mapping of new features in the landscape and in improving the consistency of land use classification. To this end, it is of paramount importance that MapBiomass developers maintain their focus and resources aimed at the continuous improvement of the mapping capabilities. The initiative should keep a strong capacity dedicated to innovation, constructing new algorithms and testing new remote sensing products with the goal of improving land-use classification.*

Response:

- MapBiomass annual land use and land cover maps are set to continue development and improvement. That is why we organize data in collections so in each revision/collection we are revisiting the entire dataset from 1985 to present. This allows us to include new classes and improve the quality of data series in each collection. In collection 4, for example, we used for the first time Deep Learning algorithm to classify the cross-cutting theme of Aquaculture.

Suggestion 7: *Invest in research and innovation to separate human-modified from natural landscapes: Development of algorithms capable of differentiating: i) pastureland from natural grassland; ii) natural forest from planted forest; iii) depredated pastureland and degraded forestland; iv) different types of crop land from pastureland; v) intensified use from extensive use.*

Response:

- All topics from (i) to (iv) are in our wish list of development and are mostly achievable. The separation of planted and natural pasture is almost done in Collection 4. For the other three, we have tried different strategies for this differentiation but have not yet come to a solution with enough quality incorporated in the maps. Work is in progress.

Suggestion 8: Test new open-access sensors: Exploring Sentinel satellites and other upcoming sensors that have the potential to enable better-quality products than those derived from Landsat satellites.

Response:

- MapBiomass tests and uses Sentinel on trials in the MapBiomass Alert System but is not using that on MapBiomass annual land use and land cover mapping since it is crucial to have time consistency in the collection that starts in 1985. Only Landsat has this consistent time series. There is a possibility to produce a base map for one-year of the collection using 10 m Sentinel data.

Recommendation 6: The primary application of MapBiomass products is related to scientific development. To this end, understanding the uncertainties in the data and controlling them are key to avoiding misleading interpretations of results. Therefore, MapBiomass should develop and follow strict protocols in reporting inconsistencies and uncertainties in the data produced by the initiative. MapBiomass should ensure that the reporting of data inconsistencies and accuracy analysis follows good practice guidelines recommended by international scientific communities.

Response:

- Scientific development is a key application but it is not the primary one. Nevertheless, the reporting of uncertainty and accuracy is a high priority at MapBiomass. To this end, an immense effort was done to collect 100,000 samples (with three interpreters for each one) throughout the biomes and for all 34 years of the Collection 4. This allows for the complete accuracy and uncertainty analyses of the data. The website shows accuracy data for each biome, year and omission and commission for each class.

Suggestion 9: Follow recommendations by the scientific community for accuracy analysis: The process of validation and accuracy assessment of MapBiomass should follow recommendations from the scientific community. Such accuracy analysis should be calculated not only for the entire country, but regionalized indicators of accuracy should be considered, as a means of identifying the regions where land-use classification is least consistent.

Response:

- We are testing “good practice guidelines” for accuracy and uncertainty analyses although they were not designed for multiclass/time series maps. The accuracy analysis is already prepared for the country, each biome and year of the collection.

Suggestion 10: Publish peer-reviewed scientific papers: MapBiomass methods and procedures for producing land-use/land-cover maps as well as measuring uncertainties should be documented in scientific publications to ensure the peer-review process and scientific validity of MapBiomass products.

Response:

- Although there are over 70 scientific papers using MapBiomass data including peer reviewed papers lead by MapBiomass teams, the unified paper that consolidates MapBiomass method and data is still to be published. This paper will be submitted for publication in 2019.

Suggestion 11: Report layers overlapped in the integration phase: In the process of integration between each class to produce the final land-use map, the prevalence rules are applied and overlapping zones of low priority are disregarded for the final map. We would encourage MapBiomias developers to produce one more product from this integration process, namely the overlapping layers disregarded in this integration, for transparency and to enable users to identify potential geographic patterns in data inconsistency. This information could potentially be useful for users who want to control uncertainties from MapBiomias products through sensitivity analysis.

Response:

- We are preparing data to publish the maps produced before integration. It will be available as an asset in Google Earth Engine in 2020.

Recommendation 7: In light of the expansion of MapBiomias to other countries and the international community's strong interest in land use and land-use change in Brazil, it is important to establish a clear link between the land-use classes adopted in MapBiomias and other international land-use classification systems. Such a link should be built through a strong consultation process with experts from various regions of the world, to harmonize the definitions of the different land use classes and set the link between the legend adopted by each system.

Suggestion 12: Define the relation to other land-use classification systems: The dataset specifying the relation between each MapBiomias class and those of other land-use classification systems should be attached to the metadata file accompanying each downloaded MapBiomias dataset.

Response:

- Since Collection 1, MapBiomias published a document that has the correlation between MapBiomias Legend of classes and its relation to the FAO and IPCC land-use criteria/classes. We do agree that it is not so clear and easy to access in the platform and we will improve the publication, access and communication.

4. Specific comments on the text

This section is dedicated to specific comments, corrections and clarifications to the text of the report which includes: (i) factual corrections; (ii) clarifications of concepts; (iii) additional information that helps to contextualize a topic; (iv) new developments from the phase 2 of MapBiomias (post July 2018) that complement/clarify/address points raised in the report.

4.1. Executive Summary

- a) The first paragraph suggests that *"The core objective of the LUC/LCC maps is to produce more accurate estimations of land-use-related greenhouse gas (GHG) emissions"*. In fact, this was the original demand to create the project and is one important application. The core objective is to provide reliable, historical and updated land cover and land use data to support informed decision making on sustainable management of Brazilian territory.
- b) At Key Evaluation Findings (7th bullet) suggests that *"In some cases, the innovative nature of MapBiomias and the need to quickly deliver products have driven the MapBiomias developers toward pragmatic choices rather than scientific-based decisions"*. All decisions on MapBiomias methods are based on science, in many cases, the science is not yet consolidated which is natural

when working on the edge of the innovation. Teams test several methods and variation and sometimes the published product will include method not yet published and peer reviewed. But this it is still science based.

- c) At Key Evaluation Findings (8th bullet) it is missing the reference to the large impact in press of the data generated by MapBiomias which is already a major reference for information on land use and land use management (ex. Extensive cover of MapBiomias Launching of Collections; the usual reference to over 90% in deforestation that came from MapBiomias Alerta).
- d) The Conclusion of the Executive Summary (pg 4 – 4th paragraph) states that *“Because of the extremely innovative methodological approach, it is not clear to what extent accuracy can be improved and how it can be measured reliably along the entire map-collection time span. MapBiomias still needs to improve this understanding and objectively report data accuracy in line with good research practice guidelines”*. The Accuracy has been measured since collection 2 and presented in a very innovative manner allowing users to understand the accuracy for all the collection, by class and by year. We are also testing “best practice guidelines” proposed by Pontius et al. (2011), but it was designed for much simpler maps (very few classes) and it’s not clear it really works for a time series with so many classes.

4.2. MapBiomias: An Overview

- a) Geographic Coverage (3.1. paragraph 1) – it mentions that MapBiomias is on a “very early stage of expansion to all countries in Latin America and Indonesia” – in fact, the expansion is happening in South America and Indonesia. In the case of Amazon countries and Chaco region, the first collection was already launched in Q2 of 2019. Important also to note that initiatives in other countries are led by local organizations.
- b) MapBiomias Alerts Products (3.3. paragraph 1) – it mentions that MapBiomias Alert is “developed in partnership with government agencies and alert providers”. In fact, it includes also alert users.
- c) Local Organizations Mapping LUC/LCC (3.4.1. Paragraph 1) – it states that “in other countries, the MapBiomias initiative has one team for each country”. Not necessarily, in Indonesia there are 10 teams involved covering different regions and themes.
- d) Local Organizations Mapping LUC/LCC (3.4.1. Table 1) – it should include the information that NGOs, Universities, Think Thanks and Tech Companies participate in the arrangements.
- e) Institutional Support (3.4.6. Paragraph 1) – it’s missing in institutional support the Arapyaú Institute which is playing a key role since 2018.
- f) MapBiomias Workflow (Figure 2) - various problems in this figure. It suggests that WRI, ISA, SEEG, NICFI and Arapyaú are in the same role and for all MapBiomias Initiatives. There should be a clear separation of Funders and Institutional Supporter and it should have the coordination committee. The organization in each country is different. If including all initiatives it is missing Indonesia.
- g) Key outputs of MapBiomias to date (3.5 paragraph 1) – when report was finalized in August 2019 the Collection 4 of MapBiomias was launched covering the period 1985-2018.
- h) MapBiomias Project timeline (Figure 3) – the diagram is missing Collection 2.3 (January 2018) and 3.1 (January 2019).

4.3. Findings from this evaluation

- a) Findings 5 – it states that the current MapBiomias institutional arrangement leads to increased administrative costs and overcomplicated flow of resources and complicates accountability and transparency. This is a hypothesis not a finding since there is no evidence that it increases admin costs and decreases transparency. Also, it suggests that by institutionalizing MapBiomias would facilitate the establishment of new partnerships “in particular with government organizations”. Again, this is a hypothesis not a finding. In fact, MapBiomias could sign all agreements if found interesting and institutionalization was not an issue.
- b) Findings 6: it suggests that most teams at MapBiomias do not have enough qualified developers. This was an issue at the beginning of the project. Nowadays most of the teams have qualified developers. Most teams are developing their adaptations and applications of MapBiomias products and codes.
- c) Finding 11 (paragraph 3): it suggests that “IBGE could also contribute to financing MapBiomias” – no way. It’s much more likely that MapBiomias support IBGE than the other way around.
- d) Finding 12 (paragraph 1): it affirms that “there are several ongoing initiatives similar to MapBiomias that continuously map land-use change”. There is no similar initiative in Brazil, that is why the project has been implemented. All other initiative has lower resolution in time and space, and none use machine learning based temporal series analyses.
- e) Finding 13 (4.3. Data Quality - paragraph 1): it states that “MapBiomias Collection 1 has been heavily criticized by its inconsistencies” – it is important to highlight that a very clear disclaimer was used when data of Collection 1 was released explaining the various limitations of the data.
- f) Finding 13 (4.3. Data Quality – last paragraph): it states that prevalence rules for integration “have a weak technical foundation, and layers of high accuracy may overlap with layers of poor accuracy”. All prevalence rules are based on technical decisions including the accuracy of the classes and clearly described in the ATBDs.
- g) Finding 14 (paragraph 1-2): it states that “various stakeholders pointed out that MapBiomias has not been following good research practice recommended by scientific communities, in the validation and accuracy analyses of the land cover and land use maps produced”. We have been working to apply the best practices available including by collection 100,000 samples (with three repetitions each) to allow for validation, accuracy assessment and, luckily, area adjustments. It is fundamental to recognize that literature does not cover the extent of MapBiomias Collections in years of time series, number of classes mapped and need to report data by several geographic boundaries (ex. States, municipalities etc.).
- h) Finding 14 (paragraph 3): text suggests that “failures and inconsistencies of the data are poorly reported” and “MapBiomias should make clear for what purposes the products can be used and for what purposes there is a restriction in order to prevent any kind of misuse”. MapBiomias has on the website the most comprehensive presentation of accuracy data that we could find. It presents the accuracy by year, biome, and each class of the legend including the confusion matrix (omission and commission errors) for each combination. It is extremely transparent and complete.

We also have a disclaimer of the limitation of the data in the opening of the platform. The decision whether it can/should be used for one or another application is for the user, not MapBiomias to take.

- i) Finding 15 (bullet 4): it should read MapBiomias Arida instead of Semi-Arida.
- j) Finding 19 (4.5. Impact of MapBiomias Project): It is missing the reference to MapBiomias Award and the examples of applications from Fiocruz (Malaria prevention), ICMBio (high conservation area forest study), TCU (evaluation of protected areas management) and IBAMA (environmental licensing of power lines).
- k) Finding 24 (paragraph 2): when discussing MapBiomias expansion to other countries it states that “the possibility for civil society to enhance land-use governance could also trigger political resistance or face legal restrictions, making MapBiomias networks impossible to consolidate in some places”. It is a hypothesis and not a finding. All places where MapBiomias started the work there were no such limitations.

* * *