

Different types of capital goods in agriculture and the estimation of capital costs

Regional Training Course on Agricultural Cost of Production Statistics
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1 - Capital assets: definitions (1/2)

- Capital goods = capital assets = capital inputs
- **Def: input not entirely used up during one production period:** it generates services for a period that goes beyond the cropping or annual production cycle
- Typical capital goods :
 - **Farm buildings and infrastructures** where production takes place
 - **Machinery and equipment** used in the production process
 - **Animals** used in farm operations (tilling, harvesting, etc.)
 - **Animals breed and used to obtain livestock products** (milk, wool, meat, skin, etc.)
 - **Permanent crops** such as orchards, coffee, cacao, olives, etc.)
 - **Tree plantations**

1 - Capital assets: definitions (2/2)

- **Residual capital:** inputs other than traditional capital assets that can yield benefits beyond the current production period
- Examples: some types of **fertilizers**
- The **carry-over effect** may be amplified by specific cropping practices, such as crop rotations
- **it is not recommended to treat these inputs as capital assets**, because:
 - It is difficult to separate those inputs that have a carry-over from those that do not
 - The identification of the nature and extent of these carry-over effects is too complex: they depend on cropping practices, type of fertilizer used, etc.

2 - Capital costs: definitions

- **All costs associated with the ownership of capital:**
 - **Economic depreciation** (or consumption of fixed capital) : it represents the reduction in the useful service life of capital (due to obsolescence and age)
 - **Opportunity cost of capital:** the return on capital had it been invested in the next best alternative
 - **Other costs** associated with capital ownership or use, such as property taxes, insurance expenses, licenses, fees, etc. These should not be subject to depreciation and grouped into a different item
- Capital depreciation has to be **allocated over the service life of the capital asset**
- **Costs associated with rented capital** are generally grouped in a specific cost item (ex: rental services)

3 – Measuring depreciation costs: first best approach

- Depreciation of owned capital goods \approx **change in the market price of the capital:**

$$\text{Depreciation costs (t)} = P(t) - P(t-1)$$

Where $P(t)$ is the current market price of the asset

- If current market prices are available only for a similar asset (pivot asset) but not the asset itself:

$$\text{Depreciation costs (t)} = \Delta P(t) \cdot P(0)$$

Where $\Delta P(t)$ is the percentage change in the market value of the pivot asset and $P(0)$ the purchase price of the asset

While simple and desirable as a concept, using the change in market prices is often difficult because markets with enough transactions to establish representative prices for those goods are rare.

4 – Measuring depreciation costs: alternative approaches (1/4)

In the absence of reliable market prices for capital assets, assumptions on the asset's service life and the depreciation rate have to be made:

- **Linear depreciation schedule** (or "straight-line depreciation"):

$$\text{Depreciation costs (t)} = [P(0) - P(T)] / T$$

Where T is the useful service life of the asset and $P(T)$ its price at the end of its service life (salvage value)

- Advantages : easy to implement, easily understandable by analysts
- Drawbacks: the asset is depreciated at each period of a fixed amount, which is unrealistic => under-estimation of depreciation at the beginning of the period, over-estimation at the end

4 – Measuring depreciation costs: alternative approaches (2/4)

- **Non-Linear depreciation schedule**

$$\Rightarrow \text{Depreciation costs (t)} = P(0) \cdot f(t)$$

Where $f(\cdot)$ is a non-linear function of time and $\sum f(t)=1$ to ensure full depreciation

- Advantages : more realistic depreciation schedule, reduced data requirements (only the purchase price of the asset is required)
- Drawbacks: how to determine the depreciation schedule / choose $f(\cdot)$?

4 – Measuring depreciation costs: alternative approaches (3/4)

- **Declining balance approach:** a fixed rate is applied to the current value of the depreciated asset

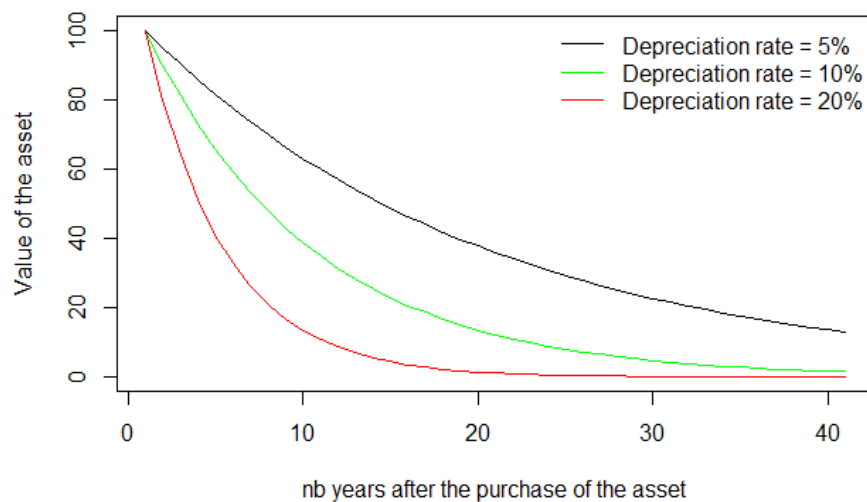
$$\text{Depreciation costs (t)} = \alpha \cdot P(t)$$

Where $P(t) = P(t-1) \cdot (1 - \alpha) = \dots = P(0) \cdot (1 - \alpha)^{**T}$

- Advantages : more realistic depreciation schedule, reduced data requirements (only the purchase price of the asset is required).
- Drawbacks: the asset never depreciates to zero; method best limited to those capital assets with a long service life

4 – Measuring depreciation costs: alternative approaches (4/4)

Declining balance approach: example



5 – Measuring depreciation costs: measurement issues

- **Fully depreciated assets that keep being used**

- Systematic \neq between the effective and theoretical service life of an asset should lead to a revision of the parameters
- The effective service life is often prolonged, mostly in developing countries, through repair work -> if these are substantial, they should be accounted for as an investment and a new asset created (e.g. engine change)

- **Lack of reliability / availability of market values**

- **Farm and household use of capital have to be distinguished:**

- Small/medium farms which use assets such as vehicles or buildings for their farming activity as well as for private purposes
- Only the share relative to farm use has to be accounted for as depreciation costs for the farm

6 – The opportunity cost of capital: definitions

- **Opportunity Cost of Capital (OCC) = expected return on the capital invested in the farm operation if it had been invested in the next best alternative**
- **OCC provides a measure of the profitability of farm investments relative to other sectors:** it is relevant for analytical and policy purposes, less so for the farmers themselves
- **The purchase of capital assets is an investment.** Improvement works that lead to an increase in the service capacity and/or service life of the asset, such as land terracing, wells, engine change, etc. are also an investment
- **Interest payments associated with the purchase of capital assets should be accounted for as a financial cost** for the farm in a separate cost category

6 – The opportunity cost of capital: measurement

- **First Best Approach:**

$$\text{OCC}(t) = \text{Market value of the assets}(t) \cdot (1+r)$$

Where r is the rate of return on capital in the next best alternative

- In theory, r should depend on the investment possibilities in the region, the size of the investment, etc.
 - In practice, r is difficult to determine: it varies across region/localities, time and... preferences ! Its determination is highly subjective and therefore prone to criticisms
- **Alternative Approach:** if region/area specific rate of return are absent, long-term government bond rates are generally used

7 – Rented capital (1/2) : main issues

- **Widespread practice in developing countries** because of the difficulty to finance the purchase of capital assets
- **Rental price often includes services associated with the capital asset** (machine operator, fuel, inputs, etc.): this leads to allocation questions
- **The renting of capital services may not necessarily involve a monetary transaction:**
 - Exchange of other services -> value at the opportunity cost
 - Share of the harvest/production -> value at the producer price for the commodity

7 – Rented capital (2/2): accounting options

- **Grouping rental costs under a specific item**, such as “rented services” or “custom services”:
 - Simplest option, but leads to underestimation of capital costs for farmers who rent
 - Comparability is affected when comparing cost items between those who rent vs. those who do not
 - But the comparison of total costs informs on the relative profitability of each option (renting vs. owning), all things equal
- **Allocate rental costs to each cost item:**
 - Ensures comparability
 - Complexity: how to separate labor, inputs, etc. from the cost of the asset?
 - Double counting: implicit capital costs included in the rental price => a given asset can be depreciated twice (in then rental company’s accounts as well as in the farmer’s accounts) => over-estimation of capital costs at the aggregate level

8 – References

AAEA Task Force on Commodity Costs and Returns (2000). *Commodity Costs and Returns Estimation Handbook*. United States Department of Agriculture: Ames, Iowa, USA.

Global Strategy to Improve Agricultural and Rural Statistics (2016), Handbook on Agricultural Cost of Production Statistics, Handbook and Guidelines, pp.60-66. FAO: Rome.