A Socio Economic Assessment of yield increasing GM Wheat in Germany

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Introduction/ Objectives

• 20% of the world's calorie and protein demand is met by wheat (Shiferaw et al., 2013). By that wheat is the most important source for carbohydrate in human nutrition and is crucial for food security.

• The GM technology was used to develop novel winter wheat lines named HOSUT. Under field-like conditions in semi-controlled glass houses HOSUT lines showed a yield increase potential of 28% when compared to the non-transgenic control variety Certo.

• German wheat breeders have used GM technology to develop novel winter wheat lines named HOSUT. In field trials HOSUT lines showed a yield increase potential of 28% (Saalbach et al., 2014).

• Ex-ante we analyze the socio-economic potential of an immediate market introduction of HOSUT wheat in Germany and determine Maximum Incremental Social Tolerable Irreversible Costs (MISTICs) (Wesseler, Scatasta, & Nillesen, 2007).

• A scenario with decompensation indicates the social benefit potential.

Material and Method

Incremental benefits and costs of the HOSUT innovation are distinguished with respect to reversible and irreversible private, non-private and social. The different scenarios show the incremental effect of the cultivation of HOSUT lines compared to their conventional counterpart. Additional to the assumption under scenario I, scenario II includes a decompensation zone, within the area dedicated to wheat cultivation, just as large that the absolute crop yield per hectare remains constant.

The MISTICs concept is based on the real option approach (Dixit & Pindyck, 1994) and assumes that future gross margins develop according to a Geometric Brownian Motion

\[ W = \alpha W(t) + \sigma W dt + \delta W dz, \]  

Dixit & Pindyck (1994) formulation of minimum incremental net benefits as

\[ W^* = \frac{\beta}{\beta - 1} (1 - J) \]

, which can be rearranged for MISTICs (I') as

\[ I' = \frac{\beta - 1}{\beta} W + J \]

With

\[ \beta = \frac{1}{2} - \frac{r - \delta}{2} + \sqrt{\left(\frac{r - \delta}{2}\right)^2 + \frac{2r}{\sigma^2}} > 1 \]

\[ \delta = \mu - \alpha \]

\( \beta \) captures flexibility, irreversibility and uncertainty with \( r \) (riskless rate of return), \( \delta \) (convenience yield), \( \mu \) (risk adjusted rate of return) and \( \alpha \) (drift rate of the mean annual rate of return).

Data

• Detailed gross margins times series per ha for German wheat farmers, considering 28% incremental yield/ha and 5% lower price due to lower protein concentration for HOSUT innovation (Saalbach et al., 2014).

• Adoption structure of the HOSUT lines is assumed to be the same as for hybrid rape seeds in Germany.

• Carbon emission (tons per ha) are determined using the ENZ02 Greenhouse Gas Calculator (ifeu, 2014).

• Carbon emission are economical evaluated following Toll (2011).

Results

\[ W = \int_{0}^{t} w(t) e^{-r dt}\]

\[ I = \int_{0}^{t} j(t) e^{-r dt}\]

\[ \text{Hurdle rate (I'/r)} \]

Scenario I: 1.94

Scenario II: 1.08

MISTICs in €

\[ \text{Society} \]

\[ \text{Per person} \]

\[ \text{Per ha wheat} \]

\[ \text{(wheat cultivation in million annual year)} \]

Scenario I: 840 585 436 10.44 654.72

Scenario II: 926 530 829 11.51 749.12

An immediate introduction of HOSUT lines in Germany in 2014 would have been economical if the actual social irreversible costs (I') did not exceed the particular MISTICs value.

Conclusion

• When a new technology is developed for practical agricultural application decision makers have the option to postpone their decision or authorize its market introduction.

→ Only if the benefit of an immediate release outweighs those of keeping the option and postponing the decision, should the option to release be exercised. MISTICs can be used for a monetary evaluation of the situation and to structure the decision finding process.

• The quite low MISTICs for German citizen (between €11.51 and €10.44) in combination with their negative attitude towards GMO (European Commission, 2010) indicates conflicts of interest and a low political chance for an approval of HOSUT lines anytime soon.

• HOSUT wheat might have further global potential to increasing global supply with its positive effect on price stability and food security.


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