An agricultural route of physic nut production – environmental assessment using Life Cycle Inventory

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Jatropha was introduced in Brazil to expand the range of renewable raw materials with potential for energy supply. Its technological infrastructure for biodiesel production is being created. Environmental performance from small-scale agricultural systems is still unknown and must be evaluated.

In 2010 Brazil produced 2.2 million m3 of biodiesel (84% obtained from soybean and 14% from tallow). Physic nut (Jatropha curcas L.) is a promising alternative for this segment considering its high agricultural productivity (1.5 ton oil/ha), and the fact that it does not compete with a food feedstock. Two agricultural routes can be used in the production: manual and mechanized. The small scale manual route has a social appeal. This study presents an assessment of the environmental performance of manual route of physic nut production as feedstock for biodiesel production, using Life Cycle Assessment (LCA). This study aims not just subsidize strategic government decisions, but also provide elements that can contribute to the technological development of Brazilian's biodiesel production.

The methodological structure of the study was based on ISO 14044 standard; and an approach from cradle to gate was considered in order to prepare the Life cycle Inventory (LCI).

As function of the system it was adopted 'production of physic nut grains for biodiesel production'. Functional unit was defined as 'production of 79.5 ton of dry physic nut grains which corresponds to the production in 1ha during 20 years (time frame for physic nut cultivation, before soil recomposition). Unit processes included in product system under examination are: production and distribution of electricity, diesel oil, agricultural inputs (physic nut seeds, and fertilizers) and post harvest treatment. In order to prepare LCI it were used secondary data sources: agricultural inputs (Brazilian agronomic institutions); production and distribution of electricity and production of agricultural inputs (Ecoinvent version 2.2 - databases); diesel production (PE International). Emissions were calculated from models obtained in scientific literature. Table 1 presents the main data of LCI for production of 79.5 ton of dry physic nut grains.

Carbon dioxide balance is positive in terms of CO_2 capture once its emission corresponds to about 40% of the uptakes. On the other hand, consumption of phosphate and potassic fertilizers, as well, limestone for soil's pH correcting should be highlighted.

INPUTS – Natural resources	
Water (m^3)	28,0
Carbon dioxide (ton)	13,0
Land	1,00
INPUTS - Materials	
Limestone (ton)	4,60
Potassium chloride (ton of K_2O)	1,85
Manure (ton)	20,0
Single superphosphate (ton of P_2O_5)	1,18
Urea (ton of N)	2,46
OUTPUTS – Atmospheric emission	
Carbon dioxide (ton)	2,19
Fossil carbon dioxide (ton)	0,29
Carbon dioxide from agricultural inputs (ton)	5,36
OUTPUTS - Underground water emission	
Nitrate (ton)	0,74
Phosphate (ton)	0,08