Residue Retention Requirement (Crop Residues)

Definition

The residue retention requirement represents the **minimum quantity of crop residue (dry tons per acre per year)** that must remain on the field to satisfy soil sustainability constraints, including maintenance of soil organic carbon and limits on wind and water erosion.

Values are derived from process-based modeling (EPIC and RUSLE) as reported in Muth et al. (2012):
Muth, D. J., et al. (2012). Sustainable agricultural residue removal for bioenergy: A spatially comprehensive US national analysis. Applied Energy.
http://dx.doi.org/10.1016/j.apenergy.2012.07.028

Units

Dry tons per acre per year (tons/ac/yr)

Interpretation

- Values range from **1 to 10 tons/acre/year**
- Lower values (e.g., 1) → **minimally constrained** (most residue can be removed)
- Higher values (e.g., 10) → **highly constrained** (effectively no residue removal allowed)

These values represent **absolute minimum retention requirements**, not fractions.

Use in Modeling

To estimate removable residue:

$$\text{Removable residue} = \text{Total residue production} - \text{Retention requirement}$$

These values define the **biophysical constraint only**. Actual residue availability may be further limited by:

- Operational constraints (e.g., harvest limits)
- Behavioral assumptions
- Economic feasibility

The **binding constraint** is the most restrictive among these.

Attributes

Parameter	Value Description
muth_id	Unique row identifier
muth_model	Concatenation of key scenario attributes (dataset, tillage, yield)
muth_dataset	Crop residue type: 1 = Corn stover; 2 = Wheat straw; 3 = Sorghum stubble; 4 = Oat straw; 5 = Barley straw
tillage	Tillage system: ct = conventional till; rt = reduced till; nt = no-till
yield	Yield scenario: base or high
linecntid	Line count identifier (values 1–3,109)
county	County name
state	State name
fips	County FIPS code
poly	POLYSYS region identifier (values 1–305)
fips_1	State abbreviation plus last three digits of county FIPS code
yr_2009 through yr_2040	Annual residue retention requirement (dry tons/acre/year) for each year. Values represent the minimum residue that must remain on the field to meet soil organic carbon and erosion constraints.
enterdate	Date the record was entered into the KDF database (if available)

Notes and Clarifications

- These values are **not percentages or fractions**.
- A value of **10 tons/acre/year** should be interpreted as:
    - Residue removal is **effectively constrained (no removal feasible)** under modeled conditions.
- Values vary by:
    - Crop type
    - County
    - Tillage system
    - Yield scenario
    - Year