

Test on The Exploitation of The Madagascar Peanut Sector, Case of The Volcanic Region of Itasy

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Abstract -The Itasy region, our study area, is one of the 22 regions of Madagascar, and is possibly with a vocation and a great agricultural potential; among them, there is also the groundnut industry. So far, there have been very few scientific studies done around this area. This leads us to have a further study to the area. We carried out two geological reconnaissance and sampling missions in two sectors: one was in the commune of Ampary district of Soavinandriana and the other one was in the commune of Anosibe-Ifanja, followed by various analyses and tests of culture. Our goal is to carry out more scientific studies on the valuation of the groundnut industry in the Itasy region. In the laboratory we carried out various analyses: chemical analysis, mineralogical analysis by X-ray fluorescence method, particle size analysis, and peanut culture tests of two varieties, equipment design followed by improvement and various tests extraction of peanut oil. The results of the chemical analysis showed a fertilizing value of the samples. The mineralogical analysis showed the richness of minerals and trace elements of the different samples. Cultivation tests showed positive action to the groundnut variety of groundnut volcanic soil than to the variety of peanut menakely. The extraction tests have told us that the more the pressure force increases, the more extraction efficiency increases.

Keywords – Peanut Variety Menakely; Peanut Variety Marabe; Volcanic Soil; Itasy Region; Single and Double Cylinder Hydraulic Press.

I. INTRODUCTION

The Itasy region, which is our study area, is one of the most important agricultural areas of Madagascar. The groundnut sector appears as one of the promising sectors in this region: an activity generating considerable income and a profession with a high potential for job creation.

However, there are considerable and well-known constraints to this sector, which erect barriers to potential opportunities for their development, such as the lack of control and the non-exploitation of some elements of the network, namely the variety adapted to the ecosystem in this zone, harvest period, processing technology, etc...

Thus, we propose as part of this research work, the valuation of the groundnut sector adapted to the socio-economic situation of small farms in the Itasy region: the emphasis of productivity and efficiency, improvement of competitiveness and increase of profits.

II. STUDY AREA

The study area is located in the Itasy region (experimentation on peanut culture), which is divided into two different volcanic soil sectors:

- Sector of Ampary : district of Soavinandriana Itasy whose geographical coordinate Latitude is 19°05'16'' South, Longitude 46°42'55'' East and 1341m of Altitude ;
- Sector of Anosibe-Ifanja, district of Miarymarivo Itasy whose geographical coordinate Latitude is 18°52'01'' South, Longitude 46°44'55'' East and 1070 m of Altitude.

III. MATERIALS AND METHODS

A. SYNTHESIS BIBLIOGRAPHICAL

Different synthesis bibliographical, consultation of various national and international scientific and technological documents, were undertaken before the

preliminary surveys allowing to recognize and to recall some different notions and technical data essential for the understanding of this investigation.

B. EXPERIMENTATION

According to the choice of the study area, surveys were carried out among the resident population working around the peanut sector: farmers, artisanal processors and peasants grouped in cooperatives. Semi-open questions are focused on planted peanut species, the reason for choosing these species, cropping methods, peanut processing materials and methods.



Photo 1: Peanut crop, seed (Sector of Anosibe-Ifanja)



Photo 3: Marabe variety peanut products



Photo 2: Culture Interview (Sector Ampary)



Photo 4: Menakely variety peanut products

We conducted experiments on the planting of two peanut species in different areas mentioned above. The goal is to select the favorable species in a specific area ecologically. The experimental protocol are the following:

- Period of planting : mid-November 2016 (this is the most and favorable period used to the farmers)
- Maximum temperature : 28 ° C
- Minimum temperature : 20 ° C
- Method of cultivation: seeding in line of 40cm x 40cm from one another and forming tiles.

C. WORKING OF LABORATORY

1. Soil analysis

1.1 Chemical analysis

We realized the chemical analysis of the samples collected at the Laboratory of Radio-Isotopic in Ampandrianomby Antananarivo, whose methods are the following:

- Research of assimilable phosphorus (P olsen) by Olsen method or blue method. The extraction reagent is the sodium bicarbonate NaHCO_3 . The assay

reagent is the ammonium molybdate $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$;

- Research of phosphorus total (Ptot) by the vanadomolybdate yellow method. The extraction reagent is the concentrating perchloric HClO_4 , and the assay reagent is the mixture of molybdate and ammonium metavanadate ;
- Research of nitrogen total (N) by the Kjeldhal method ;

- Research of potassium total (K_{total}): with the cobaltihexamine method.

1.2 Physical analysis

Two different methods of physical analysis are realized by the samples from each sector:

- Analysis by X-ray fluorescence spectrometry in the laboratory of the cement manufacturing company HOLCIM Madagascar: It is an elementary analysis method that allows us to determine the concentration in pure elements that are often present as a compound (molecules, crystals, polyatomic) in the initial material, expressed in percentages of these elements. The compound concentration is calculated automatically by the analysis software. X-ray fluorescence analysis results are also given in spectrum form.
- Granulometric analysis at the Soil Laboratory of FOFIFA-Antananarivo: The final objective is to determine the dimensional distribution of the elementary particles of the material constituting a soil: characterization of the texture. It is carried out according to the standardized method AFNOR NF X31-107, described as following : After separation of fine earth (fractions less than 2 mm) coarse elements (gravel, pebbles, blocks), and destruction of organic cements by the action of hydrogen peroxide, the fine earth is dispersed in water added with a dispersing agent. The particles will then slowly sediment according to their size and the temperature of the water. Samples at different time steps make it possible to recover the particles remaining in solution. This method makes it possible to determine the contents of clay and fine silt.

2. Analysis of the oil content

To determine the amount of oil contained in the peanut and the amount of oil remaining in the cake, we carried out the solvent extraction at the Laboratory of Chemical Engineering at Vontovorona. This type of extraction uses apolar organic solvent (hexane).

D. EQUIPMENT DESIGN WORKS

Considering the multidisciplinary character of this investigation, an extraction apparatus, a manually operated hydraulic press, was designed and carried out at the Ankatso en technical unit workshop, working with some technicians and specialists from this workshop. This apparatus is necessary firstly for carrying out tests on soil-time and crop-

variety interdependence and secondly for contributing to the improvement of artisanal transformer extraction equipment.

IV. RESULTS, INTERPRETATION AND DISCUSSION

The two sectors are located on the central highlands of our island. They have a tropical climate with alternating two seasons: a warm and rainy season (October-March) and a cold and dry season (April-September).

A. PRELIMINARY INVESTIGATION

Two categories of people were investigated during our investigation: ungrouped peasants and peasants grouped in cooperatives, working around the peanut sector.

Four peanut varieties are found in the study site, distributed in the following figure:

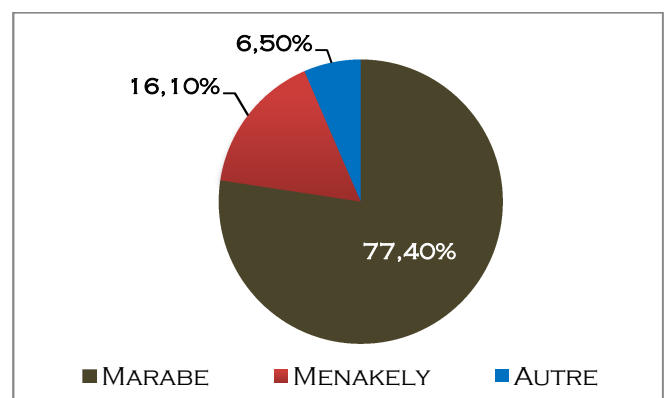


Figure 1: Distribution of variety planted in the studying site

The Marabe variety is the most planted in this region (more than $\frac{3}{4}$ of planters). This variety is the only most favorable variety from efficiency/ecology based on the experience of farmers. Other varieties also occupy a little important place: menakely variety.

The most practiced technical planting by these planters is the 25cm x 25cm in-line technical, i.e. about 160 000 plants/ha, with the type of rainfed crop.

For commercialization and transformation, 60% of farmers sold raw groundnuts to collectors due to inefficiency of extraction equipment and the remaining 40% directly processed peanuts, and then sold to two different customers the obtained products: crude oil and cake.

With regard to the latter, most of the artisanal mills in both sectors use only non-traditional equipment, with an unsatisfactory extraction efficiency (defined by the ratio between the amount of oil obtained by extraction and the quantity of oil contained in the raw material). that leads to a

loss of oil, which leads us to orient one of our researches for improvement.

B. SOIL ANALYSIS

1. Chemical analysis

Table1: Chemical Analysis of samples from the sector of Ampary and Anosibe-Ifanja

Samples	N%	K(me/100g)	P(Oisen) in ppm
AMPARY	0.021	2.490	321.250
ANOSIBE-IFANJA	0.090	0.910	60.170
REFERENCESOIL (Arivonimamo)	0.014	0.060	2.790

The soil which was taken from the field of Ampary sector is six times rich in Phosphorus element compared to the one from Anosibe-Ifanja. However, these two samples are very rich in nitrogen, phosphorus and potassium compared to the Arivonimamo reference soil (Table 1). We can say that they have a fertilizing value because P and K

are among the major nutrients. Nitrogen could be improved by cropping methods or provided by precipitation.

Table 2: X-ray Fluorescence Spectrometry Analysis Result from the Ampary Sector

Elements	Al ₂ O ₃	SiO ₂	CaO	TiO ₂	V ₂ O ₃	MnO	Fe ₂ O ₃
% in mass	13.066	39.348	10.524	4.417	-	0.219	15.158
Elements	PdO	K ₂ O	SeO ₃	SrO ₂	SrO	P ₂ O ₅	BaO
% in mass	2.500	1.724	0.100	0.05	-	1.028	0.150

Table 3: X-ray Fluorescence Spectrometry Analysis Result from the Anosibe-Ifanja Sector

Element	Al ₂ O ₃	SiO ₂	CaO	TiO ₂	V ₂ O ₃	MnO	Fe ₂ O ₃
% in mass	24.000	35.000	11.900	3.700	0.100	0.280	20.800
Element	PdO	K ₂ O	SeO ₃	SrO ₂	SrO	P ₂ O ₅	BaO
% in mass	-	0.480	0.098	-	0.090	0.600	0.100

These samples contain some minor elements such as Ca and Mg and many trace elements are presented in the form of oxide essential for the development of plants (Table 2 and 3).

2. Physical Analysis

The two X-ray fluorescence specter is the soil specter from the Ampary sector and Anosibe-Ifanja field. They have a lot of similarity.

The very intense line peak at 6.5 keV corresponds to the iron element for the K α line and to 7 keV for the K β line. These soils also contain Calcium Ca with a mean energy intensity of 3.8 keV, Potassium K at 3.2 keV. For Manganese Mn, there is the intense K β line at 6.7 keV and the low intensity K α line at about 6 keV. The sample also contains low-intensity line silicon at 1.8 keV.

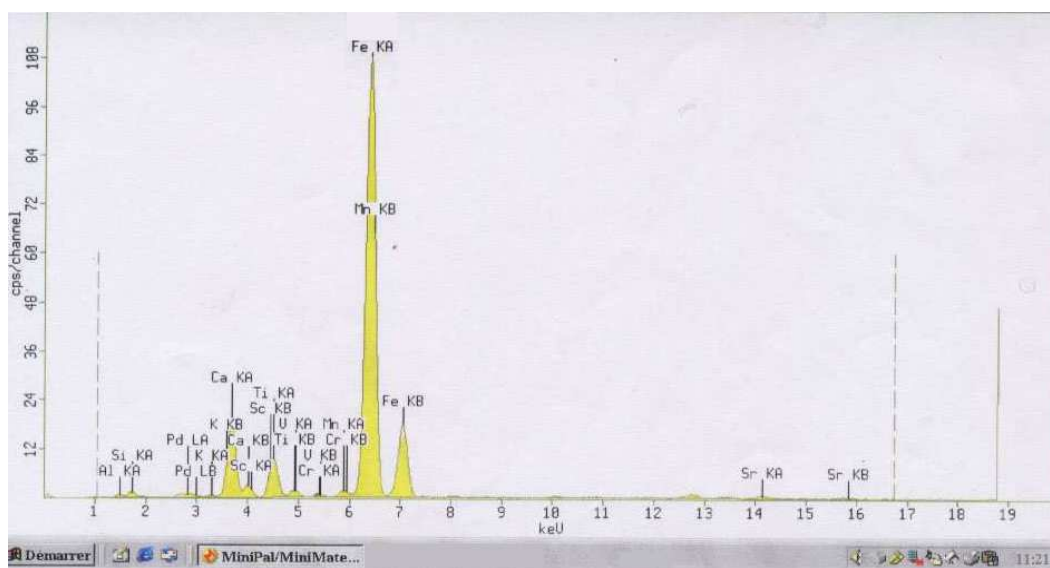


Figure 2: X-Ray Fluorescence spectrometer analysis of Soil in Ampary Sector

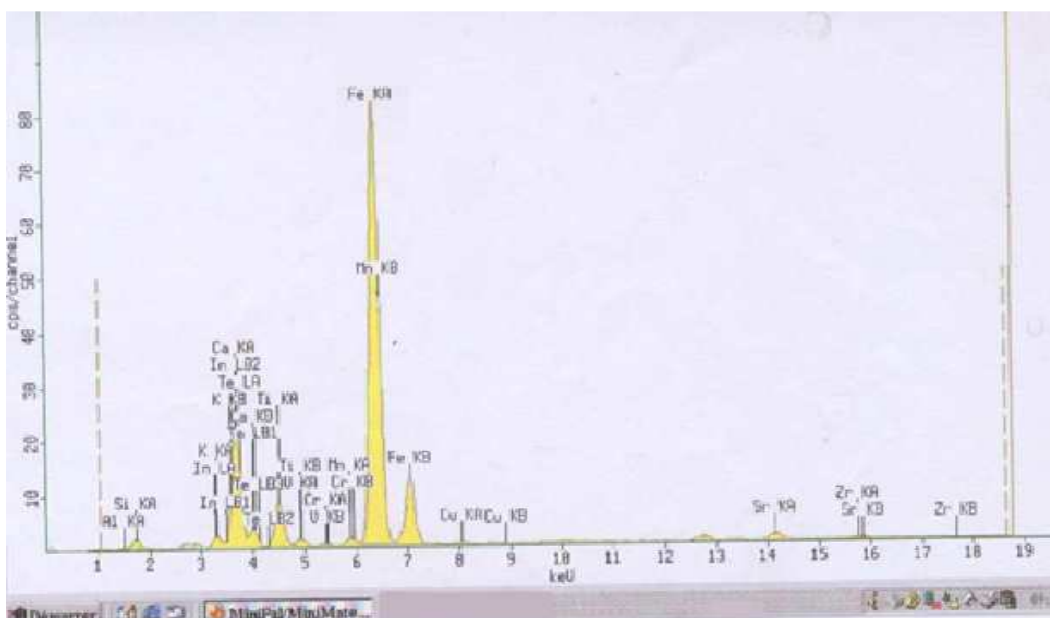


Figure 3: X-Ray Fluorescence spectrometer analysis of Soil in Anosibe-Ifanja Sector

C. GRANULOMETRIC ANALYSIS

Table 4: Granulometric analysis: sample from Ampary

Samples	Ampary 1	Ampary 2	Ampary 3
Texture	Silty sand	Silty sand	Silty sand

Table 5: Granulometric analysis: sample from Anosibe-Ifanja

Samples	Ans-Ifanja 1	Ans-Ifanja 2	Ans-Ifanja 3
Texture	Sandb laster	Silty sand	Silty sand

These samples generally have a silty sand texture with the abundance of silica (Table 4 and 5). This texture favors the aeration of heavy soils. For THUN (German researcher), silica is useful for strengthening plant tissues and increasing natural resistance to diseases and parasite attacks.

D. ANALYSIS OF THE OIL CONTENT OF PEANUTS

1. Plantation Place: Ampary

The evolution of oil content according to the peanut harvesting period is given by the following figures 4 and 5:

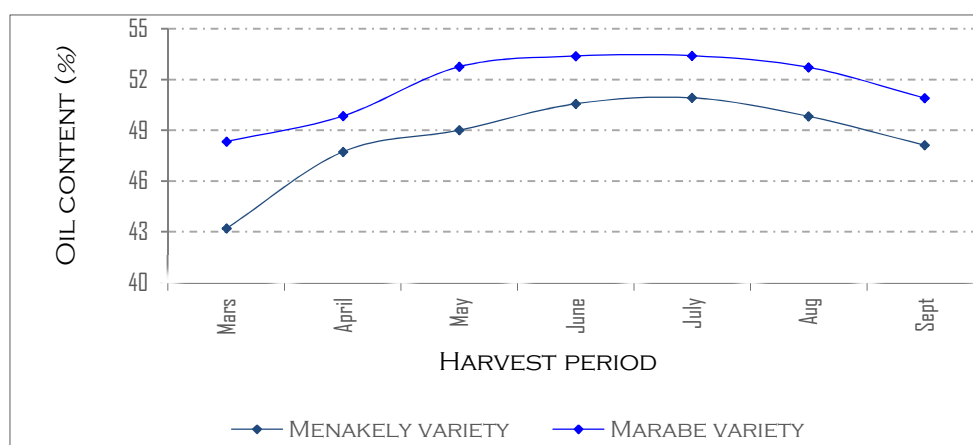


Figure 4: Evolution of the peanut oil content of two different species planting in Ampary according to the harvest period

2. Plantation Place: Anosibe-Ifanja

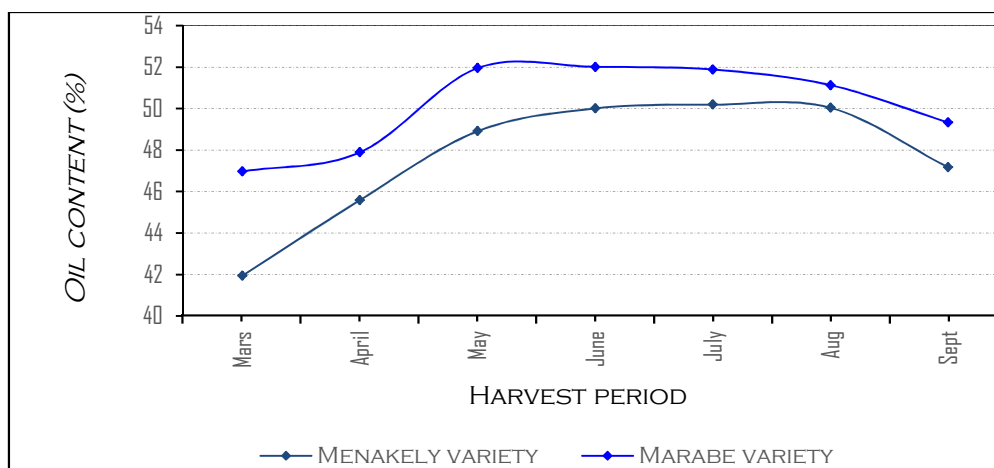


Figure 5: Evolution of the peanut oil content of two different species planting in Anosibe-Ifanja according to the harvest period

The two graphs above (figures 4 and 5) show that the optimal harvest period is between May and July in both study areas:

- For Ampary sector : the maximum oil content is 53.41% for Marabe variety (in June) and 50.94% the menakely variety (in July) ;
- For Anosibe-Ifanja sector: the maximum oil content is 52.01% for Marabe variety in May and 50.19% the menakely variety (in July).

Beyond this period, this oil content is not interesting.

On the soil side, the volcanic soil of Ampary is more favorable and therefore interesting for the cultivation of

peanuts compared to the volcanic soil of Anosibe-Ifanja: this is the presence of trace elements and nutrients essential for development cultures in volcanic soil, but in different quantities.

E. EXTRACTION EQUIPMENT DESIGN TEST

Almost all the artisanal plants found in the study area have inadequate extraction efficiency, due to the inefficiency of the extractor. As a result, the design of new equipment was carried out during our study with the aim of substituting the horizontal screw press.

Four different constraints were overcome during this work:

- *Security constraint:* To avoid any impact during handling, the equipment must have protections and meet a certain standard to ensure the safety of users.
- *Flexibility for utilization:* The device requires a flexibility of use, that is to say easy to handle and easy to maintain, it must be compact and easy to move.
- *Economic constraint:* the cost of production is a very important factor in the design of the device. To minimize the cost of investments, this

equipment must be made from locally available raw materials and parts that can be new or recovered. In addition, the hydraulic press must also be designed so that its use and maintenance do not require additional investment.

- *Material constraint:* Design and construction are limited by the machines and machines available. In addition, some important pacylindereters mentioned in the first part are not accessible and calculable due to the lack of measuring devices and available data.



Photo : Horizontal screw press



Photo : Single cylinder hydraulic press

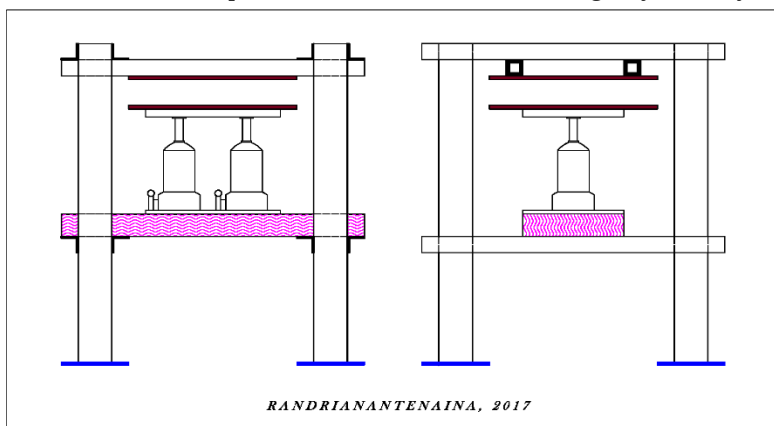


Photo : Double cylinder hydraulic press

Table 6: Evolution of the extraction efficiency by the horizontal screw press and the improved press (hydraulic press with single and double cylinder) for the sample collected at Ampary in March of the marabe variety

	Test 1	Test 2	Test 3	Test 4	Average value
Extraction efficiency HSP ¹ (%)	39.10	38.30	39.00	36.20	38.15
Extraction efficiency of SCHP ² (%)	63.00	61.20	60.60	61.00	61.45
Extraction efficiency of DCHP ³ (%)	71.90	71.00	72.10	70.10	71.27

¹Horizontal screw press

²Single cylinder hydraulic press

³Double cylinder hydraulic press

Table 7: Evolution of the extraction efficiency by the horizontal screw press and the improved press (hydraulic press with single and double cylinder) for the sample collected at Anosibe-Ifanja in March of the marabe variety

	Test 1	Test 2	Test 3	Test 4	Average value
Extraction efficiencyHSP (%)	37.50	36.00	33.00	36.40	35.72
Extraction efficiency of SCHP (%)	55.00	59.30	57.00	56.60	56.97
Extraction efficiency ofDCHP (%)	69.80	70.30	68.90	69.80	69.7

The tables 6 and 7 show the extraction efficiency of these three different extraction equipment. However, the extraction efficiency results are highly variable from one processing unit to another and sometimes even from one production cycle to another. As a result, it is difficult to establish the average oil efficiency of artisanal mining.

During the sample extraction test collected in the two sectors at the same time, of the same variety (marabe or

menakely), a satisfactory efficiency is obtained when using a hydraulic press compared to the traditional screw press: a variance from 21.25% to 23.30% (single cylinder hydraulic press).

In addition, productivity also increases when increasing the pressure force: an increase in efficiency from 9.82% to 12.73%.

Table 8: Evolution of the extraction efficiency by the horizontal screw press and the improved press (hydraulic press with single and double cylinder) for the sample collected at Ampary in March of the menakely variety

	Test 1	Test 2	Test 3	Test 4	Average value
Extraction efficiencyHSP (%)	35.10	34.90	36.00	34.10	35.02
Extraction efficiency of SCHP (%)	58.90	57.00	56.20	57.10	57.30
Extraction efficiency ofDCHP (%)	69.10	67.00	68.10	67.20	67.85

Table 9: Evolution of extraction efficiency by the horizontal screw press and improved press (hydraulic press with single and double cylinder) for the sample collected at Anosibe-Ifanja in March of Menakely variety

	Test 1	Test 2	Test 3	Test 4	Average value
Extraction efficiencyHSP (%)	34.50	33.10	33.20	32.20	33.25
Extraction efficiency of SCHP (%)	53.10	52.30	54.40	52.60	53.10
Extraction efficiency ofDCHP (%)	64.20	63.90	63.90	64.20	64.05

Similarly for the menakely variety, the higher the pressure force increases, the higher the extraction efficiency is (Table 8 and 9).

However, we can say, without much error, that the average oil efficiency of a craft unit depends only on the

efficiency of the technology used. Referring to the previous result (optimal performance depending on the technology used), the results quoted for the rest of our work are obtained with the hydraulic double cylinder press.

F. EVOLUTION OF EXTRACTION EFFICIENCY ACCORDING TO TIME, FIELD OF CULTURE, VARIETY AND EXTRACTION TECHNOLOGY

1. Marabe variety

1.1 Cultivation site : Ampary sector

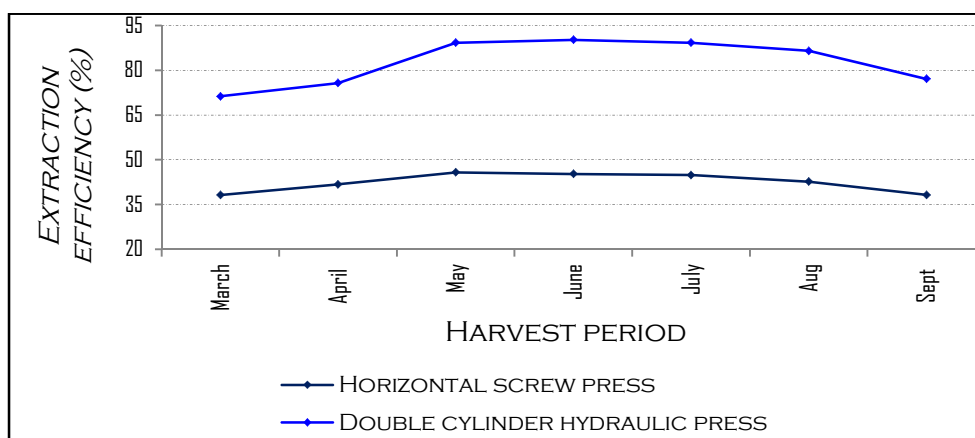


Figure 6: Evolution of the extraction efficiency of peanut oil of marabe variety, grown in Ampary, by the horizontal screw press and the improved press according in the harvest period

1.2 Cultivation site : Anosibe-Ifanja sector

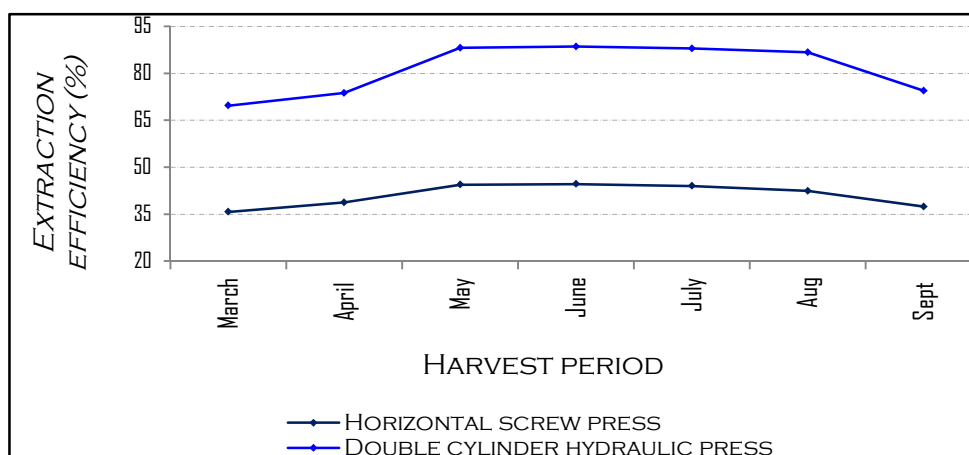


Figure 7: Evolution of the extraction efficiency of peanut oil of marabe variety, grown in Anosibe-Ifanja, by the horizontal screw press and the improved press according in the harvest period

These two figures (Figure 6 and 7) represent the extraction efficiency of peanut oil according to the collection time, with the marabe variety but grown in two different sectors. Whatever the extraction technology used

(horizontal screw press, or hydraulic press actuated a double cylinder), the sample from the Ampary sector gives a good performance compared to the sample from Anosibe-Ifanja:

- The average annual efficiency (March - September) is 42.37% for the Ampary sector against 41.04% for the Anosibe-Ifanja sector, using the traditional screw press;
- And an annual efficiency of 82.77% for Ampary and 81.32% for Anosibe-Ifanja, using the hydraulic press.

In addition, the best peanut oil extraction efficiency, that is, to have a peanut well matured is the peanut harvested in May and in June, when one plants in mid-November, some in the volcanic region of Itasy. This efficiency is less interesting if we harvest the peanut at the end of this period.

2. Menakely variety

2.1 Cultivation site : Ampary sector

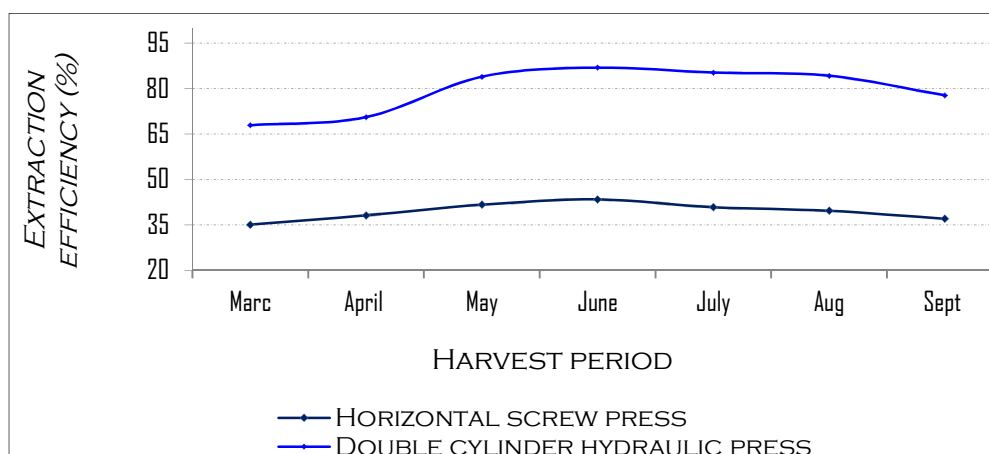


Figure 8: Evolution of the extraction efficiency of peanut oil of menakely variety, grown in Ampary, by the horizontal screw press and the improved press according in the harvest period

2.2 Cultivation site : Anosibe-Ifanja sector

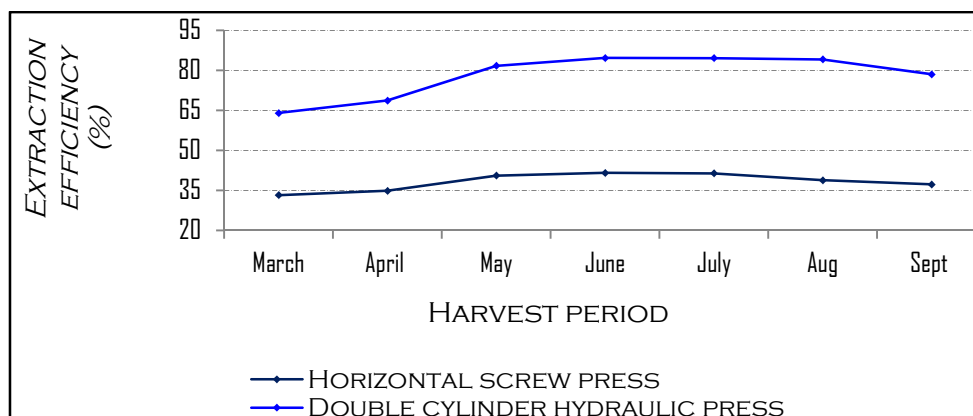


Figure 9: Evolution of the extraction efficiency of peanut oil of marabe variety, grown in Anosibe-Ifanja, by the horizontal screw press and the improved press according in the harvest period

As the marabe variety, the menakely variety harvested between May and June (planted in mid-November) in the Itasy region has an interesting efficiency especially with the improved press (Figure 8 and 9).

G. EVOLUTION OF THE EXTRACTION EFFICIENCY ACCORDING OF CULTIVATION SITE, OF TIME AND OF EXTRACTION TECHNOLOGY

1. Marabe variety

1.1 Extraction by the traditional screw press

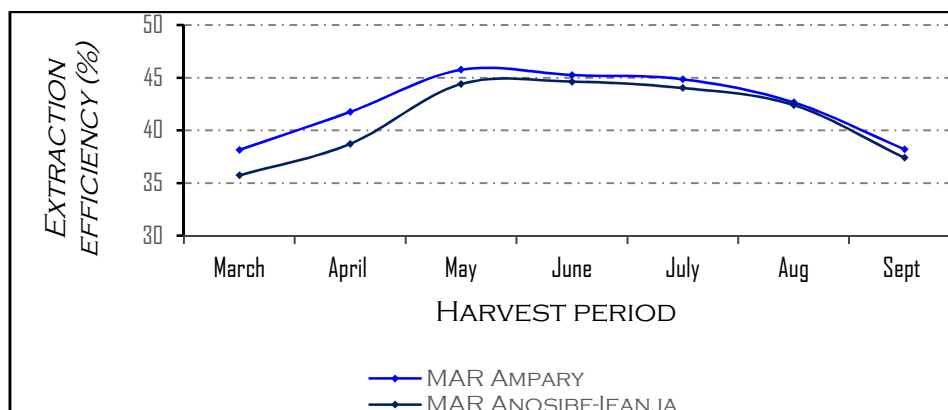


Figure 10: Evolution of the extraction efficiency of peanut oil for marabe variety by the horizontal screw press according to the time, of harvest period and the culture site

1.2 Extraction by hydraulic press actuated with double cylinder

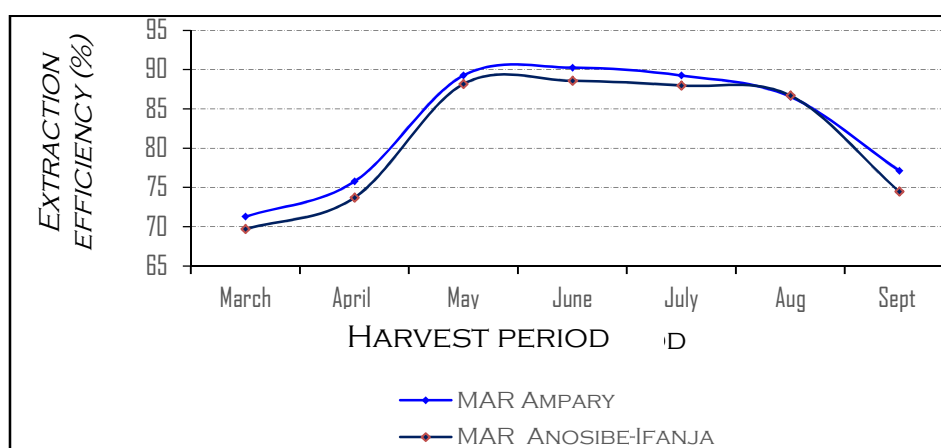


Figure 11: Evolution of the extraction efficiency of peanut oil for the Marabe variety by the hydraulic press actuated with double cylinder according to the time, of harvest and the cultivation site

The maturation of peanuts evolves gradually as a function of time. Between April and May, this maturation has a sudden change of increasing variation. From May, oil content is almost constant until July, followed by a slight decrease in August. Then, the yield decreases sharply from

August until September. Hence, the ideal and favorable period for harvesting Marabe variety peanut is between May and June; there is a decrease in yield beyond this period (Figure 10 and 11).

2. Menakely variety

2.1 Extraction by the traditional screw press

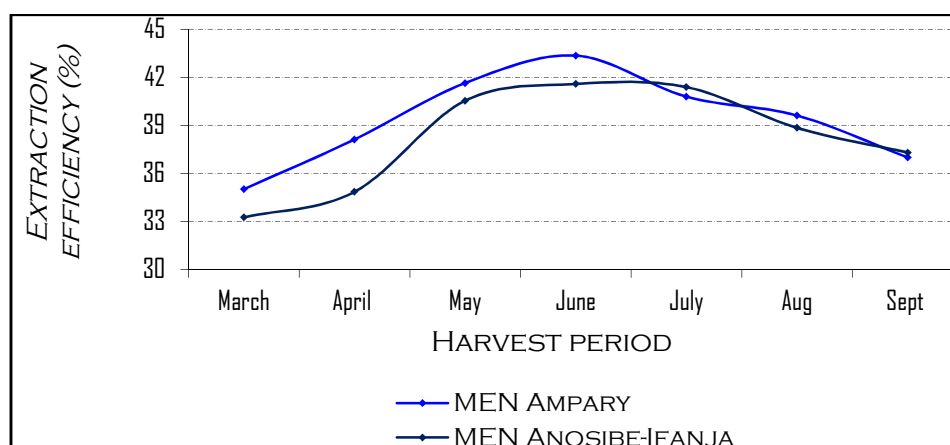


Figure 12: Evolution of the extraction efficiency of Menakely peanut oil by the horizontal screw press according to the time of harvest and the culture site

2.2 Extraction by hydraulic press actuated with double cylinder

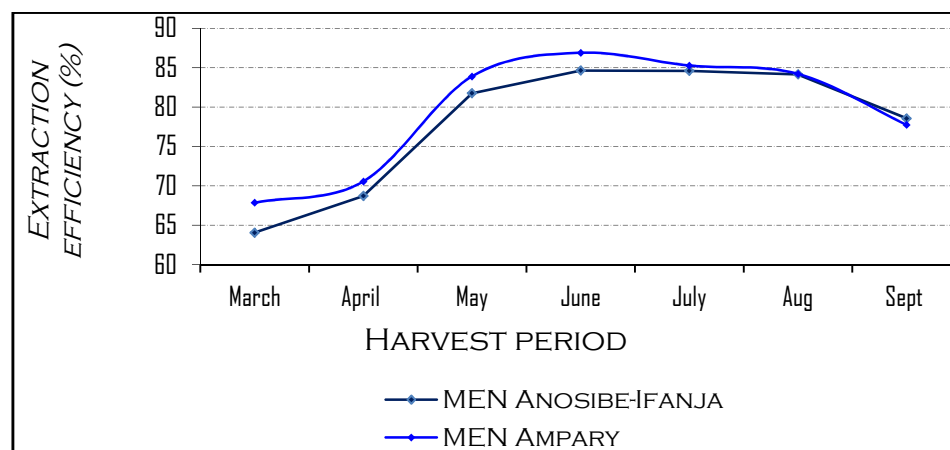


Figure 13: Evolution of the extraction efficiency of Menakely peanut oil by the double cylinder hydraulic press according to the harvest time and the growing site

As for the marabe variety, the maturation of the menakely variety also evolves over time. But the favorable collection period for oil extraction is between mid-May and mid-June. From where a delay of about 15 days compared to the Marabe variety (Figures 12 and 13).

V. CONCLUSION

. This research we have carried out on the groundnut sector in the Itasy region are already showing interesting results and encouraging small farmers to choose the variety to be exploited and the technology adapted for the extraction process.

Indeed, after a review of the scientific literature and the technique on the groundnut sector in Madagascar, the pedological characterization of two study sites, the experimentation on peanut cultivation, the design of an extraction apparatus to On the artisanal scale, we have tried to determine the optimum period of harvesting peanut oil.

From the point of view of the selection of the peanut variety among the most cultivated varieties of this zone, the Marabe variety is the most compatible with the soil of this region having a quantity of oil which is always important. In addition, the harvest period for obtaining the optimum amount of oil is between May and June for the Marabe

variety and from mid-May to mid-June for the menakely variety, in the seed condition, the most applied by farmers (mid-November). Finally, for the extraction technology, the use of hydraulic double-jack presses is efficient, more efficient, flexible to use from the technical point of view but an expensive people from the economic point of view.

In short, the results of our work allow us to affirm that we can improve the exploitation of the groundnut sector in the Itasy region, especially for small farmers. In conclusion, this project is in great demand for the economic development and the improvement of living standards of the peasants of this region.

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