This data article focuses on sustainability indicators for bioenergy generation from Brazilian Amazon's non-woody native biomass sources, considered to be modern forms of biomass. In the construction of the indicators, the Indicator-based Framework for Evaluation of Natural Resource Management Systems (MESMIS, from the original Spanish) method was used, with the application of the seven sustainability attributes to identify critical points and limiting and favorable factors for sustainability. The data yielded a list of 29 indicators distributed across 27 critical points, selected from three system evaluation areas: 11 environmental indicators, 11 social indicators, and 7 economic indicators.

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How data were acquired

Literature review

Data format

Filtered and analyzed

Experimental factors

In the construction of the sustainability indicators, the Indicator-based Framework for Evaluation of Natural Resource Management Systems (MESMIS, from the original Spanish ‘Marco para la Evaluación de Sistemas de Manejo de Recursos Naturales Incorporando Indicadores de Sustentabilidad’) method was used, considering the seven sustainability attributes to identify critical points and their respective indicators.

Experimental features

Data are focused on the development of sustainability indicators to be used in bioenergy production systems from Brazilian Amazon’s non-woody native biomass sources

Data source location

Brazilian Amazon

Data accessibility

Data included with this article

Related research article

None

Value of the data

- The data contribute to minimizing the impact of non-renewable energy sources by expanding research into modern biomass for bioenergy generation.
- Sustainability indicators are needed to evaluate the suitability of Amazon’s non-woody native biomass an alternative source for bioenergy production.
- The data describe sustainability indicators used in the Brazilian and international literature for bioenergy.
- Adequate application of these data may fill the gaps of sustainability evaluation of Amazon’s non-woody native biomass sources for bioenergy generation, a still incipient area of knowledge.
- The data provide information on bioenergy sustainability indicators that can be used for decision-making.

1. Data

This data article focuses on sustainability indicators for bioenergy production systems that use Brazilian Amazon’s non-woody native biomass sources. The creation of this data set is based on the analysis of globally recognized scientific certifications and publications related to sustainability standards for the biomass-bioenergy sector. The data of the sample were processed and shared in the Supplementary material of this data article as a Microsoft Excel spreadsheet (XLSX file) containing raw extracted and filtered data.

The data yielded a list of 29 sustainability indicators for bioenergy generation from Amazon’s biomass native sources, selected from seven sustainability attributes: productivity, stability, reliability, resilience, adaptability, equity, and self-reliance. Table 1 shows the 27 critical points identified for the bioenergy production system analyzed in this study, linked to their respective sustainability attributes. Table 2 then describes the indicators linked to these critical points, according to the system evaluation area.

Based on the data set of the sample, it was possible to categorize and quantify the indicators and critical points. This stratification was performed according to the respective evaluation area, for each one of the seven sustainability attributes (Table 3). Figs. 1 and 2 provide a comprehensive visual comparison of sustainability attributes in relation to indicator and critical points standards for bioenergy production systems that use Brazilian Amazon’s non-woody native biomass sources.
Table 1
Critical points identified for bioenergy production systems that use Amazon’s non-woody native biomass sources.

| Sustainability attributes | Critical points | References |
|---------------------------|-----------------|------------|
| **Productivity**          | 1. Productivity  | [1–3]      |
|                           | 2. Profitability | [1–3]      |
|                           | 3. Regulatory compliance | [1,2,4] |
|                           | 4. Soil degradation | [1–4] |
|                           | 5. Pollution     | [1,4]      |
| **Stability, reliability, resilience** | 6. Food competition | [1–4] |
|                           | 7. Use of forest management practices | [1,4] |
|                           | 8. Waste disposal | [1,2]      |
|                           | 9. Greenhouse gas emissions | [1–4] |
|                           | 10. Availability and reuse of water | [1–3] |
|                           | 11. Use of genetically modified organisms (GMOs) | [1] |
|                           | 12. Vulnerability to external effects | [1] |
|                           | 13. Biodiversity and ecosystems | [2,4] |
|                           | 14. Desertion of the area | [1,3,4] |
| **Adaptability**          | 15. Technological innovation | [1,4] |
|                           | 16. Capacity     | [1–4]      |
| **Equity**                | 17. Basic services | [1–4] |
|                           | 18. Family involvement | [1,3,4] |
|                           | 19. Equal opportunities | [1–4] |
|                           | 20. Child labor   | [1–4]      |
|                           | 21. Land rights   | [1–4]      |
|                           | 22. Food competition | [1–4] |
| **Self-reliance**         | 23. Dependence on subsidies | [1,2,4] |
|                           | 24. Dependence on external inputs | [1] |
|                           | 25. Dependence on fossil fuels | [1,3,4] |
|                           | 26. Sources of income | [1,3,4] |
|                           | 27. Organization and participation | [1,4] |

Table 2
Sustainability indicators by critical point and evaluation area.

| Evaluation area         | Indicators                                | Critical points | References |
|-------------------------|-------------------------------------------|-----------------|------------|
| **Environmental**       | 1. Land use and diversity                 | Food competition | [1–4]      |
|                         | 2. Soil erosion                            | Soil degradation | [1–4]      |
|                         | 3. Agrochemical use                        | Pollution       | [1,4]      |
|                         | 4. Forest management practices             | Use of forest management practices | [1,4] |
|                         | 5. Waste management                        | Waste disposal  | [1,2]      |
|                         | 6. Greenhouse gas emissions                | Greenhouse gas emissions | [1–4] |
|                         | 7. Availability and reuse of water         | Availability and reuse of water | [1–3] |
|                         | 8. Management of GMOs                      | Use of GMOs     | [1]        |
|                         | 9. Abiotic stresses                        | Vulnerability to external effects | [1] |
|                         | 10. Compatibility with native biomes       | Biodiversity and ecosystems | [2,4] |
|                         | 11. Use of renewable energy                | Dependence on fossil fuels | [1,3,4] |
| **Social**              | 12. Permanence of traditional populations | Desertion of the area | [1,3,4] |
|                         | 13. Training                               | Capacity        | [1–4]      |
|                         | 14. Health care                            | Basic services  | [1–4]      |
|                         | 15. Basic services                         | Basic services  | [1–4]      |
|                         | 16. Family participation                   | Family involvement | [1,3,4] |
|                         | 17. Distribution of employees              | Equal opportunities | [1–4] |
|                         | 18. Child labor                            | Child labor     | [1–4]      |
|                         | 19. Land tenure rights                     | Land rights     | [1–4]      |
|                         | 20. Access to land tenure                  | Land rights     | [1–4]      |
|                         | 21. Use of basic crops                     | Food competition | [1,3,4] |
|                         | 22. Organization and participation         | Organization and participation | [1,4] |
| **Economic**            | 23. Yield                                 | Productivity    | [1–3]      |
|                         | 24. Benefit-cost ratio                     | Profitability   | [1–3]      |
|                         | 25. Regulatory compliance                  | Regulatory compliance | [1,2,4] |
|                         | 26. Scientific and technological innovation| Technological innovation | [1,4] |
|                         | 27. Self-financing                         | Dependence on subsidies | [1–4] |
|                         | 28. External inputs                        | Dependence on external inputs | [1] |
|                         | 29. Income diversification                 | Sources of income | [1,3,4] |
| Sustainability attributes | Critical points by evaluation area | Indicators by sample |
|---------------------------|-----------------------------------|----------------------|
|                           | Environmental | Social | Economic | Total | Valdez-Vazquez [1] | ABNT [2] | GBEP [3] | Moret [4] |
| Productivity              | 2             | –      | 3        | 5     | 5                  | 4       | 3       | 3        |
| Stability, reliability, resilience | 8             | 1      | –        | 9     | 8                  | 5       | 4       | 5        |
| Adaptability              | –             | 1      | 1        | 2     | 2                  | 1       | 1       | 2        |
| Equity                    | –             | 6      | –        | 98    | 6                  | 8       | 8       | 8        |
| Self-reliance             | 1             | 1      | 3        | 5     | 5                  | 1       | 2       | 4        |
| Total                     | 11            | 9      | 7        | 27    | 28                 | 17      | 18      | 22       |

**Fig. 1.** Number of indicators per sustainability attributes coded by a sample model.
2. Experimental design, materials, and methods

2.1. Study area description

In the construction of the sustainability indicators of non-woody native biomass, the study area was the Amazon biome, which integrates the various Amazons. Fig. 3 shows that the term “Amazon” is used in several different ways at the global and regional levels, and, although these are interrelated, they have distinct meanings [5].
2.2. System characterization: description of the study biomass sample

Considering the universe of forest biomass, the construction of the indicators aimed the creation of sustainability parameters for Amazon's non-woody native biomass sources (fruits) [6], which are modern forms of biomass. Selection followed the typology described by Brand [7] in the physical flow of forest biomass for energy generation (Fig. 4).

Fig. 3. Explaining the various Amazons.

Fig. 4. Physical flow of forest biomass for energy generation. Source – Brand [7].
2.3. Construction of sustainability indicators

The process of construction of sustainability indicators of non-woody native biomass sources for bioenergy generation relies on the Indicator-based Framework for Evaluation of Natural Resource Management Systems method (MESMIS, from the Spanish Marco para la Evaluación de Sistemas de Manejo de Recursos Naturales Incorporando Indicadores de Sustentabilidad). MESMIS is aimed at researchers and professionals from different areas of knowledge who are interested in developing and disseminating tools for sustainability evaluation systems. It can be applied in case studies in the rural sector, especially in the rural context of Latin America [8].

MESMIS is characterized by its flexibility and adaptability to different levels of information and technical training, providing a participatory and interdisciplinary approach that allows the adaptation of the sustainability evaluation process to the specificities of each study [9–11]. This flexibility was used for the identification of critical points, determination of diagnostic criteria, and definition of sustainability indicators (Fig. 5) [12].

As described in the MESMIS method, the seven sustainability attributes (productivity, stability, reliability, resilience, adaptability, equity, and self-reliance) used for identification of critical points were applied to the present system, revealing limiting and favorable factors for sustainability.

For selection of critical points and subsequent sustainability evaluation for bioenergy, different types of scientific publications were used. Table 4 presents the composition of the sample, characterized by documents that varied in terms of geographical scope, authorship, and typology. The diversity of these publications allowed the data to encompass multiple viewpoints and goals of sustainability indicators for bioenergy. Then, each of the selected critical points was linked to sustainability indicators structured into the economic, environmental, and social dimensions.

The sample allowed the data set to encompass the characteristics of representativeness, comparability, clarity and synthesis, data collection, and forecasting and goals [13].
| Document                                                                 | Origin                                                      | Typology       | Scope          | Date of publication |
|-------------------------------------------------------------------------|-------------------------------------------------------------|----------------|----------------|---------------------|
| ABNT ISO 13065: Sustainability criteria for bioenergy [2]               | International Organization for Standardization              | Technical      | International   | 2015                |
| Description: This standard specifies principles, criteria and indicators for the bioenergy supply chain to facilitate evaluation of environmental, social and economic aspects of sustainability. |
| Sustainability criteria and indicators for bioenergy [4]                 | Working Group on Energy of the Brazilian Forum of NGOs and Social Movements for the Environment and Development | Technical      | National       | 2006                |
| Description: Set of sustainability criteria and indicators to guide discussion among the various social and economic segments involved in enterprises of energy generation from biomass, in its social, environmental, and economic dimensions |
| Proposal for a sustainability evaluation framework for bioenergy production systems using the MESMIS methodology [1] | Renewable and Sustainable Energy Reviews                    | Scientific     | International   | 2017                |
| Description: The aim of the present study is to develop a sustainability evaluation framework that is suitable to Bioenergy Production Systems, integrating any feedstock, technological process, and social component for low and middle-income countries. |
| Sustainability Indicators for Bioenergy [3]                             | Global Bioenergy Partnership (GBEP)                         | Technical      | International   | 2011                |
| Description: This report presents 24 indicators of sustainability regarding the production and use of modern bioenergy, broadly defined. The indicators were developed by the Global Bioenergy Partnership (GBEP) and provide a framework for assessing the relationship between production and use of modern bioenergy and sustainable development. The indicators were intentionally crafted to report on the environmental, social, and economic aspects of sustainable development. |
Acknowledgments

The present work was conducted with the support of the Graduate Support Program for Private Community Colleges (PROSUC) of the Coordination for the Improvement of Higher Education Personnel (CAPES) at the Brazilian Ministry of Education.

The authors thank Grupo Rovema for providing essential financial support for the publication of this study of sustainability indicators for bioenergy generation from Amazon’s non-woody native biomass sources.

Transparency document. Supporting information

Transparency document associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.11.022.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.11.022.

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