

Feasibility Study of a Project to Produce an Insecticide Formulation Based on the Essential Oil of *Rosmarinus officinalis*

Ayoub Ainane¹, Fatouma Mohamed Abdoul-Latif²,
Talal Mohamed Abdoul-Latif² and Tarik Ainane^{1*}

¹Superior School of Technology (EST-Khenifra), University of Sultan Moulay Slimane, Morocco.

²Medicinal Research Institute, Center for Research and Study of Djibouti, Djibouti

*Corresponding Author: t.ainane@usms.ma

Received: September 25, 2020; Revised: October 15, 2020; Accepted: October 28, 2020

Abstract

Local products now play a role in local and sustainable development. These products protect the environment, ensure stable jobs and improve the social level of local society. Likewise, they are the center of the concerns and expectations of consumers, especially those seeking authenticity, originality and food safety. In this perspective, Morocco attaches importance to these local products. The promotion of local products responds to the second pillar of the green plan in order to create jobs, generate added value for small farmers and allow these farmers better access to markets (local, national and international). The development of local products, in particular products based on aromatic and medicinal plants, is considered to be a privileged objective in the Moroccan agricultural strategy. It constitutes a promising alternative for local, viable and sustainable development, and more particularly in marginal and difficult areas. In this context, the present work consists of a processing of the economic data of the implementation of a product in the form of a formulation based on essential oil of *Rosmarinus officinalis* by the feasibility study of a production project according to the market, the technical aspect and the financial evaluation of profitability.

Keywords: Essential oil; Feasibility study; Insecticidal formulation

1. Introduction

The agricultural production sector is a booming market worldwide, aimed at improving food security and protecting public health (Ainane *et al.*, 2020). Among the areas most affected in this sector, we find cereals, which have always been the main food resource for humans and domestic animals. In this regard, the cost of cereal products, their quality and above all food safety have been the main areas of interest for manufacturers (Pinstrup-Andersen, 2002; Popp *et al.*, 2013; Godfray and Garnett, 2014).

Among the recognized problems, seeds are subjected, during the storage period, to attacks of biotic origin (insects, micro-organisms) which lead to significant losses as well as a consequent drop in agronomic and organoleptic qualities.

The use of synthetic insecticides is one of the effective methods of combating these attacks (El-Ramady *et al.*, 2015). Unfortunately, this method has drawbacks which limit its use. These include the presence in foodstuffs of residues, the development of strains of insects resistant to these insecticides, environmental pollution, numerous cases of intoxication and poisoning reported in some countries, as well as relatively high prices and the scarcity of good quality products on international and local markets (Negash, 2018). As an alternative method of struggle, aromatic and medicinal plants are among the most effective biopesticides of botanical origin which often constitute the bioactive fraction of plant extracts and which give a positive effect to

protect crops (Naboulsi et al., 2018; Trivedi et al., 2018).

On the other hand, local products now play a role in local and sustainable development. These products protect the environment, ensure stable jobs and improve the social level of local society. Likewise, they are the center of the concerns and expectations of consumers, especially those seeking authenticity, originality and food safety. In this perspective, Morocco attaches importance to these local products (promotion and development). As such, the promotion of local products responds to the second pillar of the Green Morocco Plan in order to create jobs, generate added value for small farmers and allow these farmers better access to markets (local, national and international).

The objective of this study is to address the feasibility of a project to produce the insecticide formulation based on the essential oil of *Rosmarinus officinalis*, through a technical and economic presentation.

2. Materials and Methods

2.1 Preparation of the formulation

The product in the form of an essential oil-based formula, was prepared mixing a well-defined quantity of the essential oil of *Rosmarinus officinalis*, with another quantity of powder from an argillaceous rock from the region of Beni Mellal - Khenifra (Morocco). The tablets (Figure 1) were obtained using an electromechanical tablet press device.

It is noted that the essential oil of *Rosmarinus officinalis* has an interesting activity against pests of stored food (Ainane et al., 2019).

2.2 Market study

Market research is based on documentary work rather than field work (surveys, observations, etc.). In our case, this part was limited only to a desk study and inquiries into local markets.

2.3 Technical study

The technical study is a delicate step in setting up an investment project (Reichardt et al., 2016; Hughes et al., 2017). This phase consists in particular of:

- Identify the needs required for the implementation of the project;
- Quantify in physical terms all the necessary needs;
- Quantify all costs in monetary terms.

2.4 Financial evaluation of the profitability of the project

Before launching the said project and before putting the project idea into action, the project must be profitable and capable of generating cash flow for the investor. In this regard, it is essential to verify the economic viability of the project in terms of its profitability and its capacity to create wealth, using criteria for evaluating the financial profitability of the project. The criteria for choosing the investments mobilized in this project are based on the notion of discounting in the certain future.

In order to assess the financial profitability of the project, it is essential to calculate the cash flows which constitute the basis for the calculation of all the criteria



Figure 1. Tablets of the insecticidal formulation based on essential oil of *Rosmarinus officinalis*

of financial profitability (Zeinoddini-Meymand and Vahidi, 2016; Zsiborács et al., 2018). In fact, cash flows correspond to the difference between receipts (income) and disbursements (expenses) related to the project:

$$\text{Cash-flow} = \text{Revenue attributable to the project} - \text{Expenses attributable to the project}$$

Evaluating an investment project consists of comparing the invested capital with all of the cash flows generated by the project (Ball et al., 2016). However, we cannot compare or add sums that appear over time on different dates, since they do not have the same value. In this regard, the comparison must be made on the same date, generally on date 0.

Indeed, it is through discounting that we will transform the various cash flows of the project generated in the future into today’s currency and thus make them comparable.

The discounting procedure converts a monetary unit of tomorrow into the same monetary unit of today. It allows intertemporal comparison of project costs and revenues. In other words, discounting makes it possible to compare sums that appear over time on different dates. The discount rate used is around 8%, which corresponds to the bank investment interest rate.

The Net Present Value (NPV) corresponds to the difference between the discounted cash flows generated over the life of the project and the capital invested (Willems et al., 2017). In other words, NPV represents the enrichment provided by the project after having covered all expenses and remunerated the invested capital at a predetermined discount rate.

The Net Present Value (NPV) is expressed by the following formula:

$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+a)^t} - I_0$$

With:

- I_0 : Initial investment;
- CF_t : Cash-flow generated by the project in year t;
- n : Project lifespan;
- a : Discount rate.

3 Results

3.1 Project display

The project to produce the insecticide formulation based on the essential oil of *Rosmarinus officinalis* is part of an investment project which aims to enhance the value of Moroccan medicinal and aromatic plants, as well as to set up a new “bio” product as a good quality local product. The main components of this project are summarized in Figure 3.

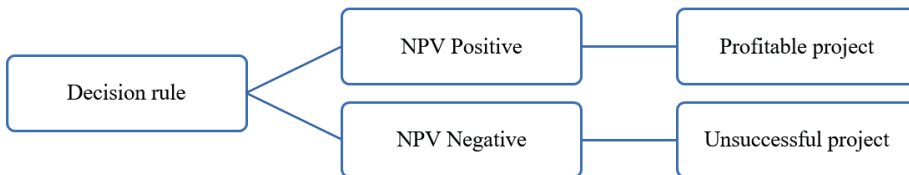


Figure 2. Decision rule based on the Net Present Value (NPV)

Table 1. Project sheet.

| | |
|----------------------------|---|
| Project title | Production of an insecticide formulation |
| Location rural territories | Surface area of the premises 5,000 m ² |
| Product | Insecticidal formulation based on essential oils. |
| Chemical formula | Essential oil + Clay (10% w / w) + adjuvant. |

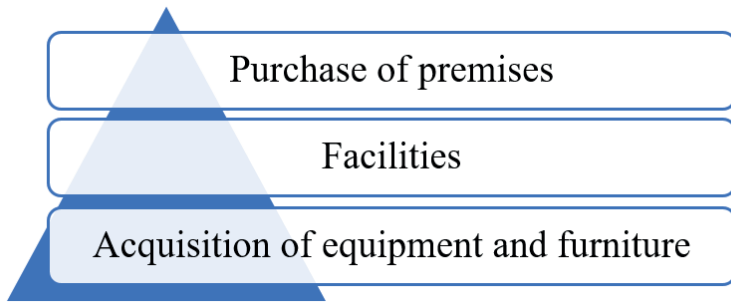


Figure 3. Consistency of the project

The project to produce the insecticide formulation based on the essential oil of *Rosmarinus officinalis* mainly aims:

- The development of “bio” and sustainable local products aimed at protecting the environment;
- Promotion of aromatic and medicinal plants through the rational management of basic natural resources.
- The production of a better-quality insecticide formulation.
- Reducing the costs of biopesticides for local farmers;
- The creation of employment through the various activities of the project.

3.2 Market study

Any project must start with a market study (Kostopoulos *et al.*, 2019) which mainly allows to:

- Test the idea of the project;
- Know the chances of success of the project and the risks;
- Check the presence of customers;
- Identify a business strategy;
- Make the process more credible with partners and banks.

The insecticide formulation of our project will be targeted for commercialization at the local, regional, national and even international market level in the medium term.

The direct competitors of this project are made up of synthetic molecules which exhibit remarkable insecticidal activities.

Competitive products sold in the local market can be found in tablet form. These products contain a single formulation of Aluminum Phosphide (ALP) with different percentages (from 33% to 90%). We note that this molecule is a salt of phosphorus (anion: P^{3-}) and aluminum (cation: Al^{3+}), with the appearance of white powder, it is hydrolyzing (it reacts with water), that is why it must be kept dry, because mixed with water or an acid, it undergoes hydrolysis and gives a hydroxide and phosphine (PH_3), the latter is a very dangerous gas (toxic and flammable).

Table 2 shows some brands of commercial insecticide products available in the local market.

The marketing mix is a strategy used which can give all the actions relating to the product, the price, the distribution and the communication and which allows the company to reach its objectives with its market and to satisfy the needs of the customers. Thus, determining a marketing strategy based on product, price, distribution and communication is essential for the other stages (Trivedi, 2018).

Table 2. Some commercial insecticide products

| Commercial name | Active ingredient | Number of tablets | Unit price |
|----------------------------------|-------------------------|-------------------|------------|
| Kingphos [®] | Aluminum phosphide 56% | 334 Tablets (1kg) | 8 USD |
| Aluminium phosphide [®] | Aluminum phosphide 56% | 30 Tablets | 8 USD |
| Phostoxin [®] | Aluminum phosphide 57 % | 30 Tablets | 8.5 USD |
| Celphos [®] | Aluminum phosphide 56% | 100 Tablets | 9 USD |

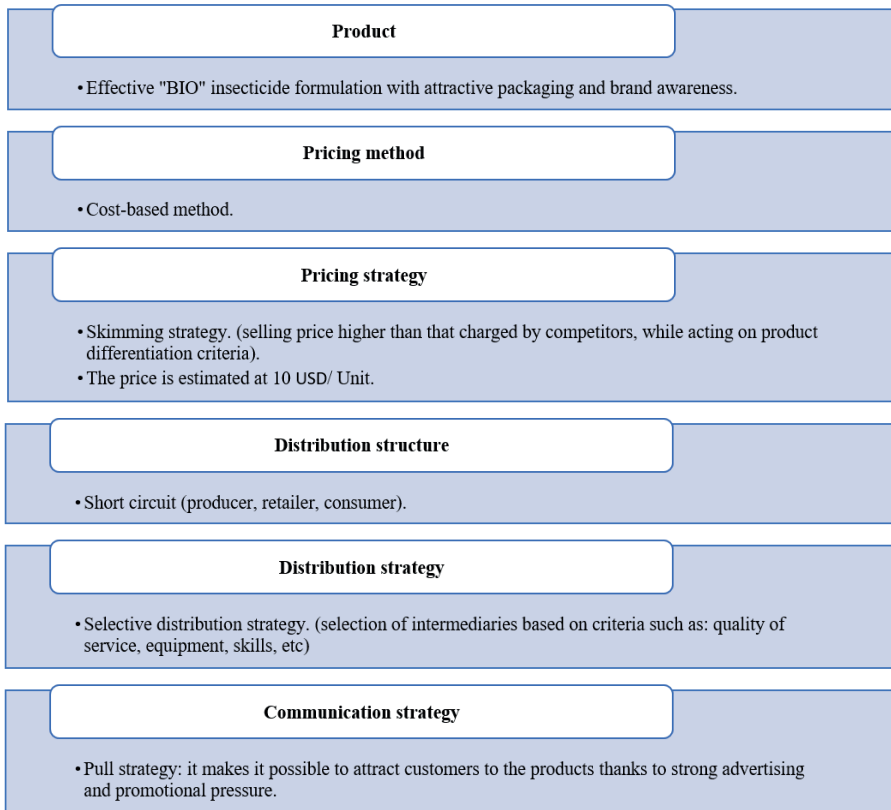


Figure 4. Marketing mix strategy

Table 3. Cost of investment needs

| Designation | Amount (USD) |
|---|---------------|
| Establishment costs | 2,000 |
| Land acquisition | 10,000 |
| Improvements and constructions | 40,000 |
| Material and tool requirements | 20,000 |
| Furniture and information technology (IT) equipment needs | 8,000 |
| Total | 80,000 |

3.3 Technical study

3.3.1 Investment needs

All of the investment requirements for the preparation of the insecticide formulation are listed in Table 3 by US Dollar

3.3.2 Depreciation and amortization

Depreciation is a term for the depreciation and loss in value of fixed

assets, due to wear and tear, time or obsolescence. Depreciation constitutes a calculated non-disbursable expense, its recognition leads to a reduction in the tax paid, which facilitates the renewal of fixed assets for the investor (Souza *et al.*, 2019).

The depreciation charges for the depreciable fixed assets of the project in question are worth 20% per year, at an amount of 16,000 USD.

3.3.3 Production standards

Table 4 summarizes all the costs associated with the activity process: Production of the insecticide formulation. If we assume that the annual production is 12 tones, then the annual total is worth an amount of 36,000 USD.

3.3.4 Human resource requirements

Table 5 details the human resource requirements over the life of the project.

3.3.5 Fixed charges (Excluding depreciation)

Table 6 summarizes all the fixed costs relating to the project. Indeed, fixed charges refer to charges independent of the production volume and which are reimbursed by the company regardless of its level of activity (remuneration of permanent staff, insurance, etc.)

3.3.6 Production forecasts

Table 7 shows the evolution of the production of the insecticidal formulation based on essential oil of Cedarwood over the 5-year lifespan of the project.

Table 4. Production standards.

| Input | Amount (USD) |
|------------------------|--------------|
| Plant | 2,000 |
| Clay | 500 |
| Phytosanitary products | 50 |
| Fuel | 100 |
| Lubricant | 70 |
| Purchase of packaging | 200 |
| Electricity + water | 80 |
| Total | 3,000 |
| Annual total | 36,000 |

Table 5. Human resource requirements

| Qualification | Workforce | Payroll (USD) |
|-----------------------|-----------|---------------|
| Laboratory technician | 2 | 16,800 |
| Skilled workers | 4 | 14,400 |
| Goalkeeper | 2 | 7,200 |
| Total | | 38,400 |

Table 6. Fixed charges

| Designation | Amount (USD) |
|-------------------------------|---------------|
| Transport costs | 500 |
| Purchase of cleaning products | 500 |
| Purchase office supplies | 300 |
| Service provision | 1,000 |
| Maintenance & repairs | 2,000 |
| Insurance premiums | 9,000 |
| Displacement | 500 |
| Communication budget | 1,000 |
| Telecommunications costs | 200 |
| Banking services | 150 |
| Social charges | 3,000 |
| Staff compensation | 10,000 |
| Total | 28,150 |

3.3.7 Estimated turnover

The turnover generated by this project over 5 years is reported in Table 8.

3.4 Financial evaluation of the profitability of the project

All of the cash flow results obtained during the financial evaluation of the profitability of the project for the production of the insecticide formulation based on essential oil of Cedar are shown in Table 9.

The net present value (NPV) of the project, calculated over a period of 5 years with a discount rate of 8% amounts to 541,962 \$. Thus, the NPV is positived, therefore the project is profitable in the long term.

4. Conclusion

This work dealt with the evaluation of the profitability of a production and valuation project for the insecticide formulation based on the essential oil of *Rosmarinus officinalis*. After an identification of the project, a market study and a financial study, the evaluation indicator "Net present value" testifies to the financial profitability of the said project. In this respect, the project is interesting in the long term.

Table 8. Revenue forecast

| Year | Production (tons) | Average unit price (USD) | Turnover (USD) |
|------|-------------------|--------------------------|----------------|
| 1 | 12 | 1 | 240,000 |
| 2 | 24 | 1 | 480,000 |
| 3 | 24 | 1 | 480,000 |
| 4 | 36 | 1 | 720,000 |
| 5 | 36 | 1 | 720,000 |

Note: The weight of a formulation unit is 50 g, each ton contains 240,000 units.

Table 9. Discounted cash flows and cumulative cash flows in USD

| Year | Initial investment | Cash-flows | Discounted cash-flows | Cumulative cash-flows |
|------|--------------------|------------|-----------------------|-----------------------|
| 0 | - 800,000 | | | |
| 1 | | 137,450 | 57,450 | 57,450 |
| 2 | | 341,450 | 335,050 | 392,500 |
| 3 | | 341,450 | 335,050 | 727,550 |
| 4 | | 719,826 | 777,412 | 1,504,962 |
| 5 | | 719,826 | 777,412 | 1,504,962 |
| NPV | | | | 541,962 |

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