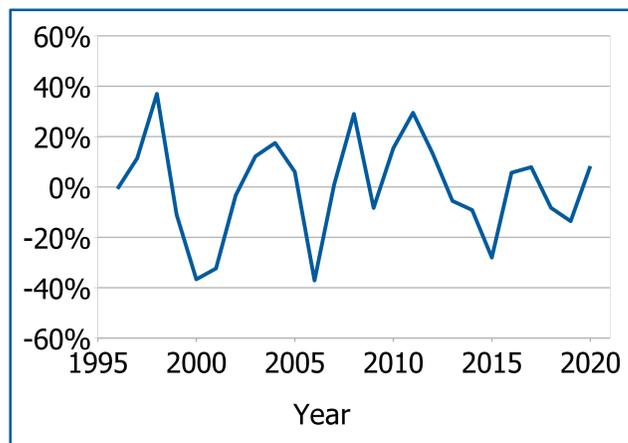


# Real-Options Management of Oil Palm Plantations under Price Shocks

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## Price shocks



### Deviation of CPO price from a 5-year period average

For the purposes of modeling, we exploit the linkage between oil palm fresh fruit bunches (FFB) and crude palm oil (CPO) prices. The scale of price shocks is assumed to be comparable with the annual price fluctuations seen on the market in the past (<http://indexmundi.com>).

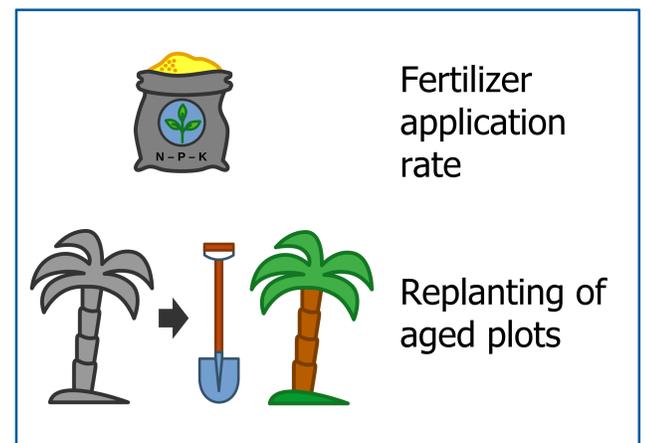
## Costs & revenues

Parameter, units	Value
FFB price, \$/tFFB	118.00
Fertilizer price, \$/kg	4.00
Yield min, tFFB/ha	11.00
Yield max, tFFB/ha	17.00
Fertilizer 100%, kg/ha	85.00
Harvesting/transport cost, \$/tFFB	16.00
Replanting cost, \$/ha	3500.00
Fixed cost, \$/ha	792.00

### Cost-revenue structure of a "medium efficiency" plantation

The parameters stem from the business as usual (BAU) scenario (<http://orbitas.finance>). Under a 20% FFB price drop, a medium efficiency plantation fully applying fertilizer would have triple the profit of what would be achievable under the "no fertilizer" management i.e. minimum yield.

## Management options



### Mutually impacting management decisions

Decisions made over time have an impact on the availability of future options: if a plot was not re-planted, there will be no yield on that land regardless of the amount of fertilizer applied later. A reduction of the fertilizer application rate can have an adverse impact on future yields.

## Net present value & other key indicators

Impacts of a 3-year FFB price drop by 40% from the baseline with a consecutive full recovery in the following year and a compensation by 40% higher price in the following three years.

	No FFB price shock	No loan	With loan, 10% IR
Net present value, USD	119,715	98,639	115,502
Replanted plots over 28 years	19	7	10
Fertilizer use change	0%	-18%	-11%

The planning period is 28 years. A virtual plantation consists of 28 one-hectare homogeneous plots growing oil palms of different age (assuming 3 years from planting to maturity and 25 years of FFB production until the end of the palm's economic life). The indicated average reduction, in percents, in fertilizer application rate is calculated over the three low price years. Management is maximizing the net present value.

## Key notes

Depending on the access to finance and the scale of the price shock, a company may decide to reduce fertilizer application rates and also suspend re-planting activities even if such suspension implies a shrinkage of the total company's cultivated area.

If the access to finance is limited, the implications of the fertilizer reduction and no-replanting enforced by a low price period may tangibly deteriorate the company's value and potentially lead to bankruptcy.

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