

HFFA Research GmbH

**The economic, social and
environmental value of plant
breeding in the European Union**

An ex post evaluation
and ex ante assessment

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Executive summary

This study aims at providing science-based but well-understandable quantitative and qualitative information on the numerous benefits plant breeding is offering to societies. More particularly, this research is meant to make the socio-economic and environmental value of plant breeding in the EU and for a rather broad variety of crops quantifiable and, thus, apparent.

Based on the application of sophisticated modelling and calculation tools as well as on a rather comprehensive assessment of plant breeding contributions to land productivity and overall productivity enhancement in EU arable farming, it turns out that plant breeding innovations count a lot: On average and across all major arable crops cultivated in the EU, plant breeding contributes approximately 74 percent to overall productivity growth equal to an increase of yields by 1.24 percent per annum.

Based on this productivity growth, plant breeding activities towards major arable crops in the EU in the last 15 years (chapter 4.1 and chapter 4.2) resulted in numerous benefits for the economy and environment as well as the society at large. With plant breeding for major arable crops in the EU in the last 15 years yields per ha have considerably increased. On average, yields and consequently production of arable crops in the EU would be more than 16 percent lower without genetic crop improvements.

Higher yields per unit of arable land increase the supply of primary agricultural products on international markets. An additional 47 million tons of grains and 7 million tons of oilseeds can currently be produced in the EU with plant breeding for these crops in the last 15 years. This contributes to stabilising markets, reducing price volatility, and increasing potential world food supply.

Indeed, plant breeding in the EU is also indispensable for combating hunger and malnutrition and improves the world food security situation. Genetic crop improvements in the EU in the last 15 years assure the additional availability of carbohydrates, proteins and vegetable oils to feed between 100 and 200 million humans.

Plant breeding in the EU additionally generates economic prosperity by increasing the GDP. The entire agricultural value chain benefits from input suppliers to final consumers. Genetic crop improvements in EU arable farming since the turn of the millennium have generated in the agricultural sector alone an additional social welfare gain of almost EUR 9 billion and have added more than EUR 14 billion to the EU's GDP.

Breeding for yields in arable farming in the EU also secures employment and increases the income of farmers and agricultural employees. Approximately 7 000 EUR on average, i.e. 30 percent of the annual income of an arable farmer in the EU, have been induced by plant breeding in the last 15 years. Moreover, almost 70 000 jobs have been created in the arable sector as well as upstream and downstream the agricultural value chain in the EU.

However, plant breeding in the EU not only brings about positive economic and social effects, but it also generates substantial environmental effects. It helps save scarce land resources around the globe by generating higher yields per unit of area. This improves the EU agricultural trade balance. Without plant breeding in the last 15 years, the EU would have become a net importer in all major arable crops. Thus, plant breeding minimises the net virtual land imports of the EU, which currently amount to more than 17 million ha. In the absence of plant breeding for major arable crops in the EU in the last 15 years the global agricultural acreage would have to be expanded by more than 19 million ha.

This contributes to preserving natural habitats and to reducing GHG emissions resulting from an expansion of the global acreage. Plant breeding in the EU secures less CO₂ being emitted by helping avoid negative land use change. A total of about 3.4 billion tons of direct CO₂ emissions have been avoided by genetic improvements in major arable crops in the EU in the last 15 years. In addition, plant breeding in the EU generates a large positive biodiversity effect.

Without genetic crop improvements in the EU in the last 15 years, global biodiversity equivalent to 6.6 million ha of Brazilian rainforest or 9.4 million ha of Indonesian rainforest would have been lost. Plant breeding in the EU for major arable crops in the last 15 years has finally contributed to saving scarce water resources around the globe. Without plant breeding 55 million m³ of water would be additionally needed.

Considering other than major arable crops, i.e. some selected fruits and vegetables as well as temporary forage crops on the one hand and other breeding objectives than breeding for yield on the other hand, even more benefits and values of EU plant breeding can be identified. The specific research findings portray genetic crop improvements offering more than a substantial contribution towards the availability of food and other agricultural raw materials per se, namely an entire tool-kit for meeting many, if not most, of the important global challenges agriculture is facing.

Looking ahead, the perspective changes only a bit. Most of the indicators which have been analysed with respect to plant breeding for major arable crops in the EU in the last 15 years show an even higher or rather stable value if applied to plant breeding in the upcoming 15 years, i.e. until 2030. This allows to summarise that

successfully innovated genetic crop improvements in the EU have been and will be essential for economic, social and environmental benefits at large scale and should indeed be considered a highly effective measure for adapting to new and very dynamic settings.

Plant breeders in the EU, however, face a rather challenging policy and regulatory framework. They have to be encouraged to further and even more invest into new seed varieties and sophisticated breeding technologies instead of being hindered to spend the necessary resources. The obviously high societal rates of return plant breeding investments generate have to be broader acknowledged and politically supported through proper administration, sound legislation, higher financial support, or overall awareness raising.

The results of this study should help better inform and facilitate an unbiased public debate on the importance of historic, current and future genetic crop improvements for specific socio-economic and environmental objectives. As such, the study should be considered an initial. Further research has to follow. Analysing the various values and benefits from a more holistic point of view, e.g., would certainly help to identify additional promising measures targeted at desperately needed future productivity growth in EU and global agriculture.



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