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Competitiveness and Profitability of First Generation Biofuel Price Following Ronald Aylmer Fisher's Normal Law

JOSIANE Jeannette

Doctoral student in 4th year of thesis, in Economics Management and Development of the Catholic University of Madagascar.

SUMMARY: The existence of a linear and significant correlation of investment capitalization with the profitability generated by a formed price of a product remains one of the main foundations that ensures the viability of the company's activity. The research aims to form an equilibrium price of biofuel that is both competitive and profitable for the producing company. Our methodological approach consists of analyzing all the determinants that could favor the equilibrium price of jatropha biofuel – from input to output – using exhaustive studies of biofuel quality and efficiency in the Institute Malagasy of Application Research _ IMRA laboratory and the processing of information and panel data according to the Ronald Aylmer Fisher normal law probability test. The results on the feasibility of the price are obtained from the analysis of indicators measuring the net present value, the profitability index, and the internal rate of return.

KEYWORDS: Competitiveness, profitability, price, first generation biofuel

INTRODUCTION

Access to reliable and affordable energy services for all described in goal 7 of the Sustainable Development Goal is a major challenge of every country worldwide (UNDP, 2018). Goal 7 is to be reconciled with goal 13, which aims to control global warming (SDG 2015, Arman A. & Claire M., 2016). The depletion of solid energy and the massive emission of greenhouse gases composed of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), are the two factors that are driving the energy transition from solid to clean energy. The first generation biofuels obtained from the jatropha oil plant is currently consumable and commercialized on the liberal market (Benoit Gabrielle, 2008). The competitiveness and profitability of the biofuel price intrude as a beacon to the formation of biofuel prices. The purpose of the research is to analyze the yield of oil obtained from the *jatropha curcas* grain, allowing then to form the competitive and profitable price. This contribution will attempt to problematize these contexts by addressing the question, is the price of *jatropha curcas* biofuel both competitive and profitable at 20% lower than the price of petroleum-based energy? We qualify as a hypothesis to be tested whether the price of *jatropha curcas* biofuel would present its competitiveness and profitability at a price 20% cheaper than the price of oil diesel. The input analysis materials on the jatropha grain and output on the jatropha oil, make use of in-depth studies of quality and efficiency of biofuel in the laboratory, Institute Malagasy of Application Research _ IMRA followed by the assistance of applied tests at the National Center of Industrial and Technological Research. Our methodological approach is to conduct a directive survey among three groups of 331 different panelists, located in the northern part of Madagascar. The information and data constituting the descriptive statistics are then processed according to Fisher's normal law probability test (Ronald Aylmer Fisher in Ricco R., 2017).

MATERIALS AND METHODS

The first method used is to determine the yield of jatropha oil opting for a cold extraction mode with an ambient temperature, and hot with a temperature of 39° C, and by solvent with hexane. The oil extraction was made from 1000 grams or 1 kilogram of grains with bark for each extraction mode opted. A semi-industrial oil press is an equipment used for the extraction of oil in cold and hot.

Figure 1. Jatropha curcas seeds

Figure 2. Semi-industrial oil press

Figure 3. Crude oil _ laboratory treatment _ biodiesel oil

Source: Photo by the author

The method of oil extraction by solvent requires specific laboratory equipment. Solvent extraction has been selected for many years for its apolar properties which give it a great affinity for lipids. The method consists in weighing the grain on a balance with a precision of re-zero. The 44.16 g of grain paste by manual grinding was obtained. The next phase was that of maceration opted three times with each time 200 ml of the solvent hexane, for one hour. Stirring for 15 minutes of each maceration was done during this one hour time. Once filtered, the hexane oil was poured into the vacuum erlene, while filtering at the same time with the watman filter paper well wet placed on the erlene. Place in an ultration shaker for one hour before evaporating it to dryness in order to remove the solvent and to have the oil constituents thanks to the rotavapor of 40° C.

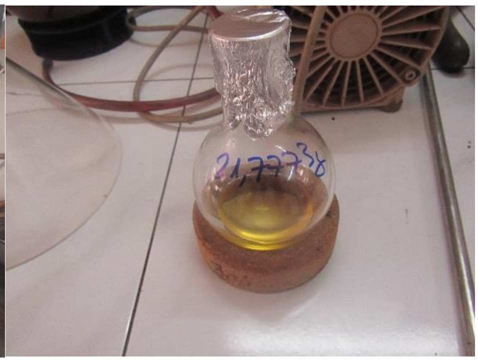

Figure 4. Erlene with filtered hexane cake

Figure 5. Rotavapor R-205; T= 40° C and rotation speed = 166 rpm

Figure 6. Hexane – extracted jatropha curcas oil

Source: Author's photograph, research conducted in the IMRA lab, 2019

Determination of the density of *jatropha curcas* oil also requires specific equipment from the laboratory, allowing then to convert the oil from mass to volume in order to conduct a study of the price formation of jatropha biofuel. After weighing the 8 vacuum vials on a precision balance; 10 ml of filtered and unfiltered jatropha oil by any type of extraction were poured into these vacuum vials to be weighed with the oil, while respecting the vial parallax. Then, leave the flasks with *jatropha curcas* vegetable oil in a thermostat of 20° C for 30 minutes.

Figure 7. Thermostat at 20° C

Source: Author's photo at IMRA laboratory

The formula of the applied density follows the standardization of the AFNOR 1996, the French standard equivalent to the international standard ISO 279: 1981 with editorial changes describes that the relative density at 20° C; it is the ratio of the mass of a certain volume of an oil at 20° C to the mass of an equal volume of distilled water at 20° C (AFNOR 1996: 77).

Density (a)= mass (m)/volume (V)

<u>Mass of Vegetable Oil (HV) at 10 ml</u>

Vacuum flask (M0)

Vegetable Oil Mass + M0 = M1

Vegetable oil at 20° C and for 30 minutes

Vegetable oil mass at 20° C= M1-M0

Density Vegetable Oil at 20° C **(a)** = m/V

(M1-M0)/V

(M1-M0)/10ml

Density = density of HV at 20° C / density of water at 20° C

The second approach relating to the analysis of the competitiveness and profitability of biofuel, at 20% cheaper than the price of solid energies such as oil at 2130 MGA and diesel at 3400 MGA (price at the pump of May 21, 2022 at 15 hours and 57 minutes), follows the analysis of probability of Fisher's normal law. Obtaining a positive Net Present Value _ *NPV* greater than zero and a Profitability Index _ *PI* greater than 1 would determine the competitive and at the same time profitable price according to the probability of Fisher's normal law. Two types of economic flows are held by the *NPV* calculation: the cost of the initial investment (*Io*) and the cash flow (*CF)* that is generated by this initial investment for future periods. The cash-flow will be discounted in order to know the present value of future flows (Fisher, Peumans H., 1971). The Weighted Average Cost of Capital (WACC) which is the discount rate applied is the minimum required rate of return < **i**>.

NPV formula applied follows the arithmetic formula:

$NPV = CF_1 (1 + WACC)^{-1} + CF_2 (1 + WACC)^{-2} ... + CF_n (1 + WACC)^{-n}$ *- Invest. Init.*

CF stands for Cash-Flow or Discounted Gross Margin (DGM). *WACC* stands for Weighted Average Cost of Capital. The arithmetic value -**1 ...**- n stands for the duration.

The NPV formula is finally simplified as

$$NPV = \sum_{j=1}^{n} DGM(1+i)^{-j} - Io$$

The '**i**' stands for the rate and the stands for the duration of n period.

The Profitability Index applied follows the mathematical formula:

$$IP = \frac{\sum_{j=1}^{n} DGM(1+i)^{-j} - Io}{Io}$$

RESULTS AND DISCUSSION

1. *Jatropha oil yield*

Headings	Cold (room temperature) 1000 g	Hot (T° at 39° C) 1000 g	A Hexane 73,6 g
Oil obtained by weight (gram)	**200**	**259,65**	**21,77**
Density at 20° C of unfiltered oil	**0,92**	**0,92**	**0,912**
Density at 20° C of filtered oil	**0,914**	**0,918**	
Unfiltered oil obtained converted to volume (ml)	**184**	**238,878**	**19,85**
Filtered oil obtained converted to volume (ml)	**182,8**	**238,36**	**19,85**

Source: IMRA laboratory results, Author 2022

2. *Feasibility study for competitive pricing at 20% less than oil and/or diesel*

2.1. Production volume

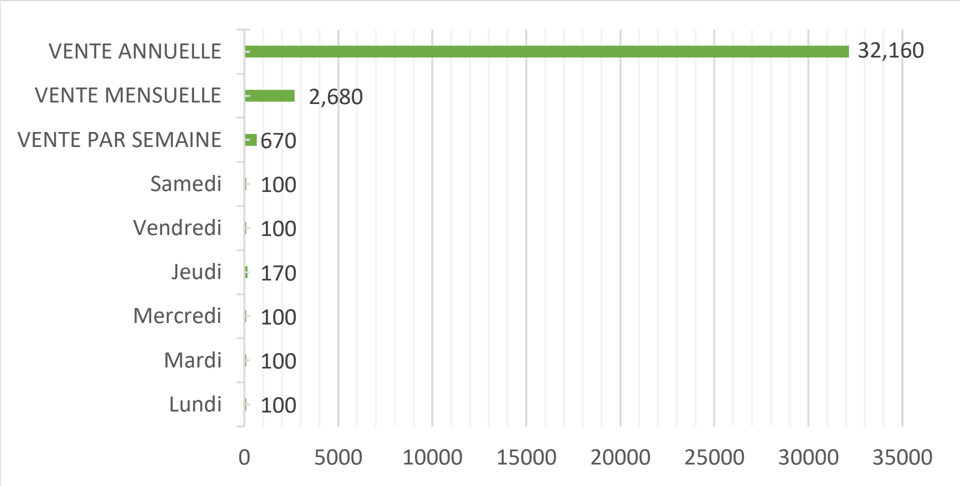

Figure 8. Volume of jatropha biofuel requirement

Source: Author, 2022.

The figure shows a trajectory of an annual, monthly and daily forecasted sale according to need at the pilot research site in the northern part of Madagascar.

2.2. Input requirements

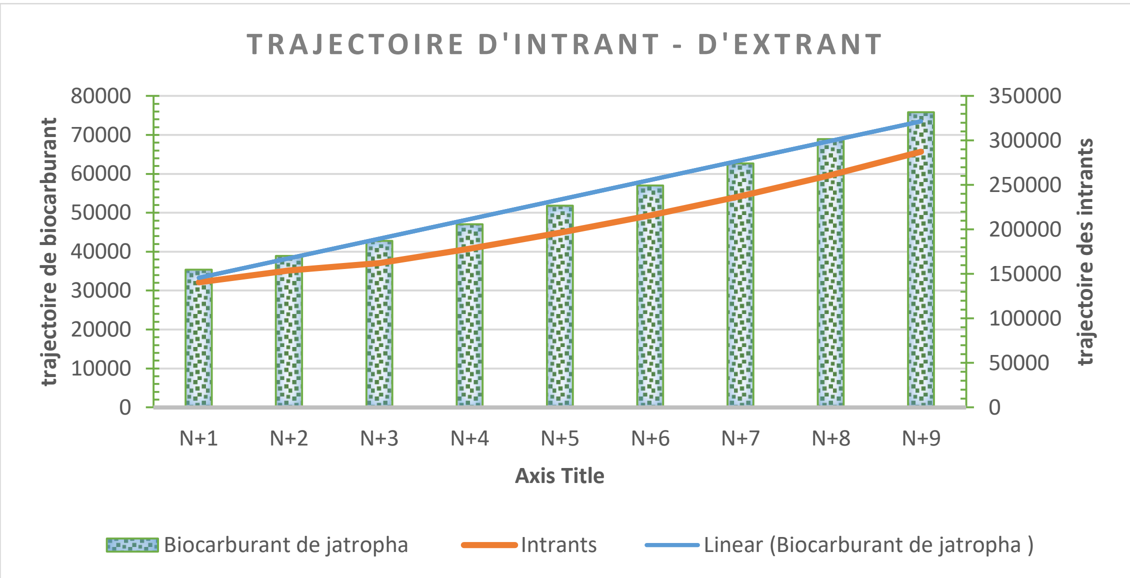

Figure 9. Biofuel demand trajectory of jatropha curcas

Source: Results of the 331 panelists survey analysis grid, Author 2022

The linear trajectory of biofuel demand in the study area shows that user demand increases over time until N+9. To meet the needs of established users, 32160 liters of *jatropha curcas* biofuel oil need to be produced in N, and for this amount of biofuel, 134000 kg of grain need to be crushed. The need for *jatropha curcas* biofuel increases to 75832 liters in N+9 and for this amount of biofuel, 315965 kg of grains need to be processed for extraction. The study shows a need to grow 105 kg of grain to provide the feedstock requirements of 315965 kg of grain in N+9. The 105 kg of kernels provide 105322 *jatropha curcas* plants to be cultivated on the 18 ha of land and that each plant produces 3 kg of nuts 2 years after cultivation and with 50 years of stable productivity of *jatropha curcas* plant.

2.3. Personnel costs

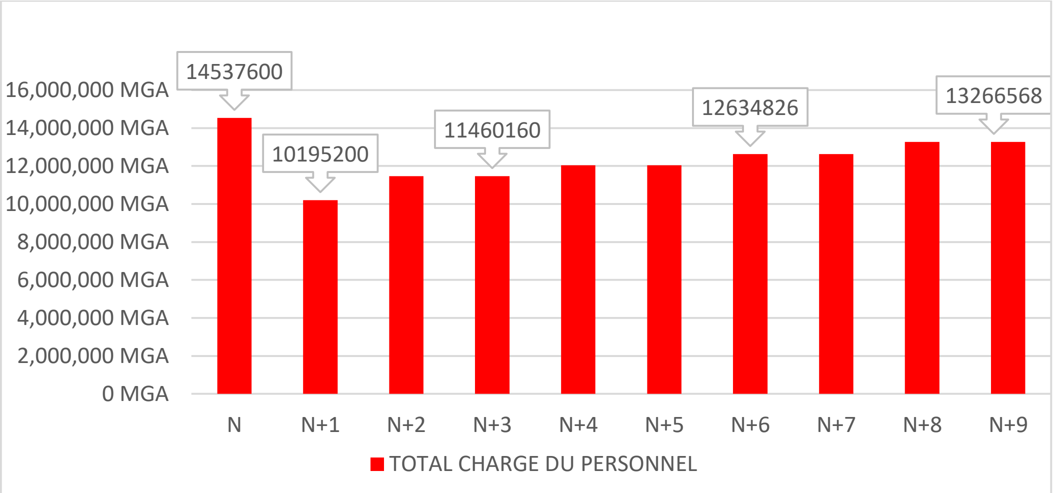

Figure 10. Payroll costs and social security contributions
Source: Author, 2022

The cost to the entrepreneur in terms of wage costs to obtain the quantity of new product studied, which is *jatropha curcas* biofuel, generally shows an increasing trajectory from N to N+9. The increase in wage costs in N+2, N+4, N+6, N+8 is explained by the increase in the inflation rate in the country of study, an estimated inflation rate of 20% from year N to N+9 where 5% per two years was considered.

2.4. Financing

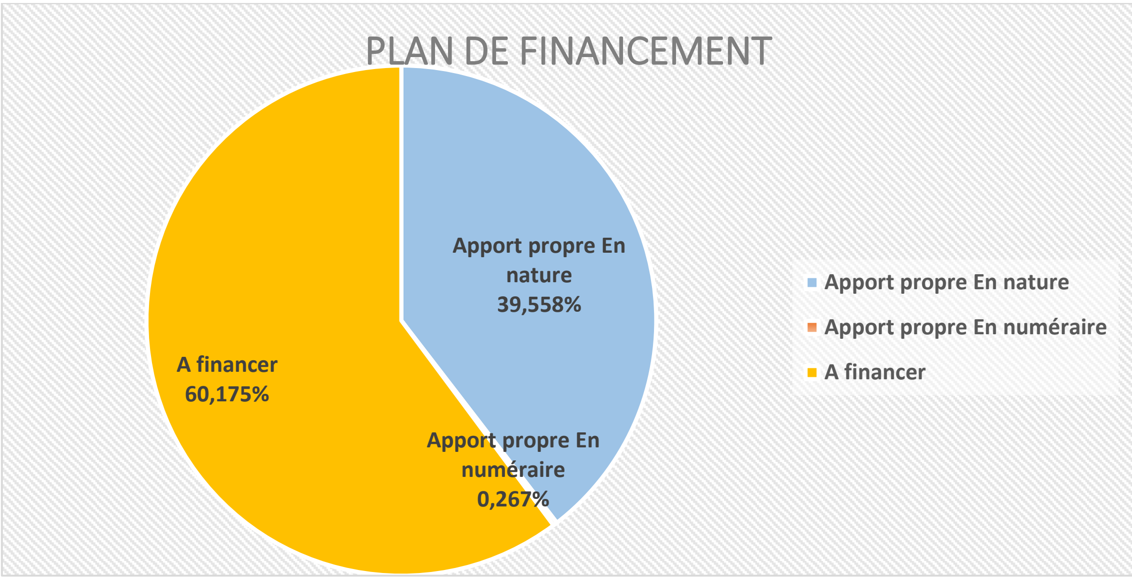

Figure 11. Breakdown of financing plan according to the company's contributions
Source: Author, 2022

The financing plan is devoted to the presentation of results on the distribution of the contributions necessary for the production specifically of biofuel of *jatropha curcas*. The total needs in working capital is 97,824,501 MGA, which represents 100% of the contributions. The amount of working capital requirements includes investments in fixed assets and production equipment in order to produce the desired annual quantity of biofuel and consumable expenses that cover the needs of inputs. It is therefore a sufficient contribution to start the production allowing to bring to an analysis of the competitiveness and profitability of biofuel prices following the cost-plus-pricing process. The contribution of the producing company totals 39.83% of the total contribution necessary for production. It can be divided into two groups: the contribution in kind and the contribution in cash. The contribution in kind of the company represents the 39.56% of the total of necessary contribution, and that the contribution in cash is to the height of 0,27% to form the total amount of the contribution of the producing company that is 39.83%. The recourse to the external financing which contributes to the good production of biofuel of *jatropha curcas* at the time of three 1st years is at the height of 60.17% of the totality of necessary contribution and at a sum of 58,865,860 MGA of . This recourse to the external fund calls for another cost of repayment of initial invested capital, including the interest rate and the duration of repayment. The formula of calculation of repayment with constant annuity was applied according to the formula,

$$a = Io\frac{i}{1-(1+i)^{-n}}$$

'*a*' is a constant annuity, '*Io*' is the principal at the beginning of the period, '*i*' is the applied interest rate and '*n*' is a repayment period of the whole *Io*. In the repayment cost analysis, the financial table version Cnapmad was used to determine the value of $\frac{i}{1-(1+i)^{-n}}$

The cost analysis related to the amortization of the initial investment is summarized in the following box. The conventional and standardized financial table of the Cnapmad version was also used to determine the value of the constant annuity.

<u>Constant annuity formula applied</u> :

$$a = Io\frac{i}{1-(1+i)^{-n}}$$

With A = Constant annuity
Io = Capital at the beginning of the period
I = Interest rate
n = repayment period

I= Io*t

With I = Annual interest
t = interest rate

- $\frac{i}{1-(1+i)^{-n}}$= 0.400346
- n= 3 years
- a= 58 865 860 * 0.400346

The value of the constant annuity obtained is 23,566,712 MGA

Year	Capital at the beginning of the period	Constant annuity	Interest	Amortization	Outstanding capital
A1	58 865 860	23 566 712	5 739 421	17 827 290	41 038 570
A2	41 038 570	23 566 712	4 001 261	19 565 451	21 473 119
A3	21 473 119	23 566 712	2 093 629	21 473 083	36
TOTAL				**58 865 824**	

Source: Author, 2022

The results of a survey with a very well-known financial institution have shown that startup companies receive more than 85% of favorable opinions if the repayment of its financing request for a new product production would be done in less than 3 years, so it is a short and medium term financing. Therefore, in this analysis of repayment costs, the 3 years term was taken into account with a *conventional* interest rate of 9.75% per year.

2.5. Initial graphic model of biofuel price at 20% lower than oil price

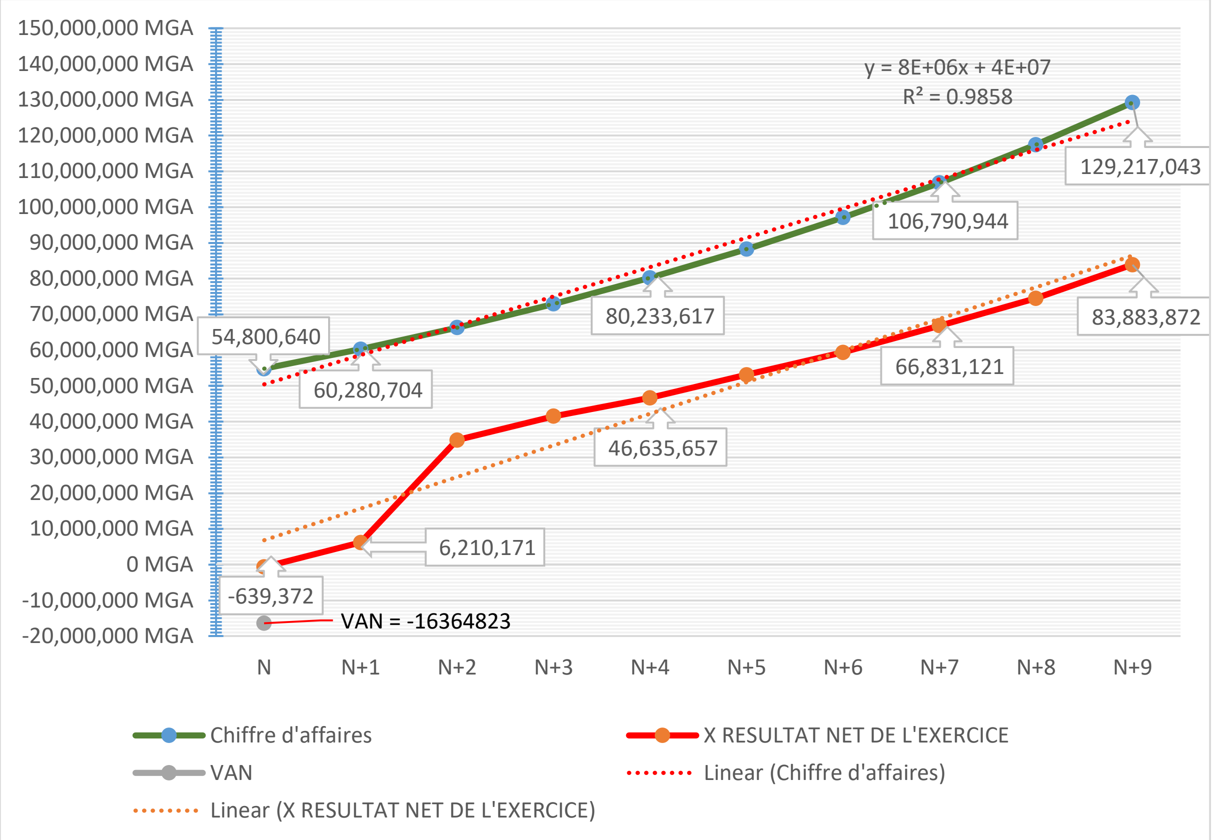

Figure 12. Biofuel from jatropha curcas at 20% cheaper than the price of oil at 1704 MGA
Source: Author, 2022.

The graphical model obtained from the study of price profitability of jatropha oil at a price 20% cheaper than oil shows the first negative net result (*NR*) of -1.167% compared to its turnover (*CA)* in N. The study on price competitiveness formed from the Net Present Value indicator for 3 years shows that the *NPV* comes out negative by – 16,364,824 MGA and its *IRR* of – 6.69%. The startup finds its growth from N+1 with its positive *NR at* the level of 10.302% compared to its *turnover*. The *NI* trajectory is not linear since in N+2, it rises to 52.518% compared to its *turnover* for the year. The *NI* after deducting the production costs from their respective *sales* presents a linear trajectory increasing from N+3 to N+9 of the analysis.

2.6. Final biofuel price model at 20% lower than diesel price

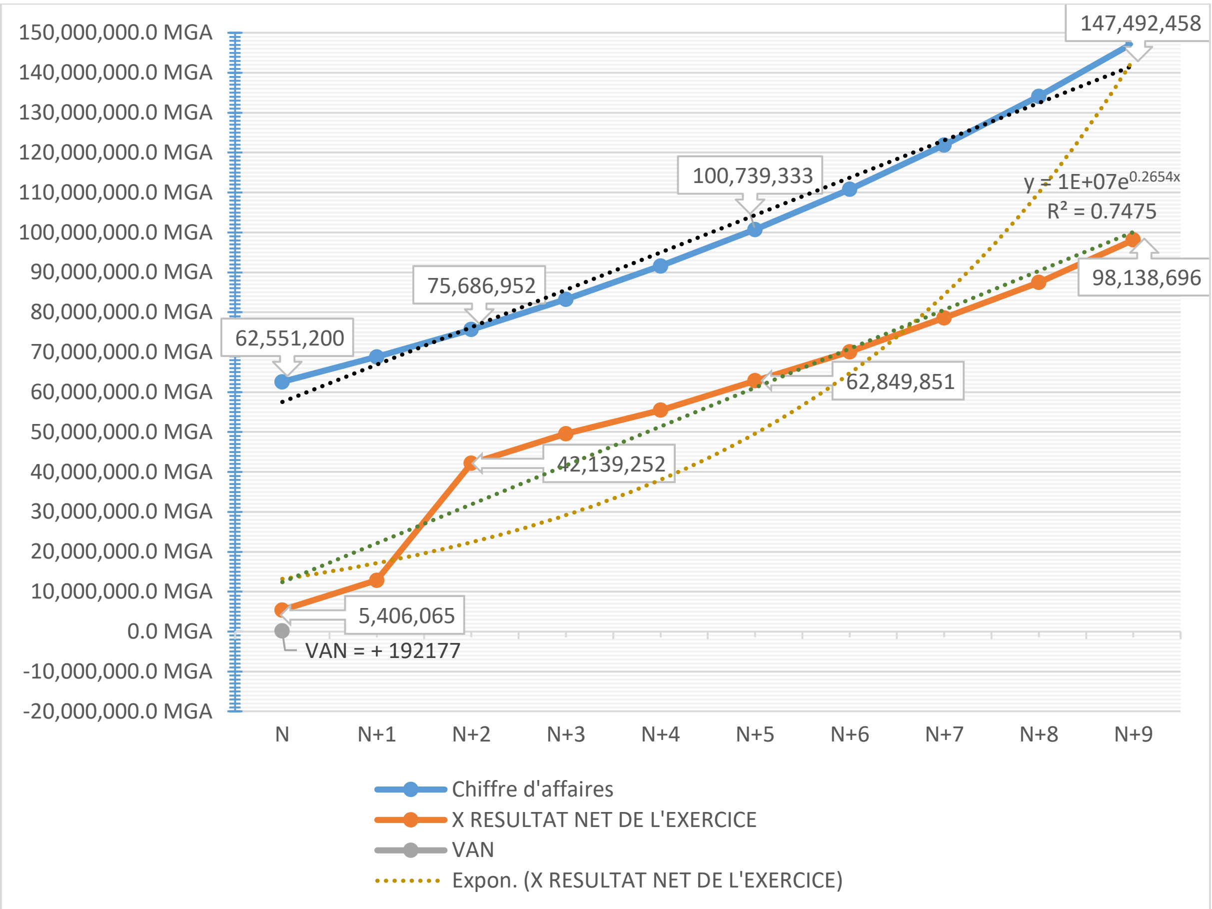

Figure 13. Graphical model at 20% cheaper than the price of diesel fuel, i.e. at 1945 MGA
Source: Author, 2022

We visualize on this graphical model two linearities that determine the trajectory of turnover and the trajectory of net income after the analysis. The two trajectories are correlated and each trajectory dictates the value generated according to a single variable to be explained which is the competitive and profitable price. The hypothesis tested to obtain this graphical model is that the price of *jatropha curcas* biofuel would be competitive and profitable at 20% less than that of diesel fuel. The price validity test formed from the *NPV* analysis therefore yields a positive result and greater than 0. The net result finds a remarkable growth from N+2. This brings the theory of the company in launching an innovative product into the real world of operation. The revenue and net income of the year have a mutually parallel growth from N+2, this is measured from the trajectory of their linearity. The validity test from the *PI* yields a positive result and greater than 1, which means that the initial invested capital generates a profit. The price validity test formed from ratio shows a positive result and greater than 0.

3. *Competitiveness and profitability study according to Fisher's normal law*

3.1. Net Present Value _ NPV

The results of the analysis on the sum of expected profitability, the new information on the investment in the future, the new information on the cash flow, will be updated by the cash flow according to Fisher's normal law. It allows to anticipate the main factors that could disturb the profitability to be achieved in the medium and long term and whose influence varies according to the size of the investment, whether it is small, medium or large capitalization.

The Net Present Value _ *NPV* is an indicator of measurement to assess the level of competitiveness and profitability of a price formed to confirm or not the ability of the company to generate desired profits. Cash Flow _ *CFM* needs to be evaluated in order to determine the value of *NPV* since *CFM* also ensures the identification of values that should be re-included in the bottom line, and leads to the determination of the Internal Rate of Return _ *IRR* and the Profitability Index _ *PI*.

The algebraic formula for determining cash flow remains unchanged, the elements to be evaluated are:

± Net results that can be beneficial or detrimental;
± Sum of depreciation of equipment and fixed assets;

± Algebraic sum of residual values likely to remain at the disposal of the company for more than one year;

The simplification of the cash flow calculation leads to the financial mathematical formula:

$$\boldsymbol{DGM = net\ result + depreciation\ and\ amortization + residual\ value}$$

The term actualized cash flow _ $CF_{actualized}$ is used to refer to the actualized *cash flow.* Following Fisher's normal law approach, the sum of the annual cash flow during the ten-year study period will be discounted today in order to determine the performance trend of the company with the current available information and data, which is calculated from Ronald Aylmer Fisher's mathematical financial probability formula:

$$CF_{actualized} = \sum_{n=1}^{N} * \frac{CF}{(\mathbf{1}+\mathbf{i})^{\mathbf{j}}}$$

The *N* stands for the number of years and the means the discount rate.

The same financial mathematical formula as the previous one is applied in the analysis of competitiveness and profitability of biofuel price of *jatropha curcas*, if it is set at 20% cheaper than diesel and a period of ten years.

$$CF_{actualized} = \frac{CF_1}{(\mathbf{1}+\mathbf{i})^{\mathbf{1}}} + \frac{CF_2}{(\mathbf{1}+\mathbf{i})^{\mathbf{2}}} + \frac{CF_3}{(\mathbf{1}+\mathbf{i})^{\mathbf{3}}} + \frac{CF_4}{(\mathbf{1}+\mathbf{i})^{\mathbf{4}}} + \frac{CF_5}{(\mathbf{1}+\mathbf{i})^{\mathbf{5}}} + \frac{CF_6}{(\mathbf{1}+\mathbf{i})^{\mathbf{6}}} + \frac{CF_7}{(\mathbf{1}+\mathbf{i})^{\mathbf{7}}} + \frac{CF_8}{(\mathbf{1}+\mathbf{i})^{\mathbf{8}}} + \frac{CF_9}{(\mathbf{1}+\mathbf{i})^{\mathbf{9}}} + \frac{CF_{10}}{(\mathbf{1}+\mathbf{i})^{\mathbf{10}}}$$

The competitiveness and profitability of price formed of *jatropha curcas* biofuel at 20% cheaper than the price of diesel would be evaluated from the mathematical formula regulated Net Present Value _ *NPV*.

This validity test of competitiveness - profitability from the *NPV* follows the calculation mode duly standardized and updated according to the formula while respecting the index rate of the conventional financial table version Cnapmad.

$$NPV = \sum_{j=1}^{n} DGM(1+i)^{-j} - Io$$

The result of the validity test from the *NPV* will dictate whether the price was competitive and profitable with the net results coming out positive from N until N+9, and that the *NPV* amount obtained would allow to set the minimum acceptable scale to generate profitability for the company. The financial table version Cnapmad was also used for the determination of $(\mathbf{1}+\mathbf{i})^{-\mathbf{j}}$ at their respective rates.

Discounted gross margin of net present value at a trained price 20% lower than diesel

Heading	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
Net income	5 406	12 860	42 139	49 572	55 486	62 849	70 093	78 611	87 468	98 138 696
Depreciation and amortizatio	4 646 326	4 646 326	4 646 326	4 646 326	4 646 326	4 219 326	4 219 326	4 219 326	4 219 326	4 219 326
Residual value										8 000 000
DGM	10 052 391	17 506 477	46 785 578	54 219 138	60 133 107	67 069 177	74 312 498	82 831 293	91 688 076	110 358 022
$(1+i)^{-j}$ $i = 9{,}75\%$	**0,911**	**0,830**	**0,756**	**0,689**	**0,628**	**0,572**	**0,521**	**0,475**	**0,432**	**0,394**
Discounted DGM i=0.0975	9 157 728	14 530 376	35 369 897	37 356 986	37 763 591	38 363 569	38 716 811	39 344 864	39 609 249	43 481 061
Cumulative discounted DGM	**9 157 728**	**23 688 104**	**59 058 001**	**96 414 987**	**134 178 579**	**172 542 148**	**211 258 959**	**250 603 823**	**290 213 072**	**333 694 133**
$(1+i)^{-j}$ $i = 10\%$	**0,909**	**0,826**	**0,751**	**0,683**	**0,6209**	**0,5644**	**0,513**	**0,466**	**0,424**	**0,385**
Discounted DGM i=0.1	9 137 623	14 460 350	35 135 969	37 031 671	37 336 646	37 853 843	38 122 311	38 599 383	38 875 744	42 487 838
Cumulative discounted DGM	**9 137 623**	**23 597 974**	**58 733 943**	**95 765 614**	**133 102 260**	**170 956 104**	**209 078 415**	**247 677 797**	**286 553 542**	**329 041 380**

Source: Author, 2022

The validity of the competitiveness and profitability of biofuel price proposed in sub- hypothesis and objectively verifiable, will therefore be tested from mathematical calculation of *NPV* below:

$$NPV = \sum_{j=1}^{n} DGM(1+i)^{-j} - Io$$

NPV = Cumulative discounted *MBA* - *Io*

Cumulative discounted *MBA* in 3 years = 59,058,001 MGA *Io* = 58.865.860 MGA

NPV = 59,058,001 – 58,865,860

NPV = 192.141 > 0

At a formed price of jatropha curcas biofuel at 1945 MGA, the NPV result comes out positive at + 192,141 MGA and higher than . According to the theory, a net present value _ NPV that comes out positive means that such a fixed price generates a certain profitability by a certain amount of the initial invested capital. The investment at a price formed of 1945 MGA is then the minimum opportune and the test of the internal profitability index would determine the exact unit of profitability generated by each unit of the initial investment _ Io, financed during 3 years at a rate of 9.75% annual.

The objective of the rate of return validity test is to produce the equilibrium price without risk to the competitiveness and profitability of the company. For this, the price itself must be competitive and profitable. The validity test makes it possible to anticipate observations on the gap between the desired competitiveness – profitability and those that will be obtained (Ronald Aylmer Fisher). The rate of return is therefore determined from the mathematical formula inspired by the Fisher probability:

$$\text{IRR} = \sum_{j=1}^{n} DGM\ [m]\ (1+i)^{-j} - Io = 0$$

With components such as $DGM\ [m]$ which stands for Marginalized Discounted Gross Margin; *i* to denote the discount rate; $-j$ as the duration of n period and *Io* as the initial investment. So, the internal rate of return _IRR:

$$\frac{\text{Rate of NPV inversed} - IRR}{\text{Rate of NPV inversed} - \text{borrowing rate}} = \frac{\text{DGM actualised at 'i' inversed} - \text{Io}}{\text{DGM actualized at 'i' inversed} - \text{DGM actualised at 'i'}}$$

The inverse net present value rate is a rate at which the *NPV* amount has become inversely negative. The discounted cash flow at the inverted 'i' rate is the value of the investment for *n* period that will be discounted back to the current period in order to anticipate the trajectory of the investment's profitability at such a product price. The determination of the discounted cash flow value is based on the value of the *DGM* and the three explanatory variables such as the value of $(\mathbf{1+i})^{-\mathbf{j}}$, At the rate '*i*' making the *NPV* inversely negative and the *n* period during which the financing would be amortized. While the discounted cash flow at rate 'i' means that the discounting of the profitability trajectory of the investment for *n* periods would be determined based on the initial borrowing rate. The *IRR* must be positive, greater than 0 and above all greater than the initial borrowing rate in order for the company to establish a certain margin that ensures its financial self-financing and its competitiveness. And that the profitability of biofuel at a fixed price would be validated only after having obtained the *IRR* higher than the loan rate.

$IRR \rightarrow NPV = 0$

If i is equal to 9.75%; $\rightarrow$ NPV at 3 years $=$ 192,141 MGA

If i is equal to 10%; $\rightarrow$ NPV at 3 years $= -131{,}917$ (i. e. 58,733,943 $-$ 58,865,860)

It is for a rate between 9.75% and 10% that the sign of the *NPV* reverses and becomes negative, the *IRR* is therefore included in this interval.

For

i = 10% Discounted *DGM* = 58,733,943 MGA

i = 9.75% Discounted *DGM* = 59,058,001 MGA

0.0975< i < 0.1

$$\frac{10 - RRI}{10 - 9{,}75} = \frac{58\ 733\ 943 - 58\ 865\ 860}{58\ 733\ 943 - 59\ 058\ 001}$$

10 – *RRI* = 0,25*(-131917/-324058)

10– *RRI* = 0,25*0,407

-*RRI* = 0,102-10

RRI = 9,898

RRI = 9,898%

The *IRR* analysis at a *jatropha curcas* biofuel price 20% lower than the diesel price shows a result of 9.898% which is positive and higher than the required 9.75%. The studied biofuel price generates a margin of 0.148. This is the strict minimum profitable and that the price of biofuel of *jatropha curcas* produced in Madagascar, financed from these dependent variables, should not have been below this threshold in order to release profitability for the company.

3.2. Recovered Capital Investment Period _ *RCIP*

The *RCIP* metric is used to designate the time $t+1$ to the ability and availability of the producing firm to recover the initial investment. The *DRCI* matches the ability of the net cash flows generated by the initial investment to repay or recover the initial capital invested. The *RCIP* notified in X is determined using the cumulative discounted cash flow using the variable interpolation method as follows:

$$t < X < t+1$$

$$X = \frac{\text{Io} - Cumulative\ discounted\ DGM \text{ at } '\text{i}', N+1}{Cumulative\ discounted\ DGM \text{ at } '\text{i}', N+2 - Cumulative\ discounted\ DGM \text{ at } '\text{i}', N+1}$$

The *RCIP is* therefore an indicator to determine the ability of a trained price to recover the initial invested capital within a specified time frame. It must be included between t and $t+1$ in order to define the temporal level of success of the price formed in the constitution of profitability to the cash flow of the company.

The *RCIP* determination applies the notifications t to designate the 2nd panel year or N+1 and $t+1$ to designate the 3rd panel year or N+2.

Determination of the Recovery Period of the Capital Invested

Heading	N	N+1	N+2	N+3	N+4	N+5	N+6	N+7	N+8	N+9
Net income	5 406	12 860	42 139	49 572	55 486	62 849	70 093	78 611	87 468	98 138
Depreciation and	4 646 326	4 646 326	4 646 326	4 646 326	4 646 326	4 219 326	4 219 326	4 219 326	4 219 326	4 219 326
Residual value										8 000
DGM	10 052	17 506	46 785	54 219	60 133	67 069	74 312	82 831	91 688	110 358
$(1+\mathrm{i})^{-\mathrm{j}}$ $\mathrm{i} = 9,75\%$	**0,911**	**0,83**	**0,756**	**0,689**	**0,628**	**0,572**	**0,521**	**0,475**	**0,432**	**0,394**
Discounted DGM i=0.0975	9 157 728	14 530 376	35 369 897	37 356 986	37 763 591	38 363 569	38 716 811	39 344 864	39 609 249	43 481 061
Cumulative discounted DGM	**9 157 728**	**23 688 104**	**59 058 001**	**96 414 987**	**134 178 579**	**172 542 148**	**211 258 959**	**250 603 823**	**290 213 072**	**333 694 133**
RCIP		58.865.860 ***n =?***								

Source: Author, 2022

$t < X < t+1$

23 688 104 < 58.865.860 < 59 058 001

$$X = \frac{58\ 865\ 860 - 23\ 688\ 104}{59\ 058\ 001 - 23\ 688\ 104}$$

→ **<u>0,994</u>**

After determining the value of the *RCIP, the* result is 0.994. The initial invested capital result is between t of N+1 and $t+1$ of N+2 which means that it will be recovered in more than 2 years. The 0.994 of the *RCIP* specifies the translation of the figure into number of hours and that it will be converted into hourly value following the conversion:

(1) *X* = 2 years + 0.99 years ;

With 0.99 years gives 11.93 months;

(2) *X* = 2 years + 11.93 months ;

With 0.93 months translates into 28 days.

The *RCIP* result of *X* is equal to 2 years 11 months and 28 days.

The result obtained means that the value of the net cash, included between t with the value of 35,662,368 MGA and $t+1$ with the value of 60,974,864 MGA, could recover the value of initial invested capital of 58,865,860 MGA. The *RCIP* determines the exact number of hours of this interval and that the amount of the initial capital and the value of net cash that recovers it, coincide in 2 years 11 months and 28 days of exploitation. This means that the net cash generated by the price formed by 1945 MGA of biofuel recovers its initial capital investment at this number of year, month and day.

CONCLUSION

The formation of producer prices follows a process of equilibrium pricing in the market, according to neoclassical theory, profitability is not predictable by a simple determination of positive net income for the year. The choice to invest in biofuel, regardless of the size of the investment, is based on an uncertain future that requires an analysis based on a probability test of the expected profitability of the investment. The information and data are still not favorable to the investment and what would lead the correlation between the variables studied, to record negative test indicators that mark the lack of linkage between the explanatory variables and the variable to be explained and that the two variables to be explained are moving in the opposite direction. This manuscript contributes to the yield study to determine a competitive and profitable biofuel price for *jatropha curcas.* The yield obtained by hexane oil extraction shows a better yield without impurities with 1.348 liters of oil for the 5 kg of grains with a density at 20° C of 0.912. But the cost of hexane does not favor a competitive biofuel price. The hot press at a temperature of 39° C allows to obtain 1.2 liter of already filtered oil for the 5 kg of treated grains with a density at 20° C of 0.918. The test of Fisher's normal law at a price of biofuel 20% cheaper than the price of conventional oil yields a net present value that automatically comes out negative, below zero of -16,364,823 MGA and a negative internal rate of return, below zero of -6.69%. The results mean that the variable to be explained, the competitiveness and the profitability of price, tend on the opposite direction and that the price of biofuel adopts only of competitiveness in front of the competitive price of petro-sources but contributes negatively to the profitability of the producing company. When involving the Fisher transformation, in error correction, it allows to transform the price of biofuel to 20% cheaper than the price of conventional diesel, the test indicators yield a positive internal rate of return of 9.922% which is also higher than the required rate on the initial capital invested of 9.75%. A payback period that follows the conventional normal payback law since the initial capital investment is recovered within the three-year financing period. The payback period gives a ratio of 0.994 which confirms that the initial investment would be recovered in two years, eleven months and twenty-eight days. The transformed price validity test using the profitability index yields a positive ratio, greater than 1. The ratio of the profitability index reaches 1.003 which describes that each 1 unit of investment generates 0.003 unit of profit, so, the expectation in gain or profitability for the producing firm. Tested with Fisher's normal law and Fisher's error correction transformation, the analysis concludes that the ratios of performance and price validity transformed positive to create a promising profitability value to the company and that the two variables to be explained, competitiveness and profitability, evolve in the same direction to meet a term "at once" of the study. It is therefore up to us to confirm the hypothesis, only at 20% cheaper than the price of diesel, that the price of *jatropha curcas* biofuel promotes an equilibrium price that is both competitive for the user and profitable for the producing company. Research is underway for second generation biofuel and biomass, obtained from the whole plant of *jatropha curcas.*

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