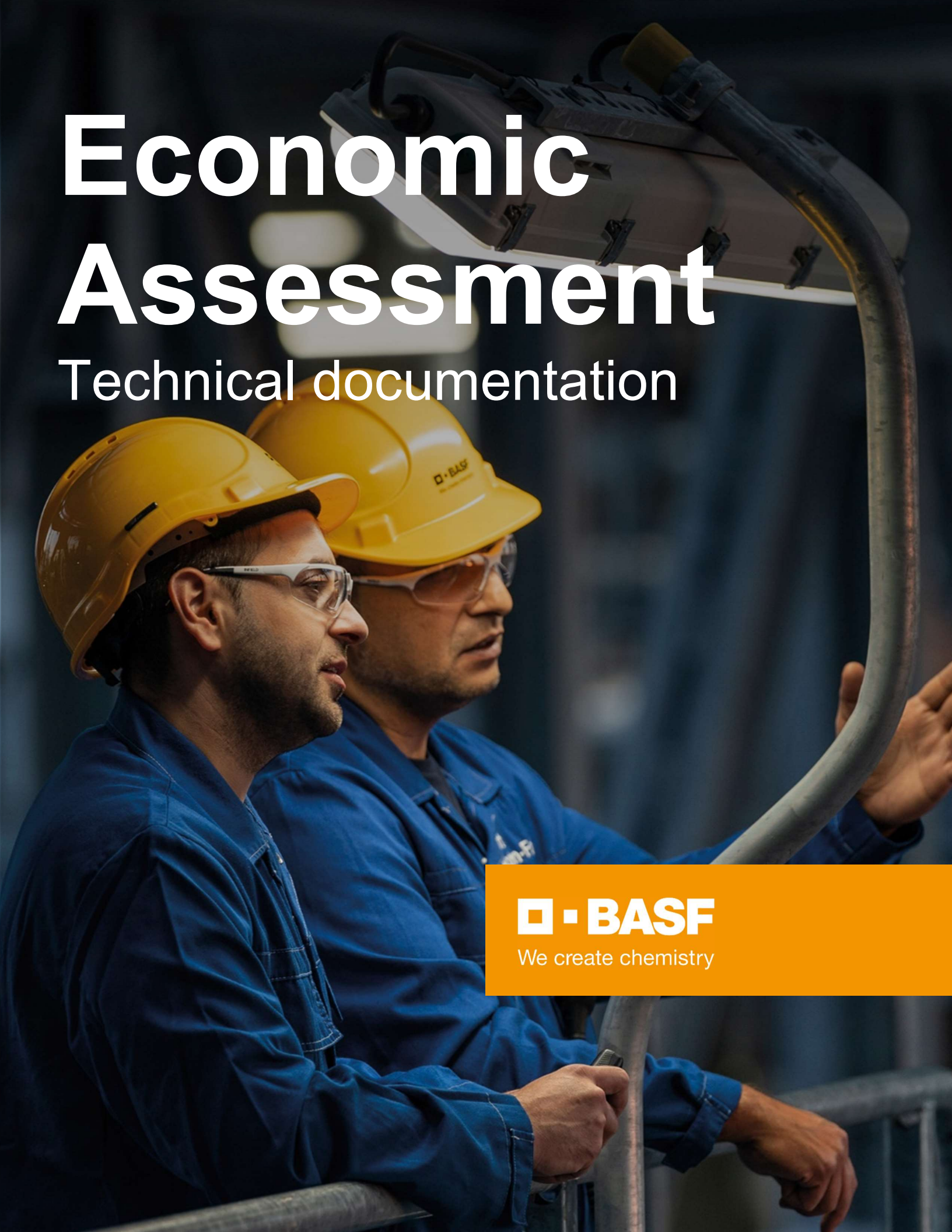
Economic Assessment

Technical documentation



BASF
We create chemistry

Authors

Dr. Kerstin Ulrich (BASF SE)

Patricia Granados (RIFCON GmbH)

Dr. Maria Stenull (RIFCON GmbH)

Dr. Peter Saling (BASF SE)

Dr. Richard van Gelder (BASF SE)

1. Economic input data

The AgBalance® Model considers economic accounts of revenues and expenses. Therefore, the economic analysis is focused on the selling price of the agricultural product and subsidies as an income and the variable and fixed costs of the agricultural system (Schöneboom, Saling, & Gipmans, 2012).

With respect to the economic analysis in AgBalance® Model, two aspects must be considered:

- Default data regarding costs and income are not available in the model, therefore it must be provided.
- Economic data representative for different time frames is not adjusted by the model.

  The economic data must be adjusted to current prices for the sustainability analysis of farming practices of previous seasons, to ensure consistency with the time frame within the scope of the analysis. This means, if the analysis is performed to evaluate the practices that took place in past seasons (more than two years back with respect to the current year) or to evaluate more than two consecutive seasons, it is recommended to correct the value of prices to one period of evaluation, for example the current year. For that purpose, it is recommended to use a gross domestic product (GDP) deflator, as the GDP deflator is a measure of general inflation of the domestic economy, enabling the conversion of data into real terms (GOV.UK, 2014). Compared to the inflation rates, which take into account the changes in price for consumers, the GDP assesses the price changes of all domestic products and the growth of economic activities.

1.1 Variable costs

The variable costs are sensitive to the amount of inputs used and the yields obtained (Kahan, 2013). In the AgBalance® Model, variable costs are divided as follows:

- **Fertilizers costs (FC):** the information must be entered as the total purchase costs of all fertilizers applied to the field during the cropping period and in hectare basis.
- **Crop protection costs (CPC):** similar to the fertilizer costs, the information must be entered as the total purchase costs of all crop protection agents applied to the field during the cropping period and in hectare basis.

- **Seed costs (SC):** these costs are calculated as in Equation 2 by entering the price of the seeds (SP) per kilogram, which is multiplied in the model with the flow of seeding rate (SR).

$$SC = SP \times SR \qquad [€/ha]$$

- **Water costs (WaC):** It comprises the costs of the water supplied for irrigation (IW) and for dilution of pesticides (DW). Both quantities are added and multiplied with the price of water (WP) per cubic meter.

$$WaC = [IW + DW] \times WP \qquad [€/ha]$$

- **Variable personnel costs (VPC):** it is calculated, by using the average hourly wages (HR) of employees with low, medium (m) and high (h) agricultural qualification level, multiplied with the corresponding working hours (WH) required to complete the field operations.

$$VPC = HR_{low} \times WH_{low} + HR_{medium} \times WH_{medium} + HR_{high} \times WH_{high} \qquad [€/ha]$$

- **Energy costs (EC):** it comprises the cost of electricity consumed for the irrigation and field work, which is calculated by multiplying the unit price of electricity ($UP_{electricity}$) in €/MJ, a data input required with the total amount of consumed electricity for irrigation and field work ($Q_{electricity}$).

$$EC = UP_{electricity} \times Q_{electricity} \qquad [€/ha]$$

- **Variable machinery cost (VMC):** it comprises the cost of chemical fuels consumed for the irrigation and field work. In this case, the cost of fuels refers to the purchase of LPG, gasoline, diesel and biodiesel. Also, the costs of lubricants are included in the energy costs. These costs are calculated by multiplying the unit price of fuels (*UP*) with the flows of each energy input (*Q*).

$$VMC = [UP_{LPG} \times Q_{LPG}] + [UP_{gasoline} \times Q_{gasoline}] + [UP_{diesel} \times Q_{diesel}] + [UP_{biodiesel} \times Q_{biodiesel}] + [UP_{lubricants} \times Q_{lubricants}] \qquad [€/ha]$$

- **Other variable costs (OVC):** if necessary, additional variable costs incurred for agricultural production can be included in the assessment, for example, purchase costs of other materials such as nitrification inhibitors. These costs must be allocated to the cropping period and entered in hectare basis.

The total variable costs (TVC) comprise the sum of the above described variable costs:

$$TVC = FC + CPC + SC + WaC + VPC + EC + VMC + OVC \qquad [€/ha]$$

1.2 Fixed costs

Fixed costs remain steady independent from the production levels and the intensification of input (Kahan, 2013). In AgBalance® Model, following fixed costs are covered:

- **Cost of land lease (LC):** it refers to the rent payments for lease of land, allocated per cropping period per year
- **Fixed machinery costs (FMC):** this covers depreciation, repairs or acquisition costs per cropping period.
- **Other fixed costs (OFC)**: for additional considerations such as capital cost, taxes, interest rates or insurance payed per cropping period.
- **Fixed personnel costs (FPC):** It comprises personnel costs such as fixed wages, employer's insurance contributions and others (Department for Environment, Food & Rural Affairs , 2010).

The total fixed costs (TFC) comprise the sum of the above described fixed costs:

$$TFC = LC + FMC + OFC + FPC \qquad [€/ha]$$

1.3 Income

AgBalance® Model considers two sources of income resulting from farming practices:

- **Sales revenue (R)**: it encompasses the income obtained from the sale of harvested agricultural product (AP_1) and by-product (AP_2). It is calculated as the sum product of the yields of the agricultural product and by-product with their corresponding prices per unit (PP_1 *and* PP_2 respectively).

$$R = \sum_{i=1}^{2} AP_i x PP_i \qquad [€/ha]$$

- **Subsidies (Su):** in AgBalance® Model, governmental direct payments to the farmer are accounted in the income (Schrank, 2003), allocated to the cropping period and in hectare basis. Other types of incentives and financial aids, such as tax relief policies or monetary exemptions, are not considered in the income.

In general, the total income (In) is an addition of sales revenue and subsidies:

$$In = R + Su \qquad [€/ha]$$

2. Economic Impact Assessment

Based on the collected economic input data, the following indicators can be evaluated in the AgBalance® Model: profit, gross margin, net value added and total production costs. Depending on the goal and scope of the study, only one of these indicators is chosen for the aggregation of the results to avoid double-counting of data. Usually, profit is selected as the economic indicator in most of the cases, as it gives a comprehensive indication of the economic performance of the farm for the analyzed crop.

The economic assessment must be consistently applied to each alternative. Additional indicators such as e.g. productivity are not included in the AgBalance® Model, but they can be incorporated as a novel indicator depending on the case of sustainability analysis, provided that input data is available.

Depending on the goal and scope of the sustainability analysis, a normalization of the economic results may be performed. While the economic assessment can be performed in the local currency of the region of scope, for the normalization step, the economic results must be converted to euro (€), which is the default currency in AgBalance®. For that purpose, the official exchange rates available at the internal Finance Portal of the BASF are used.

2.1 Profit

"Farming for profit requires that farmers grow crops or raise livestock that can be sold on the market" (Kahan, 2013). Farming for profit maximization as a goal for farm management is in line with the economic pillar of the sustainability. Therefore, profit is one of the most frequently chosen indicators evaluating the economic performance of the cultivation system for the sustainability analysis within AgBalance® Model.

The profit (P) consists of the total income (In) less the variable costs (TVC) and total fixed costs (TFC).

$$P = In - TVC - TFC$$

With profit, the farm remunerates the capital of the farm and family labor. In the United Kingdom, this indicator is often referred to as farm business income (Department for Environment, Food & Rural Affairs , 2010).

2.2 Gross margin

Another possibility for the evaluation of economic performance of a farm enterprise is the gross margin indicator, which is calculated by considering only the variable costs and setting to zero all fixed costs (European Comissions - EU FADN, 2011). This indicator is useful to compare technical performances between scenarios (Redham, 2017).

The gross margin (GM) consists of the total income (In) less the variable costs (TVC).

$$GM = In - TVC$$

2.3 Net value added

The farm net value added (FNVA) consists of the total income (In) less the variable costs (TVC) and fixed machinery costs (FMC). It indicates the economic performance from which fixed wages (FPC), rents (LC) and interest (OFC) still need to be paid (European Commission - EU FADN, 2018)

$$FNVA = In - TVC - FMC$$

2.4 Net value added

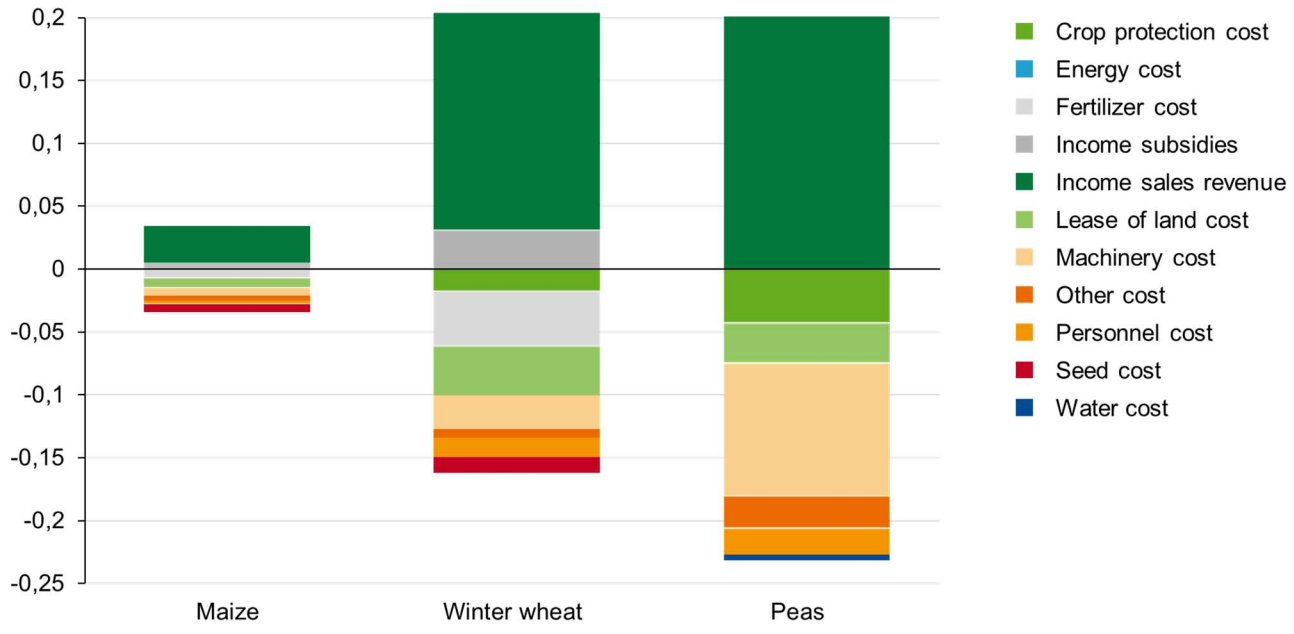
The total cost of production consists of the sum of variable and fixed costs incurred in the production of crops to field gate (Kahan, 2013). In AgBalance® Model, the variable and fixed costs are further categorized according to the inputs required for farming practices, as shown in the table below.

Categories of total cost of production in the AgBalance® Model

Cost category	Calculation	Type of cost (variable or fixed)
Energy cost	EC	Variable cost
Fertilizer cost	FC	Variable cost
Cost of lease of land	LC	Fixed cost
Machinery cost (MC)	$TMC = VMC + FMC$	Variable and fixed costs
Other cost (OC)	$OC = OVC + OFC$	Variable and fixed costs
Personnel cost (OC)	$PC = VPC + FPC$	Variable and fixed costs
Crop protection cost	CPC	Variable cost
Seed cost	SC	Variable cost
Water cost	WaC	Variable cost

The graphic representation of the total cost of production is shown in the figure below. It displays a breakdown of costs of the table above as negative cash flows and income as positive cash flows, enabling an overview of the economic contribution of inputs and outputs of farming practices.

Income and costs (€/kg product)



Graphic representation of total costs of production in the AgBalance® Model

3. Bibliography

Department for Environment, Food & Rural Affairs . (2010, January 2). *Farm business survey - technical notes and guidance .* Retrieved from GOV.UK: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/557605/fbs-definintions-4oct16.pdf

European Comissions - EU FADN. (2011). *Farm Economics brief.* Brussels: European Comission.

GOV.UK. (2014, May 20). *HM Treasury Guidance GDP Deflators: User guide.* Retrieved from GOV.UK: https://www.gov.uk/government/publications/gross-domestic-product-gdp-deflators-user-guide/gdp-deflators-user-guide

Kahan, D. (2013). *Farm management extension guide. Chapter 2: Economics for farm management extention.* Rome: FAO. Retrieved from http://www.fao.org/uploads/media/2-EconomicsInternLores.pdf

Redham, G. (2017). *The John Nix Pocketbook for Farm Management 2018* (48th ed.). Melton Mowbray: Agro Business Consultants.

Schöneboom, J., Saling, P., & Gipmans, M. (2012). *AgBalance™ Technical Background Paper.* Ludwigshafen: AgBalance™ Team at BASF SE.