The Carbon Footprint of Crop Protection Products

February 2012

CropLife INTERNATIONAL

Food Security in a Changing Climate

By 2050, the world population is expected to reach between 8.0 and 10.4 billion people, and the United Nation's Food and Agriculture Organisation (FAO) has predicted that food production must increase by 70% by 2050 to meet this growing demand. Meanwhile, food prices are rising as demand for food grows more rapidly than it is supplied.

The impacts of climate change and resource constraints are also expected to cause additional stress to crops, such as increased salinity, heat and drought, which can impact productivity. Changing temperatures create environments more favourable to weeds and result in changes in pest infestations. Changes in precipitation patterns also increase the potential for annual crop failures and declines in long-term production. For instance, the International Food Policy Research Institute (IFPRI) estimates that, by the year 2050, average yields will decline by 50% for wheat and 17% for rice in South Asia and 22% and 14% respectively in Sub-Saharan Africa (based on 2000 levels). By managing new risks and strengthening resilience to these changes, the agricultural sector can reduce its emissions and adapt to climate change, whilst avoiding a decline in global food supplies.

As the world faces rising food prices and population growth, there is increasing concern over global food security, and farmers must make use of all available technologies to meet future food needs.

Farmers also have limited access to land for cultivation, which creates an additional challenge to meeting future food needs. Since 1961, global cropland has grown by 27%, yet total crop yield has increased by 135%[1].

Agriculture and Climate Change

Agriculture is currently one of the most significant contributors to carbon emissions globally. While a large share of emissions come from livestock or is related to land use change, crop production also contributes about 14%. Yet agriculture also has the potential to significantly help adapt to and mitigate climate change, through practices that help increase soil carbon sequestration, protect carbon sinks and decrease the relative intensity of carbon emissions.

In the production cycle of a crop, many factors contribute to its overall footprint. Among these, crop protection products contribute only a small percentage (<1-4%) to the overall carbon footprint of crop cultivation, yet they help boost productivity and protect harvests.

In a study[2] conducted by Environmental Resources Management (ERM), five main processes involved in crop production were analysed, namely:

- crop protection products
- fertiliser production
- fertiliser application
- energy and fuels
- other inputs (e.g. lime, seeds, water)

These processes were compared across the main producing regions for each crop in order to calculate overall carbon footprints. This brochure provides a summary of their findings.

Key Facts about Crop Protection Products

Crop protection products (also called pesticides) are chemical or biological substances used to protect against weeds, insect pests and crop diseases such as viruses and fungi that threaten our food supply. There are three main types of crop protection products:

- **herbicides, which control weeds and unwanted plants such as nettles, dandelions and striga (witchweed)**
- **fungicides, which combat harmful crop diseases such as grey mould and blight**
- **insecticides, which control insects such as hoppers, caterpillars and aphids**

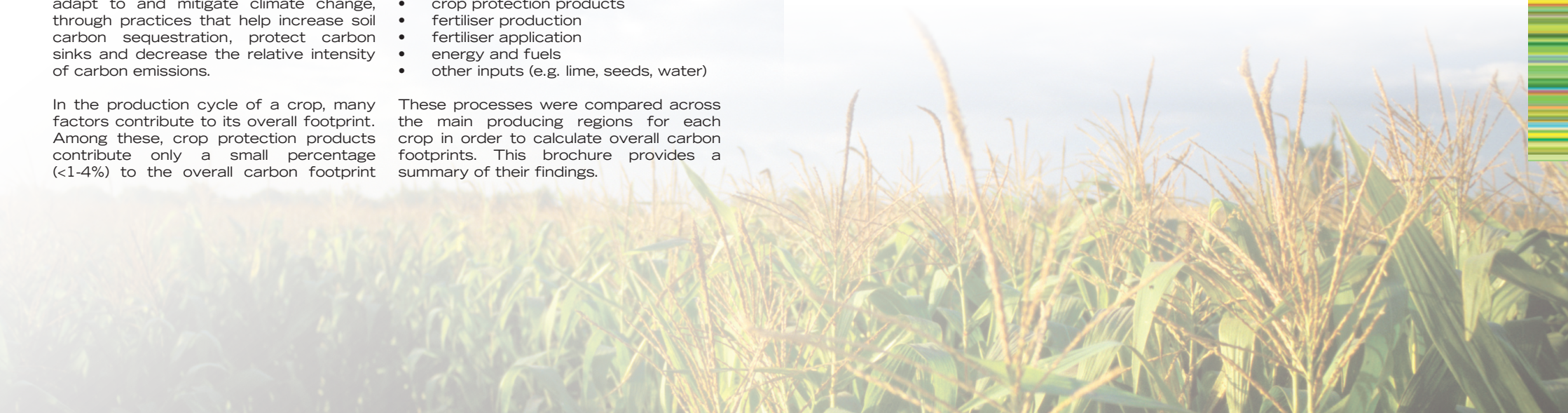
Crop protection products help the world's farmers to meet global demand for food, feed, fibre and energy by protecting harvests and avoiding wastage. Without crop protection products, crop yields would fall and many food types would be in short supply. Food prices would rise and yield losses of between 22% and 53% would require more land[3] to be cultivated as a result.

Crop protection products allow farmers to adopt agricultural practices that are sustainable and efficient. In addition, crop protection products contribute to farmers' ability to use minimum or conservation tillage farming practices, which reduce the release of greenhouse gas (GHG) emissions from the soil and help fight the damaging effects of soil erosion.

Increased food productivity and reduced waste also contribute to climate mitigation efforts by reducing the amount of food we need to import and transport around the world.

Crop protection products, in particular, improve the efficiency of other agro-inputs (e.g. fertiliser, irrigation, ploughing), whose value would be wasted as a result of losses from diseases and pests.

The importance of productivity in mitigation strategies is corroborated by studies have suggested that investment in yield improvements compares favourably with other commonly proposed GHG mitigation strategies.



Carbon Footprint by Crop (per tonne yield)

Crop protection products do not contribute significantly to the carbon footprint of any of the five main staple crops (cotton, maize, rice, soybeans and wheat).

The production and use of fertilisers makes the most significant contribution to the carbon footprints of all the crops and scenarios assessed. For wheat, maize, soybeans and cotton, the majority of this impact is attributable to the production of fertilisers; for rice, the impact is largely attributable to emissions released during the application of fertilisers (due to high methane emissions associated with flooded paddy field rice cultivation) as well to anaerobic degradation of organic material. Energy consumption also makes a significant contribution to the carbon footprints of crop cultivation.

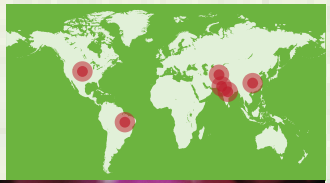
In contrast, the increased productivity which crop protection products provide is highly beneficial to addressing climate change challenges, compared to these products' small carbon footprint. In addition, crop protection products also reduce the need for other GHG-emitting activities which means that their net contribution is negligible or even positive.

Key

- Crop Protection Products
- Fertiliser Application
- Energy & Fuels
- Other Inputs
- Fertiliser Production
- Main producing regions of crop

COTTON

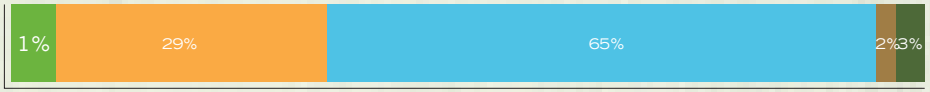
Indian cultivation of cotton results in the greatest carbon footprint while Ugandan cultivation results in the lowest overall footprint (of the scenarios assessed). This difference is largely due to the varying impact of fertilisers produced and used.



MAIZE

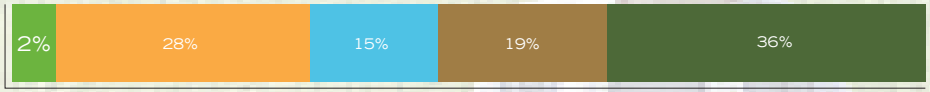
Cultivation of maize in China results in greater greenhouse gas (GHG) emissions than US cultivation while the US counties of Hardin and Codington have the lowest overall emissions from the scenarios assessed.

RICE



Italian upland rice cultivation (i.e. not in paddy fields) results in the lowest carbon footprint while Chinese cultivation of rice results in the greatest carbon footprint of all the scenarios assessed. This is due to lower GHG emissions released from the application of fertilisers to soil cultivation when compared with paddy field cultivation.

SOYBEANS



US cultivation of soybeans results in the greatest carbon footprint while Argentine cultivation the lowest of the scenarios assessed. This is due to varying levels of fertiliser inputs.

WHEAT

Australian cultivation of wheat results in the greatest carbon footprint (per tonne yield) while Mexican cultivation results in the lowest footprint of all the scenarios assessed. This is due to variations in average yield which varies the impact of high fertiliser inputs.

Addressing Food Security and Climate Change

Published literature in relation to the influence of crop protection products on crop productivity identifies the important role crop protection products play in addressing food security and climate change.

These products help to increase crop productivity and to reduce further encroachment of natural habitats for agricultural production. For these reasons, the small contribution of crop protection products to the overall carbon footprint of these staple crops is minimal compared to the productivity and mitigation benefits which they offer.

Among the many benefits indentified by recent research reports are the following:

Crop protection products have helped mitigate climate change by preventing greenhouse gas emissions in the past.

Agricultural intensification associated with increased yields has resulted in the avoidance of 161 gigatonnes of carbon emissions between 1961 and 2005. In this study by Burney et al (2010)[1], it is also suggested that investment in yield improvements – such as inputs, training, irrigation and mechanisation – compares favourably with other commonly proposed GHG mitigation strategies.

Crop protection products have one of the highest future potentials for mitigating climate change.

In the 2007 Intergovernmental Panel on Climate Change (IPCC) report[4], the authors pinpoint agriculture as having one of the highest mitigation potentials of any sector, based on further adoption of technologies and practices expected to be available by 2030. This potential increases further as the financial incentives for farmers (via carbon pricing) increase.

Crop protection products help farmers adapt to impacts of climate change, such as increased insect outbreaks.

The 2007 IPCC report[4] indicated that it is "virtually certain" that the agricultural sector would experience increased insect outbreaks as a result of warmer and more frequent hot days and nights. The report recommends addressing R&D policies, training and financial incentives for farmers, among others, as interventions that can be implemented "at low cost and/or with high benefit-cost ratios."

Crop protection products help protect harvests and ensure an adequate food supply.

In a three-year study by Oerke and Dehne (2004)[3], the use of crop protection products is estimated to save between 22% and 53% of total attainable crop yield. This study is based on eight different crops (wheat, rice, maize, barley, potatoes, soybeans, sugar beet and cotton) in different geographical regions.

Crop protection products help increase and sustain yields to meet the growing demand for food.

In a separate study by Jaggard et al (2010)[5], eleven arable crops were selected, which together occupy 56% of the world's arable land, and assessed on the extent to which changes in yield might contribute to an overall increase in available food. The results show that crop protection chemicals have played a significant part in increasing and sustaining yields of arable crops in industrialised countries. The study also suggests that restrictions on the use of chemical crop protection products, especially in Europe, could have serious implications on future crop yields.

Crop protection products help protect against disease, contributing to increased yields.

In Denmark, the use of more effective and broader spectrum fungicides since 1981 has, in general, increased wheat yields by approximately six tonnes per hectare. This is according to research by Jorgensen et al[6], which also claims that the introduction of new crop protection products has increased yields by 11-12 tonnes per hectare since 1981. The study highlights 1) the effects of on-going new product development in parallel with fungicide resistance, 2) the impacts of dosages on yield potentials and 3) the link between disease pressure and potential yields.

Crop protection products help protect against pests and weeds, contributing to increased yields.

A study by Lenne (2000)[7] reviews the progress made in the development, application and promotion of pest management technologies that farmers are adopting in developing countries. For instance, 10-35% of rice and major cereal crops in developing countries are lost due to insect pests, and 10-15% of potential food and cash crops are lost globally due to weeds.

References

1. Burney, J.; Davis, S.; and Lobell, D. (2010).
2. "Contribution of Crop Protection Products to the Carbon Footprint of Crop Cultivation", Environmental Resources Management (ERM), June 2011.
3. Oerke, E. and Dehne, H. (2004).
4. Intergovernmental Panel on Climate Change (IPCC). (2007).
5. Jaggard, K.; Qi, A.; and Ober, E. (2010).
6. Jorgensen, L.; Nielsen, G.; Hovmoller, M.; and Hansen, L. (unspecified).
7. Lenne, J. (2000).

About CropLife International

CropLife International is a global federation representing the plant science industry. It is a network of regional and national associations in 91 countries. CropLife International is committed to supporting the safe and responsible use of the industry's products in order to provide a secure, varied, healthy and affordable diet for consumers. Its member companies are committed to supporting sustainable agriculture through innovation in crop protection, plant biotechnology and seed production.

On the industry's behalf, CropLife International promotes approaches that enhance sustainable agriculture in the interests of farmers, consumers and the environment. CropLife International aims to provide transparent information to its stakeholders and welcomes open dialogue with parties interested in the future of food and farming.

To view more about CropLife International's crop protection work on its website, visit: http://www.croplife.org/en-us/crop_protection

Website: http://www.croplife.org/
YouTube: http://www.youtube.com/user/CropLifeInt
Twitter: @CropLifeIntl
Email: croplife@croplife.org