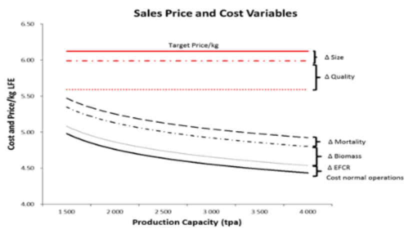
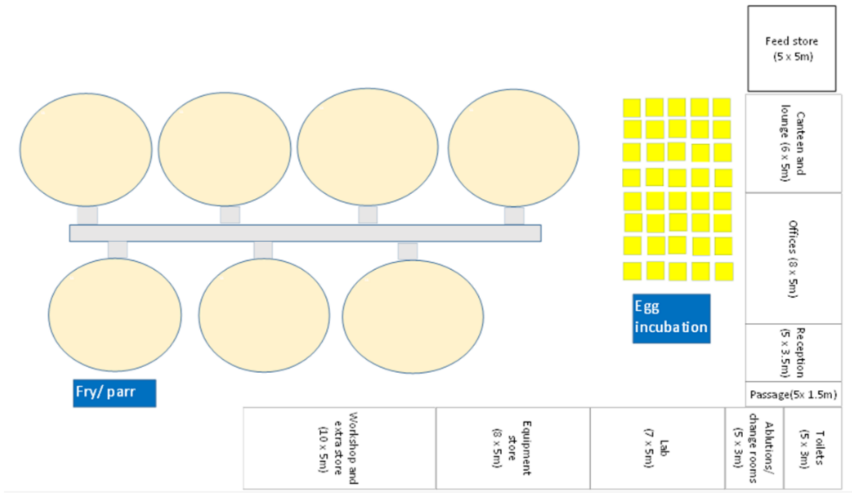
ECONOMIC MODEL USER GUIDE

User Guide to the Economic Models for Marine Finfish and Shellfish Aquaculture in South Africa

September 2016





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Title:	**User Guide to the Economic Models for Marine Finfish (dusky kob and Atlantic salmon) and Shellfish (mussels and oysters) Aquaculture in South Africa**
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1. PROJECT BACKGROUND

Advance Africa Management Services (hereafter, Advance Africa) was commissioned to develop an economic model to estimate the financial viability of the following species for aquaculture production in South Africa:

1. Marine finfish
    a. Dusky kob
    b. Atlantic salmon
2. Bivalve shellfish
    a. Mediterranean mussel
    b. Pacific oyster

Ultimately, the decision whether to proceed with a given project should be based on a thorough feasibility study that takes into account location, site characteristics, environmental parameters, available technologies, financial and human resources, environmental impacts, market opportunities and risk factors. It is envisaged that the Department of Agriculture, Forestry and Fisheries (DAFF) will use the results of this study in an advisory manner in order to focus efforts and funds for aquaculture of the candidate species. Furthermore, the results of the study, in terms of return on investment, cost of start-up, time to break even, will assist the government in determining the time period of leases and permits in order to support and secure investment. Lastly, the results can be used by government and financing institutions as a tool to captivate interest in the aquaculture sector and unlock financing schemes for the development thereof, based on sound economic principles.

A financial model has been developed for each candidate species. These models, and their assumptions, can be adjusted by the prospective investor depending on the required production volume and scale.

2. INTRODUCTION

This user guide aims to support the DAFF in providing a model user, prospective operator and/or financing institutes with a summary and explanation to the workings of the financial models and projected financial outcomes.

The financial models have been built in Microsoft Excel, to ensure that is easily accessible for commissioners.

The financial models were constructed on the back of four determinants (Figure 1). These were: market intelligence; the scientific understanding of growth, mortality, FCRs, optimal stocking densities for the candidate species and the interdependence between them; the required infrastructure for the production system and the associated cost and finally the incorporation of operational costs. This framework is illustrated in the figure below.

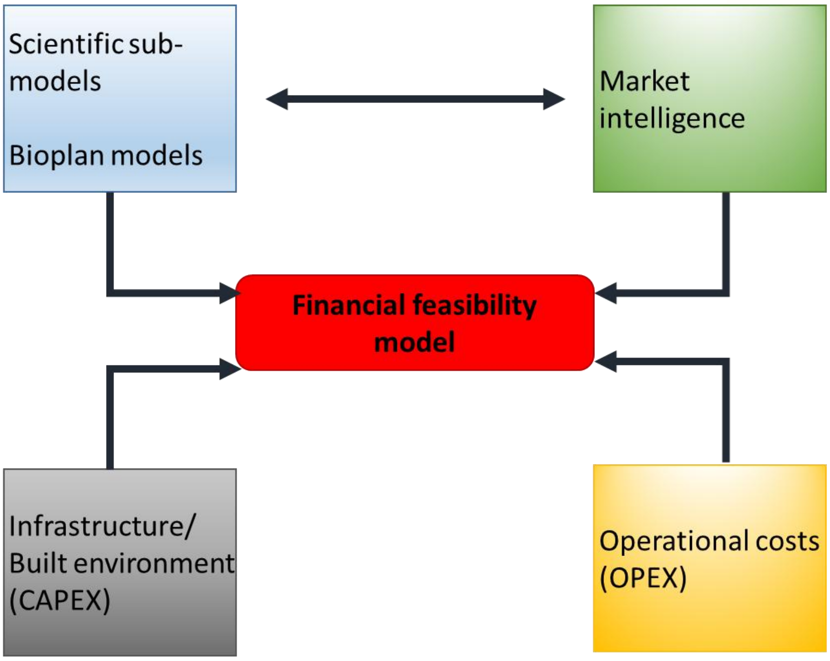

FIGURE 1: FINANCIAL MODEL DETERMINANTS.

2.1.1. Scientific sub-models

The scientific "engine room" sub-models are based on the biological performance of the candidate species under culture conditions. This information is used to derive the "bioplan model" which provides the basis for the development of the financial models.

Key data requirements for the formulation of the bioplan are:

- Growth at length/weight
- Mortality at length/weight
- Feed conversion ratio (FCR) at length/weight

Ideally, growth, mortality, and FCR data at different temperatures will allow the bioplan to more accurately track the biomass of a cohort batch over time under different environmental conditions.

Data limitations

The feasibility studies were based on the viability of farming the candidate species in South Africa and not for any specific geographic location within South Africa. Environmental conditions, and specifically water temperature, will have a significant impact on the growth, mortality, and FCR of a batch of bivalves. Water temperature varies widely in South Africa, with lower temperatures associated with the Benguela current on the west coast and higher temperatures associated with the Agulhas current experienced on the east coast. With a wide range in water temperature, it was considered unrealistic to develop bioplans that covered such a large geographic area. Therefore, it was decided to use biological performance data that were available from regions where the species had been or are currently being farmed.

Growth, mortality, FCR, and stocking density data (where possible) was obtained from industry. Growth at different sizes for both oysters and mussels was modelled based on data that were available from a specific production system.

2.1.2. Infrastructure/built environment (CAPEX)

The bioplan was used to specify and cost infrastructure and equipment requirements for the species and production system based on the biomass in the system during the production cycle. Cost estimates of the technical infrastructure required for each species were based on an intense costing exercise undertaken by Advance Africa.

The major CAPEX categories for the models are as follows:

1. Pre-development – includes typical costs associated with feasibility studies, concept designs, and fund-raising activities.
2. Land –indicative costs associated with the land requirements for different production systems i.e. cage operations will require less land than land-based RAS systems and therefore cost of land is assumed to be lower.
3. Infrastructure – costs of bulk infrastructure including electricity, roads and potable water.
4. Services – costs of pumping equipment and infrastructure, the provision of oxygen and air, and wastewater treatment and drainage from the facility.
5. Buildings – costs of the built environment including hatcheries, grow-out systems, processing facilities, laboratories, canteens, offices and ablutions.
6. Aquaculture systems - Land-based – costs of aquaculture equipment including tanks, filtrations systems, lighting and life-support services.
7. Aquaculture systems- - water-based – costs associated with water-based infrastructure.
8. Vehicles – costs of tractors, boats and cars.
9. Transport and logistics – costs associated with the delivery of equipment and other during the construction phase.
10. Professional fees – design fees for engineers, architects, technicians and project management fees.
11. Contingency – costs at 5% of total project value.

Data Limitations

In the absence of a specific geographic location, costs of land, bulk infrastructure, buildings, and services are difficult to quantify. For example, bulk infrastructure costs may vary widely depending on whether the operation is in an IDZ or remote, rural area. The cost estimates used in the models are therefore indicative.

2.1.3. Market intelligence

Market factors are of crucial importance in determining the viability of an operation. Market factors which were considered for the financial models included:

1. Existing markets
2. Size of markets
3. Domestic and export markets
4. Market maturity and
5. Product forms
6. Sales price

Based on these factors, realistic assumptions regarding the markets that could be accessed and sales prices that could be achieved were made.

2.1.4. Operational costs

Operational costs included:

- Seed costs (oysters)
- Human resources
- Processing
- Packaging

Operational costs were obtained from various sources (e.g. ESKOM website, industry sources). Rental costs are an unknown at this stage and depend on the kind of future business relationship between the company and community. Cost of seed was obtained from potential suppliers. The cost of consumables, administration cost and general repairs and maintenance were obtained from our own database.

In summary, it is important to note that this guide is for a high-level model. If a project is to go to the business planning phase, then the model will need to be further refined to an accuracy level of 90%. However, diligence has been applied in providing detail to the model in order to increase its accuracy for viability modelling the future.

3. STRUCTURE OF THE ECONOMIC MODELS

"Assumptions" tab

The "Assumptions" tab provides a summary of the following assumptions:

1. Macro-economic assumptions
2. Biological assumptions
3. Market assumptions
4. Other

The current assumptions are based on the best available information that was largely sourced through industry (where possible). The model user can input values for the different assumptions in order to determine the financial outcome of different scenarios. This will be reflected throughout the model.

Macro-economic assumptions including currencies and inflation rates are typically inputted in each tab in rows 3-6 such that costs are inclusive of inflation throughout the ten-year period.

"Valuation" tab

The "Valuation" tab provides a concise breakdown of the costs per kilo of production once the operation has reached terminal harvest volume i.e. the maximum potential production volume for the facility. The calculations are derived, principally, from a combination of **"Sales Costs", "Variable costs"**, **"Overhead costs"**, and **"Fixed costs"**. Each cost is then broken down into cost estimates per kilo for each major production stage e.g. hatchery, nursery, live feed production, growout production, processing. The Valuation provides the model user with a summary of the major costs associated with production. In addition, the valuation also indicates the suggested target sales price at 25% and 33% margins.

"Sensitivities" tab

Based on calculations derived in the "Valuations" tab, the "Sensitivities" tab is a sensitivity analysis which provides a summary "snapshot" of the viability of an operation at different scales based on:

Sales price/kg

Total costs/kg

The analysis is comprised of the following components:

Capital expenditure:

For a given operation at varying scales, a certain proportion of capital expenditure will be fixed and a given proportion will be variable. The model has provided an estimate for this based on the different production systems. The user can adjust this figure in order to determine the impact that this has specifically on the "Financing costs" associated with production at different scales.

Income:

Income is based on the sales price for the product. In the models, we have included a "**Sales price (local)**" and a "**Sales price (export)**". This provides the model user with an indication of how the operation would fare if product were to be exported.

The model user can adjust the sales price estimates.

Variable costs:

Variable costs are those calculated in the "Valuation tab" and highlighted in yellow. They are broken down into the major variable costs associated with production. The model user can adjust these inputs in order to determine their impact on costs at different scales. These costs typically decrease at higher production volumes due to economies of scale.

Total costs:

This sums the costs per kilo (or per oyster in Pacific oyster model) based on the variable costs above.

Sensitivities:

The sensitivities establish an "upper range" and "lower range" for:

- Sales price
- Juvenile/fingerling/smolt costs
- Laboratory costs
- Feed costs
- Processing costs
- Sales costs
- Overhead costs
- Fixed costs
- Financing of capital costs

The models are currently set to upper and lower limits based on a number of factors which may influence price and costs. The model user can input their own upper and lower range estimates to determine the impact on total cost for the operation at different production scales.

"Fin Statements" tab

This tab provides:

Income statement

This tracks Revenue, Earnings before Interest, Taxes, Depreciation, and Amortization (EBITDA), EBIT, Profit before income tax, and Profit for the year over a ten-year period.

Cashflow statement

This tracks Cashflows from operating activities, Net cash generated from operations, Cashflows from investing actitivities, Net cash from investing activtities, Cashflows from financing activities, Net cash from financing activities, Net increase in cash and cash equivalents, and Cash and Cash equivalents at the end of the financial year over a ten-year period.

Analysis

A summary table with the following financial indicators:

- Discount rate (%)
- Internal rate of return (IRR) (%)
- Max working capital required (R '000)
- Net present value (NPV) at ten years (R '000)

"Monthly FS" (Financial statements) tab

This provides a monthly breakdown of the operations financial statements.

"1. Revenue" tab

The revenue tab calculates the sales, sales revenue, and other income received based on the production per month and the sales price during that month.

"2. Sales costs" tab

A summary of monthly sales costs based on monthly production and sales costs and sales logistics assumptions, and monthly revenue and commission assumptions.

"3. Variable costs" tab

This provides a summary of the following over a ten year period (this will vary for different species and production systems):

- Processing costs
- Hatchery costs
- Nursery costs
- Growout costs
- Live feed production costs
- Laboratory and environmental costs

Figures for some of the costs are formula-driven based on HR, electricity, fuel calculations later in the model. Other figures are based on assumptions. These assumptions are inputted in "Column C" of the variable costs tab and can be adjusted by the user.

"4. OH Expenses" tab – Overhead expenses

Provides a breakdown of typical overhead expenses. Assumptions for each expense are inputted in "Column C" and can be adjusted by the user.

"5. Depreciation" tab

Calculates depreciation based on "Useful Life" and "Year of purchase" assumptions. The "Asset register" contains assets with a dropdown menu for "Category" which will input the useful life associated with the asset category. The "Value (ZAR)" column contains values for the assets which are linked to the "**9. CAPEX**" tab.

"6. Finance income" tab

Provides a summary of finance income over the ten-year period. For these models, this has been left blank but values may be inputted by the user.

"7. Finance costs" tab

Provides a summary of finance costs over the ten-year period. For these models, this has been left blank but values may be inputted by the user.

"8. Income tax" tab

Calculates income tax based on the tax assumptions in the **"Assumptions"** tab.

"9. CAPEX" tab

This provides a summary of capital expenditure over the ten-year period. Values for each item are inputted from the "**Capex Summary Sheet**" tab. The payment period for each item may be adjusted by the user ensuring that this balances with the total amount in "Column C".

"WACC" tab – Weighted average cost of capital

Calculates the discount rate for the net present value calculation which is provided in the "**Fin Statements**" tab. The user may input their own figures here in order to calculate their scenario-specific discount rate.

"Elec" tab

Provides a breakdown of the electrical components of the operation with estimated kilowatt capacities, usage and usage per month. The electricity tariff can be adjusted by the yser depending on their location-specific rates. This will reflect in the electricity costs which are included in the **"3. Variable costs"** tab.

"HR" tab – Human Resources

The HR requirements for the operation including directors, processing, grow-out, hatchery, nursery, live feed, laboratories and environmental, and sales and administration. "Column C" provides an industry-standard pay grade and "Column D" indicates the quantity of people required. These can be adjusted by the user and will reflect in the salaries and wages costs which are included in the "**3. Variable costs**" tab and "**4. OH Expenses**" tab.

"R&M" tab – Repairs and Maintenance and Fuel costs

Costs of fuel and repairs and maintenance based on the vehicles specified in the "Vehicles" tab. The user can adjust the "Distance travelled" and "Work hours" values depending on the scenario.

"Input data" tab

Growth, mortality, and FCR data of the animal based on weight categories at different "growth phases" and, where possible temperature profiles. This information is linked to the "Batch" tabs which determine the biomass of the cohort over the growth period.

"Stocking quantity" refers to the amount of animals which are stocked per batch.

"Fish weight at stocking" inputs the weight of the animal at the beginning of the production cycle.

"Harvest cap" provides a limit on the quantity of animals which are harvested per month.

"Target weight" inputs the average weight of the animal when harvesting begins

Other variables which can be adjusted include:

“Early maturation” – proportion of precocious parr and grilse per batch of Atlantic salmon.

“Batch” tabs

The batch tabs provide a detailed summary of growth, mortality, FCR, and harvest of a cohort over the period of the production cycle. Values from the “**Input data**” tab are linked to these tabs.

“Summary bioplan” tab

The summary bioplan tab collates the information from the “**Batch**” tabs and provides a summary of the total biomass, feed requirements, mortalities, and production system requirements (tanks, ponds) over time.

“Production plan” tab

The production plan tab is a Gantt chart summarising the production plan for the operation based on different life stages.

“Capex Summary Sheet”

A summary of the capital expenditure for the project. Values for each item are derived from individual tabs that follow in the model. The values are linked to the “**9. CAPEX”** tab. Tabs which link to the CAPEX summary sheet are as follows:

1. Pre-development
2. Land
3. Infrastructure
4. Buildings
5. Services
6. Aquaculture systems - Land-based
7. Aquaculture systems – Sea/water based
8. Vehicles
9. Transport and Logistics
10. Professional Fees
11. Contingency