

## Resources efficiency comparison on beef production in Germany, Argentina and Brazil

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**Introduction** Global demand for meat will increase in the coming years. For this reason, more resources will be needed for the growing production, and they must be allocated in the most efficient way. This work comparatively analyzes resources efficiency on beef production in Germany, Argentina and Brazil. For such, several typical production systems are defined for each country.

**Material and methods** In contrast to poultry or pork production, for beef production there are different systems coexisting, which are set to make the best use of the respective production factors in shortest supply, like area, feed and animals (Schwartz *et al.* 2011). In Argentina and Brazil beef systems are based on long grazing phases with high demand for land while finishing phase utilizes different feeding intensities and duration. In Germany weaned calves from cow-calf operations and Fleckvieh and Holstein male offspring are finished on intensive systems (Brüggemann, 2011). To comprehensively encompass resources usage and their effect on the environment (as for example climatic effects) or competitive relationships with alternative uses, like area, different indicators were used. A detailed assessment was made on greenhouse gases (GHG) emissions related to animals and industrial inputs over crops and pasture areas, regarding land use and feed efficiency. Calculation methodology for estimating embodied energy, CO<sub>2</sub>-equivalent emissions and shadow areas follows the methodology and indicators generated by the adapted ecological footprint approach for agriculture (Bungenstab, 2005). Shadow areas correspond to a forest area that would be necessary for carbon sequestration of the equivalent GHG emissions generated by the manufacturing of all production inputs, as well as the emissions from fuels and other energy sources used in the system. Total emissions for each input were obtained from assessments of the manufacturing process or derive from the embodied energy of each input. Shadow area is therefore the area of forest that would be necessary for permanently sequestering this total amount of carbon equivalent. For this work it was considered that one hectare forest would sequester 6600 kg CO<sub>2</sub> per year. Economic indexes like profit per product unit and per area were also calculated.

**Results** The assessment shows that in Argentina and Brazil, CO<sub>2</sub> equivalent emissions vary from 7 to 12 kg per kg beef with the lowest values on the intensive systems. In Germany emissions are lower (7 to 8 kg CO<sub>2</sub> eq per kg beef), except for the systems including intensive finishing of Holstein male offspring from the dairy sector (up to 10 kg CO<sub>2</sub> eq per kg beef). Regarding land use, values vary from 15 m<sup>2</sup> per kg beef from Fleckvieh intensive finishing in Germany to 45 m<sup>2</sup> from plain grazing finishing in Argentina. Also when comparing feed efficiency (measured in MJ ME per kg beef), intensive systems (with use of grain feed) show higher values of efficiency. Finishing based on pastures takes much longer, resulting on higher maintenance costs. In this regard, in South-American systems pasture proportions on feedstuffs ranges between 75 and 100%, while in Germany, even in the cow-calf operations with weaning calves, it reaches 55%. Also, in German intensive finishing operations, pastures are practically not used.

**Conclusions** This work indicates that differences in production systems might originate due to differences in resources availability, so that the respective shortest factors are used in the best economical way. Resources usage regarding environmental effects, as well as global food security, shows a different picture. Conclusions depend on the selected indicator. On one hand, the apparently evident result showing that resources efficiency increases with higher intensification is valid basically for the indicator of GHG emissions. On the other hand, an important aspect in indicators like area per kg of beef or feed consumption per kg of beef is the alternative use of land: in Germany there are some legal restrictions and in Brazil and Argentina, local environmental conditions might restrict alternatives land use other than pastures for cattle grazing. In such cases, extensive systems show higher resource use efficiency than intensive systems when assessed through area and feed utilization indicators.

### References

- Brüggemann, D.H. 2011. Landbauforschung, Sonderheft 345, Braunschweig.
- Bungenstab, D.J. Environmental Impacts of Beef Production in Central Brazil: The Effect of Intensification on Area Appropriation, Dr. Hut Verlag. München, 2005.
- Schwartz, H.J., Feldkamp, C.R., and Bungenstab, D.J. In: M. Benassy, S. Draggan and S. Yaya, Global Food Insecurity: Rethinking Agricultural and Rural Development Paradigm and Policy. Springer, Netherlands, 2011.