|  |  |
| --- | --- |
| 5.4 | VALUE CHAIN DESCRIPTION AND IDENTIFICATION OF CRITICAL GBEP INDICATORS - FEEDSTOCK |

**AIM**

|  |  |
| --- | --- |
|  | **Understand the sustainability impacts and the critical GBEP indicators associated with the different types of biomass feedstocks used for modern bioenergy production in the country.** |

*Note: Issues associated with the other stages of bioenergy supply chains are addressed in the individual questionnaires, which should be filled in on the basis of the pathway(s) considered, i.e. transport (Module 5.1), heat and power (Module 5.2), and cooking and heating – small scale (Module 5.3).*

*It is important to note that the most significant sustainability impacts (both positive and negative) in bioenergy supply chains tend to arise upstream, especially when dedicated biomass production takes place.*

***Please answer the questions in this chapter separately for each biomass feedstock used for modern bioenergy production as part of the identified priority bioenergy pathways in the country.***

# 5.4.1 Imported feedstock.

***Please answer the following questions for each biomass feedstock used for modern bioenergy production:***

|  |  |
| --- | --- |
|  | **Answers** |
| * **Is bioenergy feedstock imported?** *(Y/N)*
 |  |
| * **Share of total bioenergy feedstock imported** *(%)*
 |  |

If feedstock is imported, there will be no sustainability impacts (at national level) associated with this upstream stage of the bioenergy supply chain. The net trade balance of the country, which is not measured by any specific GBEP indicator, will be affected though.

|  |  |
| --- | --- |
| * **Are there a limited number of ports/international overland routes for the import of feedstock?**
 | **CRITICAL GBEP INDICATOR: Indicator 23 (Infrastructure and logistics for distribution of bioenergy)** |

**WHERE TO?**

**Imported feedstock?**

Add the identified critical indicators into the Summary Booklet in Chapter 6, adding a note as to the reason for criticality.

**Other source of feedstock?**

Continue in this Module to **Section 5.4.2**

Return to the questionnaire in **Module 5.1/2/3** (depending on specific pathway) to identify critical GBEP indicators associated with the downstream stages of the value chain.

# 5.4.2 Waste.

If waste (including unused residues and by-products[[1]](#footnote-1)) is used as a feedstock, modern bioenergy production is unlikely to trigger significant negative impacts on sustainability at national level. As a matter of fact, if waste management/disposal improves as a result of its use as bioenergy feedstock, there may be a number of positive effects, e.g., in terms of GHG emissions, water quality, air quality and human health. However, depending on the requirements and drivers/objectives of the bioenergy policy (see chapter 2), and on how the other stages of the value chain are managed, a few sustainability dimensions and related indicators could still be critical or at least relevant.

**WHERE TO?**

**Waste feedstock?**

Add the identified critical indicators into the Summary Booklet in Chapter 6, adding a note as to the reason for criticality.

**Other source of feedstock?**

Continue in this chapter to **Section 5.4.3**

Return to the questionnaire in **Module 5.1/2/3** (depending on specific pathway) to identify critical GBEP indicators associated with the downstream stages of the value chain.

# 5.4.3 Crop/livestock/forest residues and processing residues.

In the context of this questionnaire:

* *Crop residue* is plant material remaining after harvesting, including leaves, stalks, roots[[2]](#footnote-2).
* *Livestock residues* predominantly include manures from cows, pigs, and chickens.
* *Forest residues* consist of small trees, branches, tops and un-merchantable wood left in the forest after the cleaning, thinning or final felling of forest stands[[3]](#footnote-3).
* *Processing residues* encompass all materials and substances generated from biomass processing and which are not the end product(s) that a production process directly seeks to produce[[4]](#footnote-4).

In order to identify the critical GBEP indicators associated with modern bioenergy production from residues, the competing uses of these residues shall be identified.

* **What are the alternative uses of these residues that could be displaced?**

|  |  |
| --- | --- |
| **COMPETING USES OF RESIDUES** | **CRITICAL GBEP INDICATORS:** |
| Feed | **Indicator 10 (Price and supply of a national food basket)** |
| Soil cover / amendment | **Indicator 2 (Soil quality)** |
| Traditional biomass use for cooking and heating | **Indicator 13 (Change in unpaid time spent by women and children collecting biomass)** |
| Other[[5]](#footnote-5) (please specify) |  |

**WHERE TO?**

**Residue feedstock?**

Add the identified critical indicators into the Summary Booklet in Chapter 6, adding a note as to the reason for criticality.

**Other source of feedstock?**

Continue in this chapter to **Section 5.4.4**

Return to the questionnaire in **Module 5.1/2/3** (depending on specific pathway) to identify critical GBEP indicators associated with the downstream stages of the value chain.

# 5.4.4 Crops, trees and grasses.

In case domestically produced agricultural crops, trees or grasses are used as bioenergy feedstock, in order to identify likely impacts on sustainability and critical GBEP indicators, it is important to estimate how the additional demand for each crop, tree and grass was met.

This should be done in consultation with relevant experts with an in-depth knowledge of the agricultural and forestry sectors (and related markets) in the country. Information and data available in national and international databases may be used, combined with expert judgement. In some cases, ballpark estimates based on experience will be necessary.

The additional demand for each crop/tree/grass may be met through any combination of the options described below. For each option deemed relevant/significant, the related questions and guidance will apply.

Furthermore, it should be checked whether the crop/tree/grass used as bioenergy feedstock is classified as an invasive species.

**Estimating how the additional demand for the crop/tree/grass was met.**

In order to obtain a preliminary but sound indication of likely impacts on sustainability, it is important to estimate how the additional demand for bioenergy feedstock was met, by answering the questions below. These questions should be addressed to a multidisciplinary team of experts with an in-depth knowledge of the domestic agricultural and forestry sectors and of related markets. Data from national and international databases (e.g. FAOSTAT) should be used, combined with expert judgement, as well as educated guesses in some cases.

To be able to answer the questions below, the following information (or an approximation of the same) for the baseline year (year in which the bioenergy policy and the related targets were adopted) and the current year or selected reference year, will be useful:

|  |  |  |
| --- | --- | --- |
| **Information** | **Baseline year** | **Reference year** |
| Harvested area (ha/y) |  |  |
| Total feedstock harvested (tonnes/y) |  |  |
| Yield (tonnes/ha/y) |  |  |
| Total imports of feedstock (tonnes/y) |  |  |
| Total exports of feedstock (tonnes/y) |  |  |
| Final use(s) of feedstock at national level (tonnes/y) |  |  |

## 5.4.4.1 Reduced exports and/or increased imports.

|  |  |
| --- | --- |
| If the additional demand for the crop/tree/grass was met through a reduction in exports and/or an increase in imports, significant impacts on sustainability are unlikely to arise at national level (as far as feedstock production is concerned) compared to a scenario without bioenergy demand. | **NO CRITICAL GBEP INDICATOR** |

*Note: The net trade balance of the country, which is not measured by any specific GBEP indicator, will be affected though.*

## 5.4.4.2 Diversion from the food and feed markets.

|  |  |
| --- | --- |
| If the additional demand for a crop or a residue (used as bioenergy feedstock) was met by diverting it from the food and feed markets, there might be a negative impact on food security.  | **CRITICAL GBEP INDICATOR: 10 (Price and supply of a national food basket)** |

*Note: Possible impacts on food security should be carefully monitored especially in case of crops (used as bioenergy feedstock) that are part of the national food basket. However, if the domestic supply of these crops for food does not decrease after trade[[6]](#footnote-6) and if their inflation-adjusted prices do not increase[[7]](#footnote-7), it is unlikely that food security will be affected.*

## 5.4.4.3 Increased domestic production.

If the additional demand for the crop/tree/grass was met through an increase in domestic production, it should be estimated whether this increase was due to an expansion in the harvested area or a yield increase, or both.

### Expansion in harvested area.

In this case, it is important to determine: the changes in land use and land management that might have taken place; and the main characteristics of the areas where this expansion occurred. Furthermore, it is important to determine whether the crop/tree/grass used as bioenergy feedstock is classified as an invasive species.

*Note: if the crop/tree/grass is cultivated in rotation or combination with other crops/trees/grasses, then the relative role of the feedstock considered (vs. those of these other crops/trees/grasses) should be considered when answering the questions below. Similarly, in case of multi-purpose crops/trees/grasses, of which only a fraction is used as bioenergy feedstock, the relative weight of this use (vs. all other uses) should be considered. Impact allocation can be done on the basis of either mass balance or economic value of the various crops/trees/grasses and of the related uses[[8]](#footnote-8).*

|  |  |
| --- | --- |
|  | **CRITICAL GBEP INDICATORS** |
| * **Is the crop/tree/grass used as a bioenergy feedstock a nationally recognized invasive species?**
 | **Indicator 7 (Biological diversity in the landscape), specifically 7.2 (invasive species)** |
| * **Is it likely that the expansion in the harvested area of the crop/tree/grass led to the conversion of natural forests and grasslands (including savannah), peatlands, and wetlands?**
 | **Indicator 1 (Lifecycle GHG emissions);****Indicator 7 (Biological diversity in the landscape)[[9]](#footnote-9)** **Indicator 8 (Land use and land-use change)[[10]](#footnote-10)** |
| * **Is it likely that the expansion in the harvested area of the crop/tree/grass led to the conversion of nationally recognized areas of high biodiversity value or critical ecosystems?**
 | **Indicator 7 (Biological diversity in the landscape), specifically 7.1 (high biodiversity value)** |
| * **Is it likely that the expansion in the harvested area of the crop/tree/grass took place in areas:**
 |  |
| * + Prone to soil degradation (e.g., erosion)
 | **Indicator 2 (Soil quality)** |
| * + With medium, high or critical levels of water stress [only in case of irrigation and for planted trees with high evapotranspiration rates]
 | **Indicator 5 (Water use and efficiency)** |
| * + Within watersheds considered most vulnerable to nutrient and/or pesticide pollution
 | **Indicator 6 (Water quality)** |
| * + With insecure land tenure rights
 | **Indicator 9 (Allocation and tenure of land)** |
| * **Are relevant conservation methods[[11]](#footnote-11) used in the cultivation of the crop/tree/grass?**
 | **Indicator 2 (Soil quality)****Indicator 6 (Water quality)****Indicator 7 (Biological diversity in the landscape)[[12]](#footnote-12)** |
| * **Is it likely that the expansion in the harvested area of the crop/tree/grass led to the displacement of crops that are part of the national food basket?**
 | **Indicator 10 (Price and supply of national food basket)** |

*Note: If trade compensates for the above and the domestic supply of the crop for food and feed does not decrease[[13]](#footnote-13) (after trade) and if their inflation-adjusted producer price does not increase[[14]](#footnote-14), food security might not be affected and Indicator 10 might not be critical. The displacement of crops could lead to indirect land use change, which is not explicitly addressed by the GBEP indicators.*

|  |  |
| --- | --- |
| * **Is there a high prevalence of informal jobs in the agricultural sector?**
 | **Indicator 12 (Jobs in the bioenergy sector)[[15]](#footnote-15)** |
| * **Is the crop/tree/grass harvested manually, with high risk of occupational injury, illness and fatalities?**
 | **Indicator 16 (Incidence of occupational injury, illness and fatalities)** |

### Yield increase.

In this case, it is important to determine how this yield increase was achieved, i.e., through the introduction of higher-yielding species or improved varieties; increased use of fertilizers and/or pesticides; increased irrigation; increased mechanization; and/or improved management practices.

#### Introduction of higher-yielding species.

|  |  |
| --- | --- |
| * **Were alien species introduced, potentially leading to the displacement of indigenous species?**
 | **Indicator 7 (Biological diversity in the landscape)** |

#### Introduction of improved varieties.

The introduction of improved varieties is unlikely to trigger significant impacts on sustainability. As a matter of fact, the resulting increase in productivity could reduce pressure on natural resources. However, the potential of loss of genetic diversity could exist.

|  |  |
| --- | --- |
| * **Were varieties introduced in a way that could potentially lead to the loss of indigenous species and crop genetic diversity?**
 | **Indicator 7 (Biological diversity in the landscape)** |

#### Increased use of fertilizers and/or pesticides.

|  |  |
| --- | --- |
| * **An increase in the use of fossil fuel-based fertilizers and pesticides results in increased GHG emissions.**
 | **Indicator 1 (Lifecycle GHG emissions)** |
| * **Is there significant production of the crop/tree/grass within conservation value areas?**
 | **Indicator 7 (Biological diversity in the landscape)** |
| * **Is there significant production of the crop/tree/grass within watersheds considered vulnerable to nutrient and/or pesticide pollution?**
 | **Indicator 6 (Water quality)** |
| * **Is it likely that the increased application of fertilizers and pesticides led to negative impacts on soil quality, e.g., through increased tillage, soil compaction (due to the increased use of heavy machinery), and/or soil pollution/contamination?**
 | **Indicator 2 (Soil quality)** |
| * **Is it likely that the increased application of fertilizers and/or pesticides resulted in increased occupational health and safety risks for agricultural workers? Were these workers provided with adequate training and equipment?**
 | **Indicator 16 (Incidence of occupational injury, illness and fatalities)****Indicator 21 (Training and requalification)** |

#### Increased irrigation.

|  |  |
| --- | --- |
| * **Is it likely that the increase in irrigation of the crop/tree/grass took place in areas with medium, high or critical levels of water stress [as per SDG indicator 6.4.2]?**
 | **Indicator 2 (Soil quality)****Indicator 5 (Water use and efficiency)** |

#### Increased mechanization.

|  |  |
| --- | --- |
| * **(Increased) mechanization will result in higher GHG emissions and emissions of non-GHG air pollutants, including air toxics.**
 | **Indicator 1 (Lifecycle GHG emissions)****Indicator 4 (Emissions of non-GHG air pollutants, including air toxics)** |
| * **Is it likely that the (increased) mechanization resulted in increased tillage and/or soil compaction?**
 | **Indicator 2 (Soil quality)** |
| * **Is it likely that the (increased) mechanization, especially of the harvesting process, led to the displacement of jobs in the agricultural sector?**
 | **Indicator 12 (Jobs in the bioenergy sector)****Indicator 21 (Training and re-qualification of the workforce)** |
| * **Is it likely that the (increased) mechanization had an impact on the incidence of occupational injury, illness and fatalities among agricultural workers?**
 | **Indicator 16 (Incidence of occupational injury, illness and fatalities)** |

#### Improved management practices.

If the increase in efficiency was achieved through improvements in management practices, no negative impacts are likely to be associated with the yield increase. On the contrary, there might be positive effects on a few sustainability dimensions.

For instance, the following Climate-Smart Agriculture (CSA) practices may lead to an increase in productivity and to an improvement in the overall sustainability of agricultural systems, e.g. in terms of GHG emissions, soil quality, water use efficiency, water quality and biodiversity. These practices are covered in Chapter 7.

**WHERE TO?**

Return to the questionnaire in **Module 5.1/2/3** (depending on specific pathway) to identify critical GBEP indicators associated with the downstream stages of the value chain.

**Finished this Module?**

Add the identified critical indicators into the Summary Booklet in Chapter 6, adding a note as to the reason for criticality.

1. Alternative uses of residues are addressed in section 5.4.3 below. [↑](#footnote-ref-1)
2. https://stats.oecd.org/glossary/detail.asp?ID=480 [↑](#footnote-ref-2)
3. https://www.eubia.org/cms/wiki-biomass/biomass-resources/challenges-related-to-biomass/recovery-of-forest-residues/ [↑](#footnote-ref-3)
4. https://knowledge4policy.ec.europa.eu/node/9345\_pt [↑](#footnote-ref-4)
5. E.g., building material. [↑](#footnote-ref-5)
6. Data on the domestic supply of the main agricultural commodities for different uses are available in FAOSTAT for the vast majority of countries: <http://www.fao.org/faostat/en/#data/FBS> [↑](#footnote-ref-6)
7. Agricultural producer prices should be considered. These are the prices received by farmers for their produce at the farm gate, i.e., at the point where the commodity leaves the farm. Data on these prices are available here: http://www.fao.org/prices/en/ [↑](#footnote-ref-7)
8. For guidance on impact allocation methods, please refer to the *Implementation Guide*. [↑](#footnote-ref-8)
9. Specifically sub-indicator 7.1 (Area and percentage of nationally recognized areas of high biodiversity value or critical ecosystems converted to bioenergy production). [↑](#footnote-ref-9)
10. Specifically sub-indicator 8.4 (Net annual rates of conversion between land-use types caused directly by bioenergy feedstock production). [↑](#footnote-ref-10)
11. As explained in the methodology sheet of GBEP indicator 7 (Biological diversity in the landscape) and specifically under sub-indicator 7.3 (Area and percentage of the land used for bioenergy production where nationally recognized conservation methods are used), these methods include: no-till or low-till agriculture; integrated pest management; integrated nutrient management; maintenance or enhancement of agrobiodiversity; agroforestry/intercropping, and low impact harvesting; low impact forest management and wood harvest; maintenance and/or enhancement of ecological corridors and/or buffer zones; restoration or conservation of areas within and around production areas for biodiversity and ecosystems; monitoring populations of flagship and/or indicator species. [↑](#footnote-ref-11)
12. Specifically, sub-indicator 7.3 (Area and percentage of the land used for bioenergy production where nationally recognized conservation methods are used). [↑](#footnote-ref-12)
13. Data on the domestic supply of the main agricultural commodities for different uses are available in FAOSTAT for the vast majority of countries: <http://www.fao.org/faostat/en/#data/FBS> [↑](#footnote-ref-13)
14. As explained above, these are the prices received by farmers for their produce at the farm gate, i.e., at the point where the commodity leaves the farm. Data on these prices are available here: http://www.fao.org/prices/en/ [↑](#footnote-ref-14)
15. Specifically sub-indicator 12.2 (Total number of jobs in the bioenergy sector and percentage adhering to nationally recognized labour standards consistent with the principles enumerated in the ILO Declaration on Fundamental Principles and Rights at Work, in relation to comparable sectors). [↑](#footnote-ref-15)