Annexe X: Marchés de miels

Matrice BCG des dix principaux pays importateurs de miels

Les principaux pays importateurs de miel sont ceux qui pourraient constituer les futurs marchés des exploitations apicoles.

Tableau 65 : Matrice BCG des dix principaux pays importateurs de miels

Nom	Taux de Croissance	Part de Marché Relative	Chiffres d'Affaires
Chine	3%	3,553907	5134
Espagne	31%	1,676119	3456
Inde	36%	0,78396	1917
Royaume-Uni	27%	0,323358	1324
France	15%	0,545262	1060
Arabie saoudite	17%	0,936347	1050
Allemagne	42%	0,505754	1047
Portugal	-1%	0,593993	703
Afrique du Sud	6%	0,457023	676
Madagascar	21%	0,040747	128
Ethiopie	169%	0,583531	983
Moyenne	20%	0,94	

Source : Trade Map, 2016
Calcul : Auteur, 2016

Espagne est le marché star en termes d'importation de miels. Le taux de croissance, la part de marché relative et son volume d'importation en miel est élevé. La chine est en position vache lait. Arabie Saoudite est en phase de transition. Inde, Allemagne et Royaume Unis sont en position dilemme. Madagascar importe du miel. France, Afrique du Sud et Portugal sont en position poids mort.

Tableau 66 : Matrice BCG des importations des Pays membres de la COMESA

Nom	Taux de Croissance	Part de Marché Relative	Chiffres d'Affaires
Maurice	11%	2,191774	847,8
Soudan (Nord + Sud)	58%	2,108012	815,4
Rwanda	8%	2,898581	1121,2
Egypte	44%	0,426566	165
Zimbabwe	29%	0,41364	160
Ethiopie	51%	0,402265	155,6
Kenya	-9%	0,590729	228,5
Seychelles	6%	0,292133	113
Ouganda	-3%	0,25594	99
Malawi	8%	0,083245	32,2
Congo, République	-10%	0,137535	53,2
Djibouti	-22%	0,082728	32
Madagascar	-3%	0,023784	9,2
Zambie	-6%	0,033091	12,8
Comores	25%	0,005688	2,2
Swaziland	-44%	0,046017	17,8
Burundi	-36%	0,008273	3,2

Source : Trade Map, 2016
Calcul : Auteur, 2016

D’après la matrice des importations de miels au sein du marché de la COMESA, Soudan est en position star en termes d’importations. Le Rwanda et Maurice sont entre la position Star et Vache Lait. Le Kenya est entre la position vache lait et poids mort. Ethiopie, Egypte, Zimbabwe, Comores, Malawi et Seychelles sont en position dilemme.

Tableau 67 : Matrice BCG des importations de miels des Pays membres de la SADC

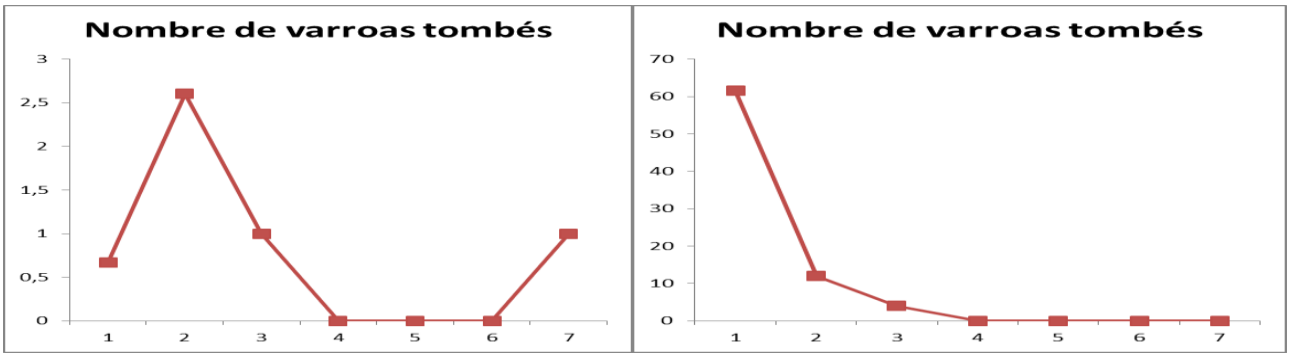
Nom	TC	PMR	CA
Afrique du Sud	2%	5,578016	3532
Maurice	11%	1,338913	847,8
Angola	-4%	1,265635	801,4
Namibie	8%	0,431459	273,2
Botswana	15%	0,299116	189,4
Zimbabwe	29%	0,252685	160
Seychelles	6%	0,178459	113
Mozambique	10%	0,168351	106,6
Tanzanie, République	13%	0,168983	107
Lésotho	2%	0,120657	76,4
Malawi	8%	0,050853	32,2
Congo, République démocratique	-10%	0,084018	53,2
Madagascar	-3%	0,014529	9,2
Zambie	-6%	0,020215	12,8
Swaziland	-44%	0,028111	17,8

Source : Trade Map, 2016
Calcul : Auteur, 2016

Annexe XI: Traitements contre la varroase

1. Traitements Apiguard

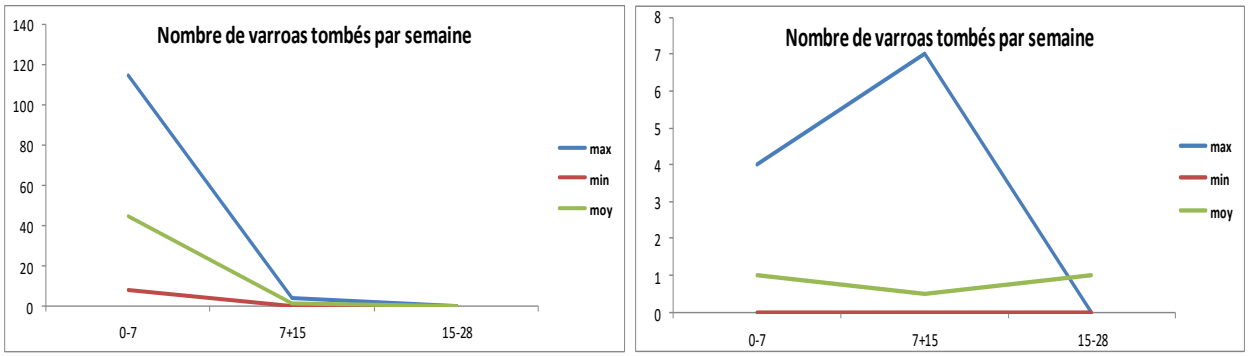
Graphe 49 : Nombre de varroas tombés chaque 3 jours sous traitement Apiguard à Rantolava de Mai-Juin 2013



Source : FENAM, 2015
Calcul : Auteur, 2016

Taux de désertion <70%

Graphe 50 : Nombre de varroas tombés chaque semaine sous traitement Apiguard à Rantolava de Mai- Juin 2013



Source : FENAM, 2015
Calcul : Auteur, 2016

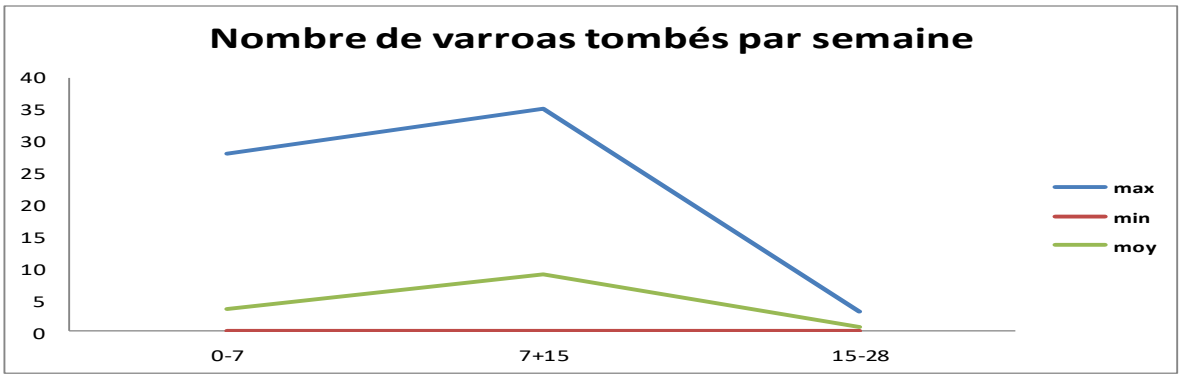
2. Traitements Apistan

Graphe 51 : Nombre de varroas tombés chaque 3 jours sous traitement Apistan à Rantolava de Mai-Juin 2013

Source : FENAM, 2015
Calcul : Auteur, 2016

Taux de désertion <20%

Graphe 52 : Nombre de varroas tombés chaque semaine sous traitement Apistan à Rantolava de Mai-Juin 2013



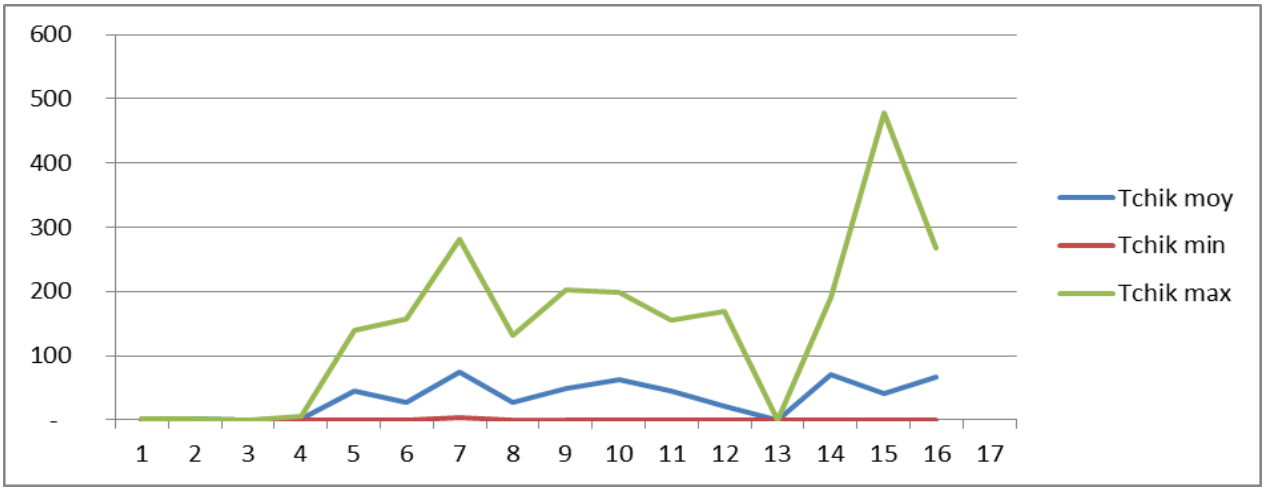
Source : FENAM, 2015
Calcul : Auteur, 2016

3. Traitements Tchik

Les trois courbes représentent le nombre de varroas tombés à chaque période de comptage de varroas:

- Tchik moy : nombre moyen de varroas tombés dans une ruche sous traitement Tchik
- Tchik min : nombre minimum de varroas tombés dans une ruche sous traitement Tchik
- Tchik max : nombre maximum de varroas tombés dans une ruche sous traitement Tchik

Graphe 53 : Nombre de varroas tombés chaque 3 jours sous traitement Tchik à Manambondro de Mai-Juin 2015



Source : FENAM, 2015
Calcul : Auteur, 2016

Taux de désertion <10%

Le résultat montre que le produit Tchik est efficace. Il fait tomber les varroas. Le taux de varroas tombé commence à partir du 2-3 ème jour de la mise en place du traitement et s'étale presque sur 1 mois. Le nombre de varroas tombé peut atteindre 480 en l'espace de deux jours.

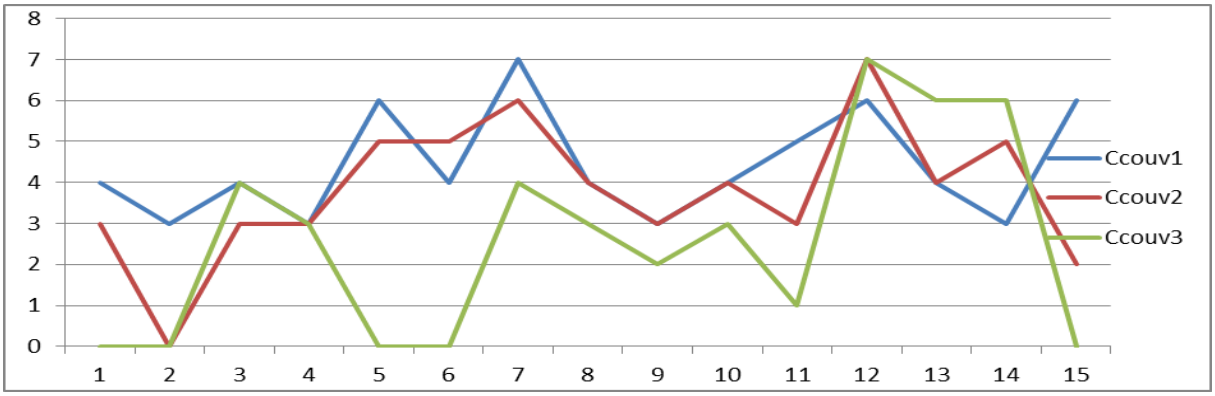
Il y a évolution du nombre de cadres à couvains mâles dans chaque ruche test après application de traitement Tchik Apigener sur 3 séances de suivi (Graphe 50).

- Ccouv1 : Nombre de cadres à couvains mâles dans chaque ruche avant la mise en place de

traitement, étape0

- Ccouv2 : Nombre de cadres à couvains mâles dans chaque ruche lors du premier suivi
- Ccouv3 : Nombre de cadres à couvains mâles dans chaque ruche lors du second suivi

Graphe 54 : Evolution du Nombre de cadres à couvains formés chaque 3 jours sous traitement Tchik à Manambondro de Mai-Juin 2015

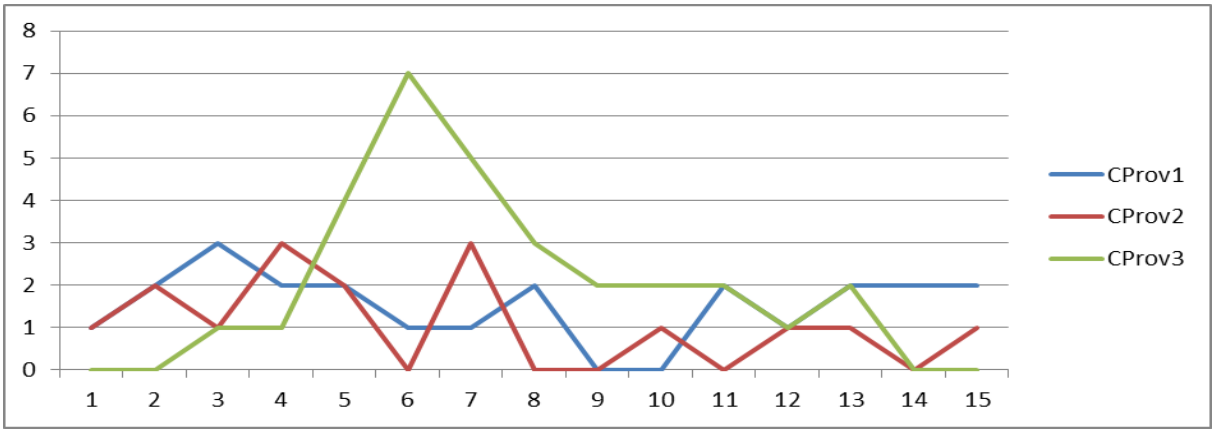


Source : FENAM, 2015
Calcul : Auteur, 2016

Les résultats par rapport à l'évolution du nombre de cadres à couvains mâles dans les ruches montrent que le Tchik agit positivement sur les ruches. Le nombre de cadres à couvains mâles en moyenne dans les ruches subit une augmentation.

Il y a eu évolution du nombre de cadres à provisions des ruches tests sous traitements Tchik apigener sur 3 séances de suivi.

- Cprov1 : Nombre de cadres à provisions dans chaque ruche avant mise en place de traitement, étape0
- Cprov2 : Nombre de cadres à provisions dans chaque ruche lors du premier suivi
- Cprov3 : Nombre de cadres à provisions dans chaque ruche lors du second suivi



Source : Auteur, 2016, FENAM

Graphe 55 : Evolution du nombre de cadres à provision des ruches testées sous tchick à Manambondro de Mai en Juin 2016

Il y a augmentation des cadres à provisions ; les colonies sous traitement de Tchik commencent à améliorer leur capacité de production de provision.

Annexe XII : Quelques définitions

Angiospermes : Ils possèdent des ovules contenus dans des ovaires qui à la suite d'une double fécondation, donneront un fruit ; leurs organes reproducteurs sont condensés en une fleur

Biocénose : Etres vivants qui résident dans le biotope

Biotope : Correspond à un milieu de vie délimité géographiquement dans lequel les conditions écologiques : température, humidité, etc sont homogènes, bien définies, et suffisent à l'épanouissement de sa biocénose, avec lesquels ils forment un écosystème

Bonne pratique : désigne, dans un milieu professionnel donné, un ensemble de comportements qui font consensus et qui sont considérés comme indispensables par la plupart des professionnels du domaine, qu'on peut trouver sous forme de *guides de bonnes pratiques* (GBP). Ces guides sont conçus par les filières ou par les autorités. Ils peuvent se limiter aux obligations légales, ou les dépasser. Comme les chartes, ils ne sont opposables que s'ils ont été rendus publics. Ils sont souvent établis dans le cadre d'une démarche de qualité

Cahiers des charges des projets : ils précisent les modes d'organisation et d'exécution des projets convenues entre les financiers et les entités bénéficiaires

Facteurs édaphiques : sont les facteurs liés aux caractéristiques géologiques et physico-chimiques du substrat dans un milieu terrestre. Les conditions environnementales sont déterminées plus par les caractéristiques physiques, chimiques et biologiques du sol que par le

Jachère apicole : consiste en la plantation de plantes appréciées par les abeilles

Jachère fleurie : a pour objectif principal d'améliorer la qualité des paysages et de servir de nourriture aux pollinisateurs

Méthode MARP : Approche de collecte rapide sur terrain d'informations riches et fiables ...qui met l'accent sur la valorisation des connaissances et savoirs des populations locales

Marché de niche : Un marché de niche est un marché très étroit correspondant à un produit ou service très spécialisé. Le fait de viser un marché de niche permet souvent d'être confronté à une concurrence moins forte et à un potentiel de marges plus élevées, mais les volumes de ventes potentiels sont naturellement plus faibles et limités.

Annexe XIII: Publications et présentations

1. R. Kahane, L.M. Martín Martín, A. Martín, XXVIII International Horticultural Congress on Science and Horticulture for People (IHC2010): International Symposium on Horticulture for Development. S. Ramananarivo, **S.I. Andriamanalina**, J.L. Raharijaona, J.Ralihalizara, R. Ramananarivo. LITCHI FRUIT AND HONEY PRODUCTION: POSITIVE EXTERNALITIES. International Symposium on Horticulture for Development, held in Lisbon, Portugal, on 22–27 August, 2010, IHC2010 congress. Acta Horticulturae n°. 921, Dec. 2011, 1 vol.,15 × 21 cm, ISBN: 978-90-66054-50-9 , ISSN: 0567-7572

2. **ANDRIAMANALINA Sendra Irina**, RAMANANARIVO Sylvain, RINDRA RAZAFIMANJATO Mandimbiniaina, RAMANANARIVO Romaine - L'APICULTURE POUR LA SECURITE ALIMENTAIRE DANS LE CONTEXTE DU CHANGEMENT CLIMATIQUE, Colloque International, "La biodiversité et les populations dans le contexte du changement climatique, présentée le 10-11décembre2013.

3. B. Patil *et al*. XXIX International Horticultural Congress on Proceeding of the Symposia of the V World Congress on Medicinal and Aromatical Plants and International Symposium on Plants, as Factories of Natural Substances, Eligible and Essentials Oils. **S. I. Andriamanalina**, S. Ramananarivo, J. Razafiarijaona, R. M. Rindra and R. Ramananarivo, Economic issues of Malagasy horticultural and beekeeping fields facing the emerging of the varroa. Acta Hortic. 1125. ISHS 2016. DOI 10.17660/ActaHortic.1125.43. pp: 333-338.

4. P R Fotso Kenmogne, F Meutchieye, **S I Andriamanalina**, A Youbissi, J Tchoumboué et J Y Pinta, CARACTERISTIQUES SOCIO-ECONOMIQUES ET TECHNIQUES DE L'APICULTURE DANS LA REGION DE L'OUEST DU CAMEROUN : CAS DES DEPARTEMENTS DE BAMBOUTOS, DE LA MIFI ET DE LA MENOUA, Livestock Research for Rural Development 26 (12) 2014, LRRD Newsletter.

Litchi Fruit and Honey Production: Positive Externalities

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Keywords: productivity, external economy, global GAP

Abstract

The East coast of Madagascar is famous for the quality of its litchi fruit and its honey. The annual litchi production, approximately 40,000 t fruit and 10 t honey justifies an economic study on the externalities of this sector. The objective of the study consists of verifying the hypothesis that positive externalities should motivate farmers towards the two products. Preliminary studies of the two sectors have been conducted in one district only. To determine the externalities, a model along with profitability analysis has been designed. The study of the two products intended to end up with one combined sector "litchi fruit and honey". Litchi fruit production is positively correlated to the amount of honey harvested. The study of externalities along with profitability analysis has revealed that investment in growing litchi trees is also beneficial to honey production. The combination of these two products generates double economic income while ensuring a significant increase in production of mono floral honey. Moreover, if litchi production complies with Global GAP standards, it will open markets for mono floral honey export.

INTRODUCTION

Malagasy national policy to redress deficit trade balance is an opportunity to promote local products exportation such as litchi. For many years the country has been exporting significant quantities of this fruit, which represents 1/3 of the national production (Groupement des Exportateurs de Litchi, 2008). Litchi has become a part of the Christmas and New Year celebrations in Europe. It is also appreciated for its exotic taste and its red color which reminds the red island where it comes from. After harvest time, litchi is transported by cargo planes to ensure that fresh fruit reach consumers without delay. Currently, Malagasy litchi dominates the European market with a volume of 20,000-25,000 t per year (70% market share), far ahead of South Africa (9,129 t per year, 28,4%) and La Reunion (321 t per year, 1%) (Groupement des Exportateurs de Litchi, 2008). Late harvest in Asian countries does not allow their litchi fruit to get into the European market at the same period of the year. However, two major constraints threaten the Malagasy position. First, the Global GAP standards impose that fruit products entering the European market come from well organized orchards (Global GAP, 2007). This is a problem in Madagascar where the litchi sector is based on gathering activity. Establishing well structured orchards would require additional and costly investments that are still lacking in Madagascar. It is also important to mention that litchi gathering is a seasonal activity for farmers, providing only secondary incomes. Complying Global GAP standards would require additional expenses which individual farmers cannot afford. Therefore, to keep the leading place in the European market, new options shall be found. Second, sulfur treatment commonly used as fungal preservative practice before shipment now is an issue at consumers' level. Consumers are more and more strict about food safety and quality and prefer organic and certified products. Consumers' preference over Malagasy fruit has decreased from 2003 to 2009 (Trade MAP, 2010). Meanwhile, competitors like South Africa have reorganized their plantation and their fruits are now

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more appreciated. Malagasy litchi growing system includes 80% wild plantation, 15% farmers planting and 5% orchards (Centre d'Information Technique et Economique, 2003). A technical and marketing solution shall be found to reverse this slowdown of Malagasy litchi exports and secure its market share again.

As litchi export principle is generally at risk, we suggest a new strategy to increase market share for Malagasy litchi during the conversion period into Global GAP orchards. As an alternative, the combination of litchi fruit and honey productions should be studied as an option to fill the gap. The two products could be presented to the European market during Christmas and New Year celebrations, both available at the same time and benefiting each other. The adoption of good practices in litchi production would imply not only ecological impacts but also social and economic changes over a long period of transition. Some dynamic external factors (externalities) would lead farmers to diversify their activities from production to commercialization. For instance, they should bring their litchi-honey to the market themselves, during a relatively short period. Gains from honey production would decrease investments supported by orchard restructuration and vice versa (Arrow, 1975). However, honey as litchi diversification would have a chance if there is a market to absorb the product.

This paper aimed to present opportunities for diversified litchi products dedicated to export through three tested hypotheses: i) Litchi market is a niche market; ii) Litchi fruit production has positive external effects on litchi honey production; iii) Litchi honey is an opportunity for developing the litchi fruit market.

MATERIALS AND METHODS

In order to face an increasing competition for fresh litchi fruit, a diversification of given products constitutes our basic approach: instead of producing litchi fruits only, its honey could also be an appealing export product. A research model based on bee's responses in a single-flower-variety system has been considered (Ramananarivo et al., 2005). It has been applied in Fianarantsoa region where the litchi industry would need some re-launching support.

A market-product approach based on honey world trade and markets on one side, and on litchi fruit (Global GAP) standards on the other side, contributed for modeling the dynamic evolution of new structured orchards (>1 ha). Circularity state of both products defined the yearly evolution of profitability, and allowed to define the existing synergies between them. From the optimization of the production functions, the external economies were used to present the positive influence (or externalities) that one had on the other (Heller et al., 1976).

Testing Hypothesis 1: Litchi as a Niche Market

1. Quantity. Export evolution of litchi fruit of Madagascar within a long period from 2003 to 2009 (Trade Map, 2010) provided valuable information for quantity; quality or price. These informations are the bases of the market study. The quantity Q_{mj} defines the average quantity exported to a country over the period. It equals:

$$Q_{mj} = \Sigma Q_{ij} / I \quad (1)$$

where i =1 to n, Q_{ii}: quantity imported by country j in the year i and I: number of years

Compared to the general average, Mq, it allows deciding between the countries according to their needs. The frequency F_j considers the total shipment number N_{ii} to the country j over all the period.

$$Fj = \Sigma N_{ij} \quad (2)$$

where i =1 to n

Compared to the general average of the shipments Mf, countries are into punctual or permanent importers. The conjunction of these two data within the same plane of the coordinates (Mq,Mf), defines the perceptual card of the product by the country according to the coordinates Q_{mj}, F_j. In order to generate visual and synoptic results, we had to

present the most or the least important countries in the system or the coordinates according to the size (Diameter) defined by the following formula:

$$Diam = ½ [Q_{mj} / \max (Q_{mj})]^{½} \quad (3)$$

Countries were positioned in relation to volume (x-axis) and average growth rate (ordinate). According to the position, a country is classified into great or small importer, and with strong or low growth rate.

2. Price. The same principle is applied for the evolution of the prices on the abscissa the quantity Q_{mj} and on the axis the price unit PU_j such as:

$$PU_j = \Sigma V_{ij} / \Sigma Q_{ij} \quad (4)$$

where i =1 to n, V_{ij}: sales

Compared to the general average, PU_m, it allows sorting out countries according to the selling prices and the imported quantities.

The conjunction of these two data within the same plane of coordinates (M_q,M_{pu}), defines the perceptual card of the product by the country according the coordinates Q_{mj}, PU_j. That allows sorting out the degree of attractiveness of the different countries.

The adjustment in relation to the evolution of exports over time, on a one year basis, is related to the history or the movements of these exports. The annual growth rate constitutes an important evolution indicator for decision making. The sign is obtained by the following formula. This allows appreciate the trends of litchi fruit exports.

$$I_n = Qt_n / Q_{base} \quad (5)$$

Testing Hypotheses 2 and 3: Synergy between Litchi Honey and Fruit Productions

In function of the experimental variables such as 'number of harvesting, X_1', 'number of swarming, X_2', and 'number of hives, X_3' the experimentation plan was defined by an equilateral triangle (Figs. 5-6). The variables evolved in the sides of the triangle. The experimental response, honey production (in kg) was a function of these three variables. Preliminary experimentations (Ramananarivo et al., 2008) carried out in Ambositra, Fandriana and Manandriana districts have contributed in defining the range of variation of these variables. These predefined positions corresponded to the values obtained in defined proportions in the following chart:

N⁰	X_1	X_2	X_3	η
1	1	0	0	η_1
2	0	1	0	η_2
3	0	0	1	η_3
4	1/2	1/2	0	η_{12}
5	1/2	0	1/2	η_{13}
6	0	1/2	1/2	η_{23}
7	1/3	1/3	1/3	η_{123}

The experimentations determined a simple mathematic model, providing the right representation of one or many phenomena in such experimental design. The resolution of the model provided a general type of production according to:

$$\eta = \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_{12}X_1X_2 + \beta_{23}X_2X_3 + \beta_{13}X_1X_3 + \gamma_{12}X_1X_2(X_1 - X_2) + \gamma_{13}X_1X_3(X_1 - X_3) + \gamma_{23}X_2X_3(X_2 - X_3) + \beta_{123}X_1X_2X_3 \quad (6)$$

The preliminary experimentation carried out in the Manakara area contributed to determine the optimal capacities for litchi honey production. Since pollination needs were only for one month (the blossoming period), the swarming variable was nullified (X_2=0) and the response curves of the model was adjusted according to the two remaining variables X_1 and X_3. The swarming value would be different if other melliferous plants were considered.

1. Modeling Profitability. The final working conditions followed these specifications:

- 70 litchi trees for 5 hives; 333 litchi trees per ha; 24 hives for 1 ha production;
- 69.5 kg of honey for 5 hives (Ramananarivo, 2008); 333 kg of honey per ha; 220 kg of

litchi fruit per tree (Centre Technique Hoticole de Tamatave, 2008) and;
- One litchi fruit weight averages 25 g.

Running the model with these specifications generated definitions of expenses, income and necessary investments for litchi fruit and honey. Investments were converted in annual uniform series of income from the general formula to the following recovery factor:

$$a = (A*i*U^n) / (U^n-1) \quad (7)$$

where a : depreciation, A = investments (orchard and hives), i: interest rate, n: number of years, U: Recovery factor (1+i)

Expenses, income and residual values were converted in the same way for comparisons purposes. Finally, the annual earning was defined as:

$$\text{Net income uniform value} = \Sigma\,[\text{Annual takings} - (\text{Annual depreciation} - \text{Annual expenses})] - \text{Residual uniforms value} \quad (8)$$

This should give an approximation of the annual average profitability, and then indications on evolutions within a longer period. The adjustment of these last indicators towards the various trends of annual production should allow obtaining the production function.

2. Positive Externalities. The detected outsources included the following relationships between a structured litchi orchard settlement and beekeeping which influenced positively the possibility of litchi honey production:

- The beekeeper worries about the volume of pollen available for his bees, and consequently about the litchi orchard on which he does not have any control;
- The fruit tree grower takes into account the value of the pollination to calculate his profit but does not consider the value of beekeeping. In this case, it is necessary to determine the production functions of each factor and assess the influences between each other. The economics theory (Coase, 1960) resolves this kind of problem for internalizing externalities by maximizing the profit for one another or by synergizing the implementation of the one by the other. A formalized presentation should follow a design where:
  - y_1 is the profitability of the beekeeper in function of litchi honey production according to the predefined conditions;
  - y_2 is the profitability of the litchi orchard in function of litchi fruit production according to the predefined conditions.

Maximizing the profit of activities, fruit and honey production is solved by their optimal profitability. The optimized profitability of the one and the other is the optimum from both activities. So it is possible to have results based on a coupled production, respectively 'Honey:Fruit' noted (y_1:y_2). It is then necessary to determine at the same time this optimum by the derivation of the respective function of profitability of the one and the other activity; the optimal conditions for each activity shall also be determined.

RESULTS

Characteristics of Litchi Fruit And Honey Exports

1. Fruit. Malagasy litchi fruit exports have declined for the last 5 years (Fig. 1) with an annual negative average rate of 17%. Among the main importers of litchi fruits in the world, France followed by Germany had an important share in volume and in growth rate. Other countries such as Mayotte and the Netherlands imported smaller volumes however, in a regular trend. The group of countries in the lower left quarter remained timid importers in both quantity and growth. With regards unit prices, those offered by France were always the highest, in contrast with Germany (Fig. 3). Prices offered by Great Britain, Mayotte, Italy and the Netherlands were attractive despite low volumes. Comoros, Belgium and the West Indies paid low unit price their imports.

2. Honey. Malagasy litchi honey exports have arisen for the last 5 years (Fig. 2). Argentina and China pulled a strong profitability of their honey export (Fig. 4). They both

dominated the international market. In comparison, market share and growth rate of Malagasy honey at the international level were very low: Madagascar appears among countries at competitive risk for honey export.

3. The Market of the Exotic Litchi Honey Product. A high number of countries presented a negative growth rate for natural honey import (Fig. 4). However, a group of countries remained with an important growth, noticeable volumes and not inconsiderable profit margin. These countries would be the ideal target for litchi honey of Madagascar.

Positive Externalities

1. Orientations of the Technical Choice for Honey Production. Following the main describing variables (Tab. 1), honey production (HP) is giving by:

$$HP = 17.6 - (17.3*X_1) - (72.8*X_2) + 67.7*X_3 + 9.3*X_1X_2 - 6.9*X_1X_3 \quad (9)$$

Without swarming (X_2=0), potential HP is shown Figure 5. With swarming ($0<X_2<36$), potential HP is presented on Figure 6. The two variables, number of harvests (X_1) and number of swarming (X_2) constituted factors of regression for the quantity of honey which should be considered. The number of hives constituted the predominant factor in honey production. As a result, the response curves of production for an optimization were drawn by fixing the swarming number to 0.

Considering the practices of local beekeepers and the rate of flowering and the number of bees visiting flowers, with 24 hives per hectare, equivalent to 14 litchi trees per hive with local condition, one hive could produce 25 kg of honey. Farmers practice was reported to be 5 trees per hive (FENAM, 2009).

2. Profitability of Honey and Litchi Fruit Productions. Litchi orchard cropping and beekeeping developed very similar trends to profitability (Fig. 7). Litchi fruit and honey profitability (TIR) could be expressed in terms of production (P) following two equations:

$$TIR_{Fruit} = -19.9+2.9*P-0.1*P^2 \quad (10)$$

$$TIR_{Honey} = -18.5+4.2*P-0.2*P^2 \quad (11)$$

The conditions for maximum profitability were indicated by derivating both equations:

$$(dTIR_{Litchi}) / dP = -0,2P + 2.9 \quad (12)$$

$$(dTIR_{Honey}) / dP = -0,4P + 4.2 \quad (13)$$

A coupled production 'Honey:Fruit' of 1:210 was calculated for maximum profitability in both production activities, meaning that 1 kg honey would be produced for each 210 kg fruits with best profitability.

DISCUSSIONS AND RECOMMENDATIONS

Drop Down Tendency of Exports

Malagasy litchi export decreases since 2003 (TradeMAP, 2010). This results from the wild old plantation which represents 80% of national production with a yield of 90 kg per tree (Centre Technique Horticole de Tamatave, 2008). That constitutes a threat to future exports as the fruit no longer follow the standards.

Results have shown that France and Germany are the major importers of fruits (Fig. 3). These countries are niche markets to keep. These two importers of fruits also have a honey market preference of lavender and niaouli honey (Apiservices, 2001).

At present, Madagascar and La Reunion only can produce such specialized honey products. However, Madagascar has not yet been able to export litchi honey. The couple product-market is new and needs promotion to accustom and attract consumers to the product. In addition, most honey importers have low development rate and low profit contribution (Ramananarivo et al., 2005). Therefore, litchi fruit producers could rather target small scale economy countries with high growth rate and qualitative demands.

Importance of Technical Choice and Economical Conditions

Since blooming of litchi tree lasts only for one month, and since swarming value is usually comprised $0 \leq X_2 \leq 36$, a zero swarm seemed to be a profitable option. Any extensions according to available cash flow could go up to 16 hectares and 330 hives over 30 years.

The association "beekeeping and litchi tree plantation" was supported by cost sharing effects; they were brought by beekeeping since it has a positive external effect on fruit production (Laffont, 1977; Meade, 1973). Our study showed that the best conditions could lead to a coupled production Honey:Fruit of 1:210. The value (210 kg) of fruit production per tree is close to the production of a well structured litchi orchard (220 kg), against 90 kg for wild litchi (Centre Technique Horticole de Tamatave, 2008), (Raharijaona, 2009).

Therefore, the coupled practice improved productivity of the litchi fruit activity and farmers' income. Litchi fruit harvest is also expected to improve in volume and quality (fruit size, taste, color, etc.). In these conditions, litchi honey was supposed to be sold at the current price of the international market, 1,771 € per ton (TradeMAP, 2010).

CONCLUSION

This report presented an economical model on positive externalities for a structured litchi orchard based on a new additional product to the fruit, litchi-honey. Producing honey appeared as a solution to help Malagasy producers become more competitive facing Global GAP standardization. This model can be considered an assistance making decision tool, intended to help the Ministry of Agriculture reducing Malagasy trade balance deficit as well as to attract regional funds for agricultural development. The model should contribute to organize a kind of International Market Fund to pull investments and stimulate innovation.

Literature Cited

Arrow, K. 1975. Political and Economic Evaluation of Social Effects and Externality. In: Frontiers of Quantitative Economics, Intriligator ed., North-Holland 3-25.

Coase, R.H. 1960. The Problem of Social Cost. Journal of Law Economics 3:1-44.

Heller, W.P. and Starret, D.A. 1976. On the Nature of Externalities. p.9-21. In: Lin, SAY (eds.), Theory and Measurement of Economic Externalities. Academic Press, New York.

Laffont, J.J. 1977. Effets externes et théorie économique. Monographie du séminaire d'économétrie, CNRS (Ed.), France. n°13.

Meade, J.E. 1973. The Theory of Economic Externalities. Institut Universitaire des Hautes Etudes. Geneva, Switzerland.

Raharijaona, J. 2009. Contraintes du référentiel Globalgap (Eurepgap) dans la culture en vue de l'exportation : cas du litchi et du corrosol. ESSA (Ed.), Antananarivo, Madagascar.

Ramananarivo, S. Ramananarivo, R. Ranaivoson, N. Randriambahoaka, T. and Rasamizafy, T. 2008. Torolalana momba ny fiompiana tantely. Fonds Compétitif de Recherche Appliquée. Antananarivo, Madagascar.

Ramananarivo, S. Ramananarivo, R. Ranaivoson, R. Randriambahoaka, T. and Rasamizafy, T. 2005. Appui à la relance de la filière miel dans la région Amoron'I Mania. Fonds Compétitif de Recherche Appliquée. Antananarivo, Madagascar.

Consulted Websites

Apiservices. 1995. www.beekeeping.com

Centre d'Information Technique et Economique. 2003. www.refer.mg

Centre Technique Horticole de Tamatave. 2008. www.ctht.org

Fédération Nationale des Apiculteurs de Madagascar. 2009. www.fenam-mada.org

Global GAP. 2007. www.globalgap.org

Groupement des Exportateurs de Litchi. 2008. www.gelmada.com

Trade MAP. 2010. Statistics for international business development www.trademap.org

Tables

Table 1. Initial data for modelisation, based on survey in Fianarantsoa, 2008. X_1: number of harvesting; X_2: number of swarming; X_3: number of hives.

X_1	X_2	X_3	X_1X_2	X_1X_3	X_2X_3	$X_1X_2X_3$	Production (kg)
1	10	100	10	100	1 000	1 000	2 100
7	35	35	245	245	1 225	8 575	280
16	16	16	256	256	256	4 096	300
6	0	50	0	300	0	0	1 500
5	2	2	10	10	4	20	6
8	5	25	40	200	125	1 000	200
4	18	18	72	72	324	1 296	120

Figures

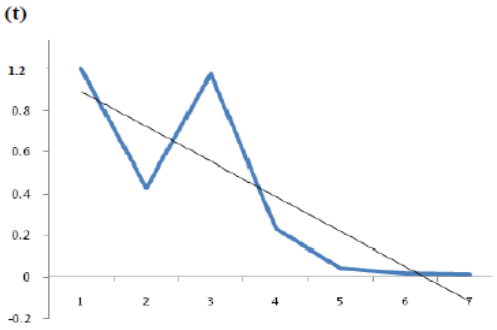

Fig. 1. Trends evolution (in tons) of Malagasy litchi fruit exports from 2001 to 2009 (TradeMAP, 2010).

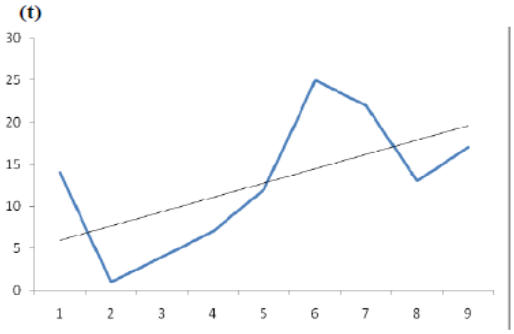

Fig. 2. Trends evolution (in tons) of Malagasy honey exports from 2001 to 2009 (TradeMAP, 2010).

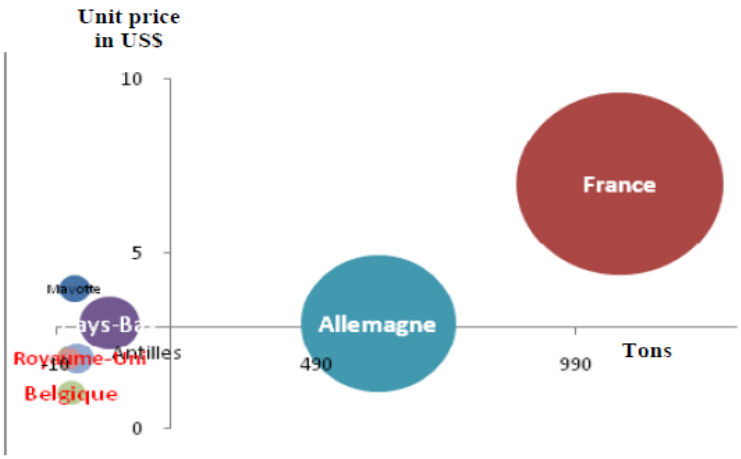

Fig. 3. Export volumes (in tons) and unit price (US$ per kg) of Malagasy litchi fruit exported to different countries (TradeMAP, 2010).

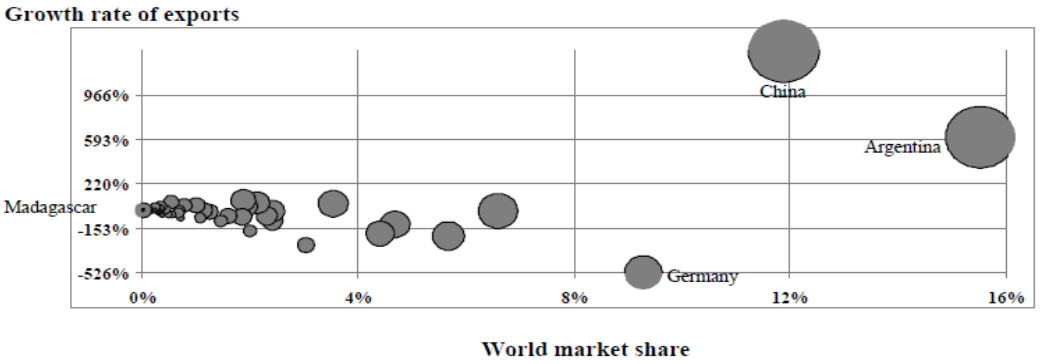

Fig. 4. World market share (in %) and growth rate (ADL) of honey exports (Trade Map, 2010).

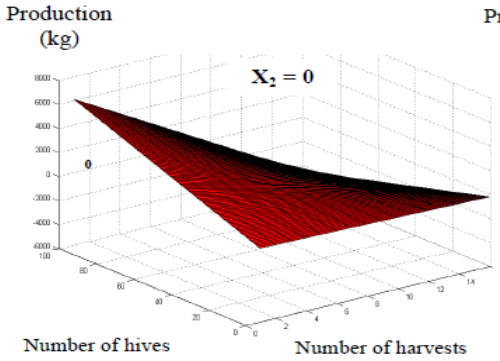

Fig. 5. Surface of response with zero swarming.

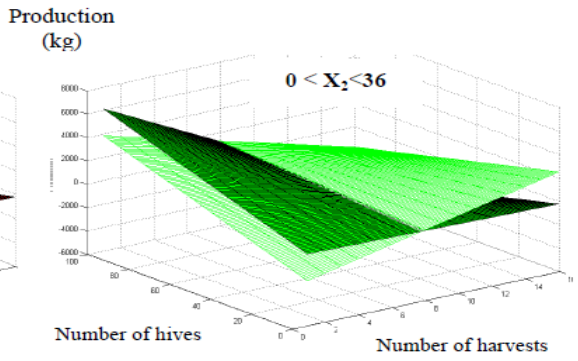

Fig. 6. Surface of response with swarming between 0 and 36.

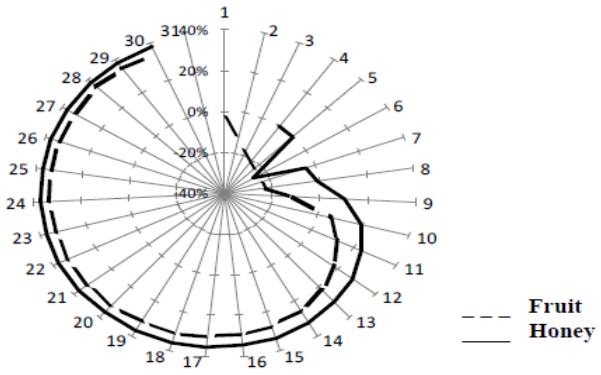

Fig. 7. Evolution of litchi fruit and honey profitability during 30 years of investments.

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