

Review Article**Levelling the ground for innovation and regional development in developing countries through APA (Automatic Patent Analysis)****ABSTRACT**

Aims:Most of the time patents are used to protect inventions. In this paper we will focus on the use of patent information to promote innovation and to facilitate regional development. Most of laboratories, regional responsible, have various questions about new areas of research, new development, valorization of local resources, etc. To provide a relevant answer to these questions, we used the APA (Automatic Patent Analysis) to show to provide various answers and suggestions.

Methodology:The APA (we will used the Matheo Patent software facility) enable from a technical subject or from a name of company or inventor from the name of a natural resource or technology, to see in details what other people have done in these fields. The level of necessary technological knowledge is also available through patent classification combined with the invention description. Competitors, possible collaborations as well as innovative ideas are also available through the APA.

Results:All this information can be used either to help innovative thinking in SMEs for instance or to engage the local decision makers in a policy of pre-clusterization or to indicate to researcher what new directions they may take with their today knowledge. In this paper the method will be presented as well as various examples dealing with Thailand and valorization of Moringa..

1. INTRODUCTION

Many works and seminars concern the use of patents to determine technologies or to analyze the strategies of different firms. Recently the patent information has been used in the WIPO program of innovation and development of SMEs[1] and in this context the clusterization, innovation and strategic dependence have been discussed in various seminars. In this paper we are not going to discuss the use of patents as a protection tool, but we will discussed of what can be done from the patent information which is available and also what is allowed or not allowed to do according the international patent laws. The used of APA Automatic Patent Analysis has been developed by various authors to facilitate the pre-clusterization especially in agricultural areas and to determine the level of strategic dependence [2][3].

In the innovation area a publication of the Carnegie council pointed out that in domains such as the wind energy, the solar power, the biofuels most of the patents are concentrated in United States and OECD countries, which means that these countries develop the technology and that the gap with the developing countries, which need these technology increase[4]. But nevertheless the aspect of technology dependence linked to the number of patents expended in developing countries has not been underlined. Other study spoke of the technology dependence according the count of the cited patents to determine the key patents [5].

The link between innovation and patent analysis has been widely described in the literature[6][7] as well as the mapping of the technologies used in various areas. But, the use of Patent analysis to open the way to create added value products from natural resources in developing countries is a starting area of applied research. The analysis of patent information allows the knowledge of products and applications already available and may suggest partnerships or new products development [8][9][10] but the focus on the couple technologies locally available and new products has not been widely explored. The WIPO (World International Patent Organization) makes available for the practitioner a wide range of information located in various publications freely available through the Internet and

46 specially directed to the SMEs[11]. Among the information available the following one are in direct
 47 relation with this paper[12]. The patent analysis conducted by Mendonça[13] which indicated that “the
 48 assumption of limited technological progress for primary commodities versus manufacturing products
 49 is no longer relevant. The relationship between manufacturing and technology has **changedover**
 50 years”. The work cited by Lisuka[14] indicates that “low technologies” may be used to create a new
 51 path for the development.**In** this paper, we will develop how to use patent information to facilitate
 52 innovation, regional development and **pre-clusterization**. A close analysis also, which can be done by
 53 using the same information source and a very close treatment may be done to determine the
 54 technological dependence of a country.[14].

55 2. THE CONTEXT

56 There are different ways to patent in a country. After the first patent granted in one country (Priority
 57 country) there is a delay of 12 months available to extend this patent to other countries. In this case
 58 there will be different patents numbers covering a family of patents. There is also the possibility to
 59 have an European Patent (EP) or a World Patent (WO), or a Patent Cooperation Treaty (PCT), or and
 60 OA patent (OAPI, the 16 French speaking countries of West Africa). For instance the following patents
 61 cover various countries:

62 **A coconut **de-husking** apparatus**, is an Australia Priority Patent PR=AU1997PO05061 10-02-1997
 63 which has been extended to Indonesia PN = ID20936A 01-04-1999. Then, the Indonesian country will
 64 be dependent of this patent (then from Australia) for this type of application.
 65

66 **Blade with empennage of vertical-axis windmills**, is a Chinese priority patent PR =
 67 CN20092052708U 16/03/2009 which has not been extended in other countries. Then if another country
 68 want to extend a patent in China or to ask for a Chinese priority patent, the foreign patent will be
 69 facing the technology already protected in China by the Chinese patent. A contrario, because this
 70 Chinese patent has not been extended, if somebody want to use it out of China it can done.
 71

72 3. MATERIAL AND METHOD

73 The database which will be used will be the worldpatent database available from the EPO (European
 74 Patent Office[16]). To query the database and to download the results (patents notices) we will used
 75 the Matheo Patent software facility[17][18]. It is also very important to note that the downloading of the
 76 patent notices from the worldpatent database is free, which is a fundamental requirement for
 77 developing countries.

78 Once the data downloaded automatically within Matheo Patent, all the possible correlations involving
 79 the various information fields of the patent notice can be done. The main fields used for the APA are
 80 the following: Patent Assignees, Inventors, IPC (International Patent Classification), word from titles or
 81 abstracts (automatically created by Matheo Patent), the different paten dates, the PN (Patent Number)
 82 the PR (Priority number). If necessary different patent notices concerning a peculiar points: group of
 83 inventors, or countries, or companies or dates or PR or PN, or words (titles and abstracts), or IPC may
 84 be created. They will be used for further analysis.

85 If the lists of technologies (through IPC), or themes (through titles and abstracts), or inventors, or
 86 patent assignee are useful, they do not answer to the various questions such as who is doing what,
 87 with whom, etc. In these conditions matrix such as the patent assignee versus the IPC or the
 88 inventors networks, will answer the questions. May example of the used to Matheo Patent in such type
 89 of analysis has been already described in the literature[19][20].

90 The method that we will used will be the following: let us say for instance Indonesia, which is one of
 91 the larger producers of coconuts in the world. In some regions, such as North Sulawesi, most of the
 92 production is aimed to a very limited numbers of transformation of the coconut product, leaving the
 93 global added value to companies other than Indonesian (for instance from Singapore). The used in

94 this case of patent analysis dealing with the concept of coconut will enable us to access to most of the
 95 technologies and applications (via the IPC), or to some detailed uses from the titles and abstracts
 96 words. Moreover, the patents possibly in the public domain (surely for those of more than twenty
 97 years, and may be for those of ten years of age) will be also available. The name of company involved
 98 in the development of products from coconut transformations will also be available, opening the way
 99 for possible collaborations.

100 The fact to underline the various applications and development of businesses from one natural
 101 product is a good way in developing countries to attract the attention of de local decision makers and
 102 to show to the various local stakeholders that may be it will be a good idea to try to move from the
 103 “ancestral” transformations to more modern ones.

104 4. RESULTS

105 The presentation of the results is done in two parts, one which deal with Indonesia and the coconut
 106 field, the second with the application of this methodology in Thailand to boost the various local
 107 clusters.

108 4.1 Indonesia

109 We present here the continuity of the analysis of the coconut field development from 2010 to 2014.
 110 Former studies dealing with the preceding years have been done and presented in various other
 111 papers. The query used was the following: coconut in title from 2010 to 2014. This leads to 624
 112 patents and 402 families.

113 4.1.1 The main countries involved

114 We build up for all the most important countries present a group for each of them. The number of
 115 patent present show the overwhelming role of China, but it is noticeable that the number of WO patents
 116 for the same country is very small. The various data are presented in the following tables:

117 **Table 1. Number of patents and families per main countries**

Countries	US A	Braz il	Indi a	Malaysi a	Australi a	Thailan d	Chin a	Mexic o	Czechoslova kia	Sout h Kore a	Taiwa n
Patents frequenc y	29	7	5	19	3	3	330	4	4	22	3
Family Frequen cy	27	4	4	5	3	3	306	4	4	22	3

118

119 **Table 2. Number of WO patents per main countries**

Countri es	US A	Bra zil	Indi a	Malay sia	Austra lia	Thaila nd	Chin a	Mexi co	Czechoslov akia	Sout h Kore a	Taiw an
WO frequen cy	8	4	3	3	2	2	2	1	1	0	0

120

From the analysis of the results of these two tables, it can be seen that if China has the larger number of patents, they have only two world patents. Other countries such as the United States show a very different trend in patenting, aiming first to World Patents. This does not mean that the Chinese patents are not relevant, because what we are considering is not only the commercial value of the patents, but the amount of information they deliver. That mean that to seek for new ideas or applications outside China, the Chine patent information contain must be carefully considered. The utility models (petty patents) which are 83 must also be considered with care because most of the time they bring new ideas of improvement.

4.1.2 Who is doing What

The matrix of the IPC 4 digits versus the main countries will provide a condensed view of which country is doing what. (partial view of the matrix)

	A01G	C05F	Empty Field	A23L	C10L	C11B	A23N	A47J	B65D	A23B	A43B	A47G	B67C	A23D	C12G	C07H	C08L	B29C	C08K	A23C	A23G	D01F	D01D	A01N	A01P	A23P
China	11		1	74		1	9	6	8	2	1	5	1	2	10	2	15	5	13	18	14	4	3	6	5	5
USA	2	2	3	11			7	4				1	1							2				2		1
Australia				1			2	2																		
South Korea	3	1		4	3		1			1				1							1					1
India	1		3																							
Brazil				1			1		1	1																
Malaysia			2	2	1	1								1						1				1		
Japan					1																1					
Taiwan				1																				1		
Thailand									1								2		1							
Mexico				1			1																			
Chinese utility model	6			2			5	5	5		1	5									1					2

Fig. 1.Various domains of development according the main countries involved IPC 4 digits)

A more precise result may be obtained using the full IPC. (partial view of the matrix)

	A01G1/00	C05F5/00	C05F11/02	Empty Field	A23L1/00	A23L2/38	A23L2/02	A23L2/44	A23L2/46	A23L2/52	A23L2/68	C10L1/08	C10L8/00	C11B1/00	C11B1/06	C11B1/10	C11B3/00	A23N1/02	A47J25/00	A23N5/03	A01G9/00	B65D5/40	B65D85/72	A23L2/385	A23L2/60	A23B7/02	A23L2/39	A23N5/08	A47J19/00	A23N15/00
China	2			1	4	14	1			8	1					1				5			4	2	3			2		2
USA	2	2	1	3	2	6	3	1	1	4	1								1	5	1			1	3			1	1	1
Australia						1	1	1	1	1	1							1	2											
South Korea	2																													
India				3																										
Brazil																				1		1	1			1	1	1		
Malaysia				2		1		1		1		1	1	1	1	1	1													
Japan												1	1																	
Taiwan																														
Thailand																														
Mexico					1																1								1	

Fig. 2.Various domains of development according the main countries involved. (IPC full)

137 The Academic R&D in the field of coconut is characterized by a large number of Chinese Universities
 138 or Institutes. Malaysia came first and South Korea third. Let us not some work of Czechoslovakia
 139 Brazil and Saudi Arabia. The result is indicated in the following table.

140 **Table 3. Universities and Institutes involved in the coconut field**

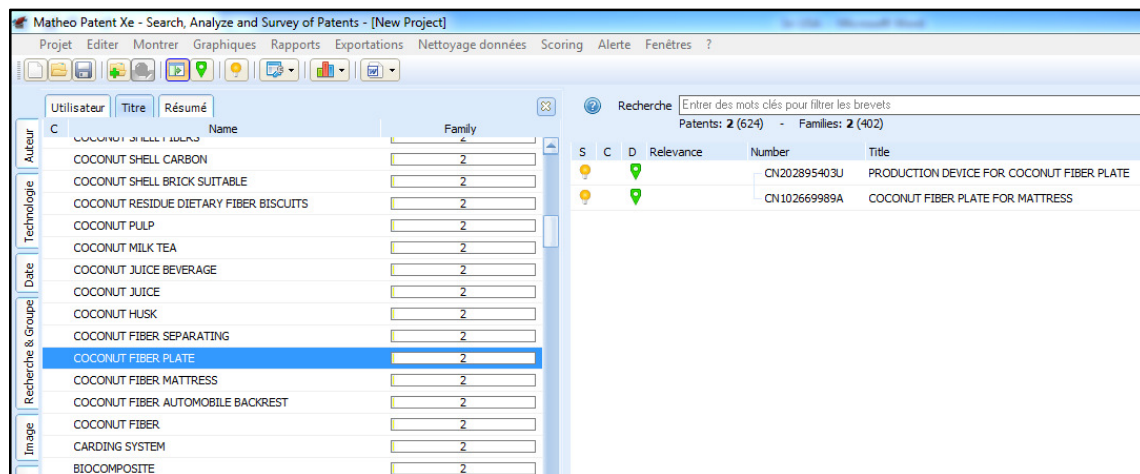
Universities or Institutes	Number of families	Countries
University Hainan	16	China
Coconut research Int. of Chinese Academy of tropical Agricultural Sciences	8	China
Coconut research Inst. of Chinese Academy of Tropical Agricultural Sciences	4	China
University Central South Forestry	3	China
University South China Tech.	3	China
Univ. Dognhua	3	China
TechnickaUniverzitaLibercy	2	Czechoslovakia
UnversityJangnan	2	China
Coconut Research Inst. of Chinese Acad. Sciences	2	China
TechnickaUniverzitaLibercyKatedraStrojirensku Technologie	2	Czechoslovakia
Coconut Inst. of Chinese Academy of Sciences	2	China
Univ. Seoul Industry Coop. Found.	1	South Korea
Univ. Transilvania Din Brasov	1	Romania
Univ. Federal Alagoas	1	Brazil
Univ Jinan	1	China
Univ Yangzhou	1	China
Shandong Inst. light Industry	1	China
Univ Putra Malaysia	1	Malaysia
Nat Univ. Chunbukind. Acad.	1	South Korea
Univ. Nanjing Forestry	1	China
FundacaoUniversidadeEstadual co Ceara	1	Brazil
Tropical Crops Genetic Resources or Chinese Academy of Agriculture Tropical Sciences	1	China
Univ of Hunan Agricultural	1	China
Federal oil and Food Research Inst. of Hanan Province	1	China
Inst. Tropical of Bioscience and Biotechnology of Chinese Academy of Agricultural Tropical Sciences	1	China
Univ Heilongjiang	1	China
Univ. South China Tech	1	China
HeinianInst Engineering	1	China
Univ Northeast Forestry	1	China
UnivChungan Ind.	1	South Korea
Univ King Saud	1	Saudi Arabia
Fujian Food Industry Research Int.	1	China
Malaysian Agricultural Research Inst. and Development inst. Mardi	1	Malaysia
Coconut Institute Chine Tropical	1	China
Univ. Teknolgi Mara	1	Malaysia
Universtar Science & Tech. Shenzhen	1	China
Inst Process engcas	1	China

141

142 4.1.3 Seeking for new ideas

143 New ideas are often present in titles and abstracts words. If the use of IPC 4 or full is interesting for a
 144 macro vision of the subject, it is very interesting to browse through the titles and abstracts words to

- 145 seek for more precise. They can be analyzed separately or put together in a group for further analysis.
 146 Let us see an example:
 147 The following figure gives an example of browsing through titles words:



148
 149 **Fig. 4. Browsing through title words**

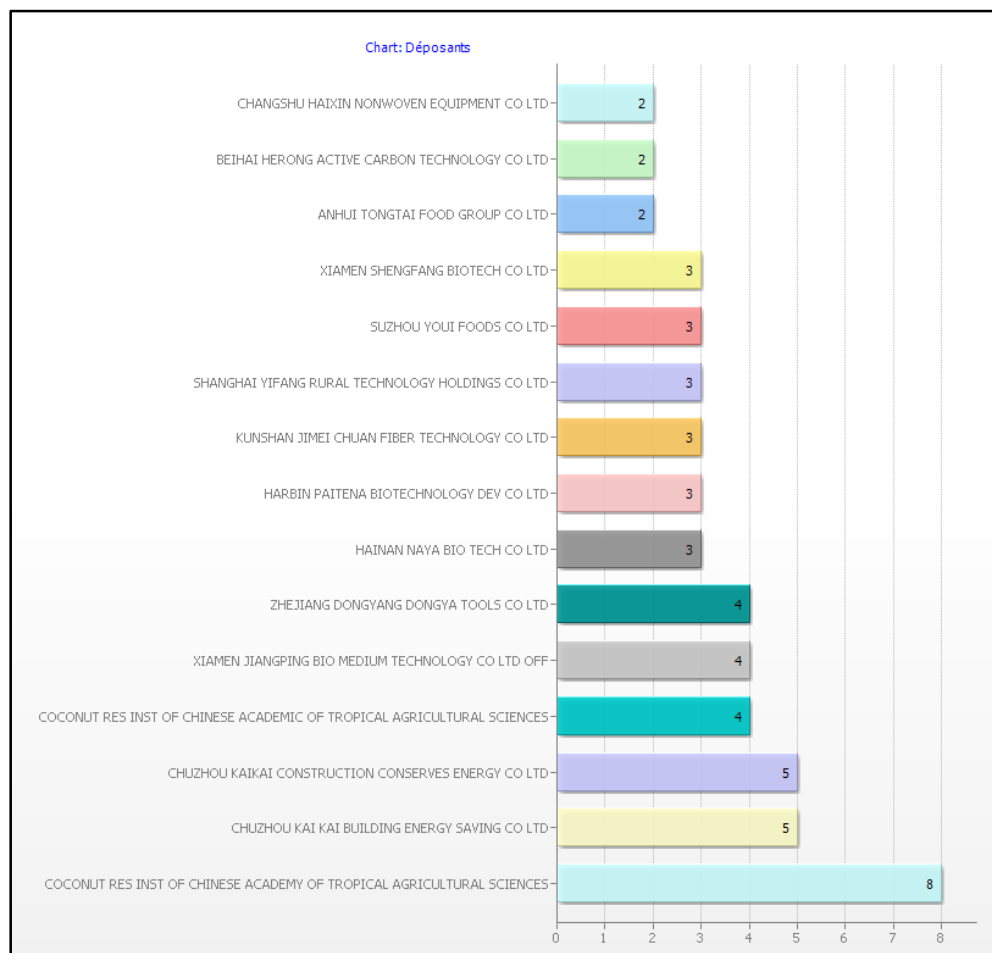


Fig. 5. Main Patent Assignees

When the subject is defined: here all the data concerning the fiber(s), we can go back to the local database and search for the term fiber* (* is used to include singular and plural) in the tile. All the notices concerned are gathered in the group fiber*. Further analysis of this group will provide indications on the technologies used, the area of application the patent assignees present. This type of analysis is useful to show what can be done from a very common part of the coconut, often burned or used only as fertilizer or soil subsidiary. The following figures show the main actors in this field and also the main technologies (IPC) involved.

Matrices:IP Class (4 digits)/Group																											
	A01G	A01D	A23L	A41B	A47C	A47G	E02D	E02N	E02B	E02C	E02B	E02N	E02D	E02C	E02B	E02N	E02D	E02C	E02B	E02N	E02D	E02C	E02B	E02N	E02D	E02C	E02B
Fiber(s) (--)	2	3	3	1	6	4	1	5	1	3	5	2	1	1	1	2	3	6	5	1	2	3	2	2	2	6	4
PN=WO (--)								2					1				2	1	2								

Fig. 6. The main domains of application in the field of fiber* and the WO concerned

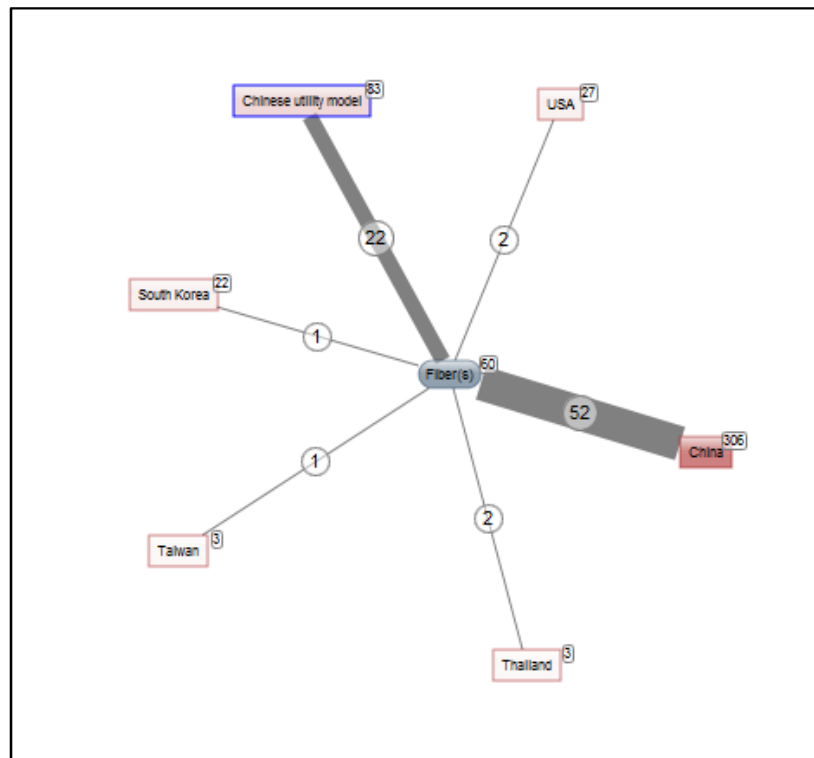


Fig. 7. The main actors in the field of fibers applications and the area of development

4.2 Example Thailand

This country developed a very aggressive cluster policy[21] which is based on the recommendations of Michael Porter and the help of USAID. Several clusters have been developed which deal with the main strategy areas of development of the country. It is remarkable to see that for most of the clusters a general APA process is followed. Part of these results is shown on Internet and surely most advanced works are done but are not available. The APA provides for one area of development the main patents, the most accurate technologies (available free or not), etc. The analysis is done by using Mattheo – Patent. The following example extracted from an article available from Internet shows the type of analysis which is done:

Although that most of the people are not speaking or reading Thai, this example is taken to show how a different country can use a powerful tool (Matheo Patent, develop by a French company) various key areas of development. Here coconut, but nanotech, palm oil, rice, water massages, are also available.[22]. The process is the following from a query (see underneath), a certain number of patents are selected and uploaded locally. The APA performed on this set of patents is done following a certain order: technologies (from IPC) and selection of the most important domains, from these domains, selection of the most relevant patents (according to the need of the Thai industry. From the selected patents, extract of the most important parts which could help the local company to “copy” or innovate. In the example underneath all the sentences in Thai have been translated into English.

"การวิเคราะห์แนวโน้มเทคโนโลยีเกี่ยวกับมะพร้าวจากเอกสารสิทธิบัตร"

ได้ทำการสืบค้นข้อมูลสิทธิบัตรนานาชาติจากสำนักสิทธิบัตรยุโรปที่ <http://ep.espacenet.com>

และสำนักสิทธิบัตรอเมริกาที่ <http://www.uspto.gov> ด้วยระบบการสืบค้นและทำแผนที่เทคโนโลยีด้วยโปรแกรมพบว่าตั้งแต่ปี 1905

ถึงปัจจุบันมีสิทธิบัตรที่สัมพันธ์กับคำสืบค้น “Coconut” ในส่วนชื่อเรื่องของสิทธิบัตร (Title) จำนวน 532 เรื่อง มีผลการวิเคราะห์ข้อมูลสิทธิบัตรดังนี้

(Analysis of technology trends on the coconut. Patent)

(Search made with the European Patent Office <http://ep.espacenet.com> and the United States Patent Office <http://www.uspto.gov> With the search and mapping technology with Matheo-Patent (<http://www.matheo-software.com>) found that from 1905 to the present has patents that relate to the search term “Coconut” in the title of the patent. 532 patents results from the search and they are analyzed)

"การวิเคราะห์แนวโน้มของเทคโนโลยีจากการจัดหมวดหมู่ระหว่างระดับหมวดหลัก"

(Analysis of the technology from the International Patent Classification, level categories)

1 (FOODS, FOODSTUFFS, OR NON-ALCOHOLIC BEVERAGES)

2. (MACHINES OR APPARATUS FOR TREATING HARVESTED FRUIT, VEGETABLES)

3 (HORTICULTURE; CULTIVATION)

4. (PREPARATIONS FOR MEDICAL, DENTAL, OR TOILET PURPOSES)

A23 (MACHINES OR APPARATUS FOR TREATING HARVESTED FRUIT, VEGETABLES)

หมายเลขสิทธิบัตร (Patent Number)	ชื่อเรื่องของสิทธิบัตร (Title)
MXJL02000017	COCONUT PERFORATION SYSTEM FOR JUICE EXTRACTION
US6722269	COCONUT SHREDDING/GRATING APPARATUS
TW576138Y	COCONUT SHELL PEELING DEVICE
WO02063981	IMPROVED METHOD FOR PRESERVING ENTIRE COCONUT PULP CONTAINING WATER
EP1360907	IMPROVED METHOD FOR PRESERVING ENTIRE COCONUT PULP CONTAINING WATER
CA2437961	PROCESS IMPROVED TO PRESERVE WHOLE COCONUT MEAT WITH ITS WATER INSIDE
TW540314Y	DEVICE FOR SCOOPING THE INNER WALL OF COCONUT SHELL
TW532079Y	DEVICE FOR CUTTING COCONUT NUCLEUS
TW556490Y	PUNCH-TYPE DEVICE FOR DRILLING COCONUT
AU6878001	SCRAGH - COCONUT SHREDDER - ELECTRICAL

199

Fig. 8 Selection of the most relevant patents

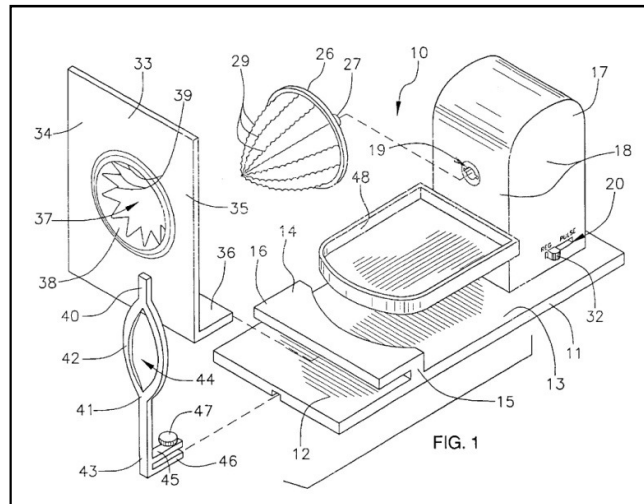


Fig. 9 Imagepreviewcoconutgrater ภาพแสดงตัวอย่างเครื่องทุคนะพริ้ว

US6722269 COCONUT SHREDDING/GRATING APPARATUS

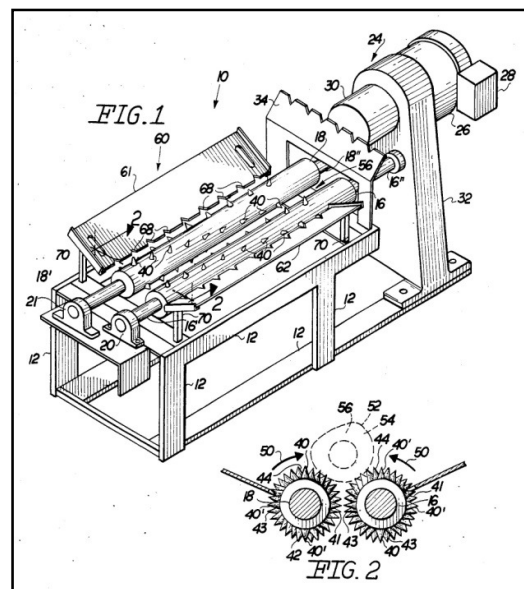


Fig. 10 The second model isacoconut shell casings ภาพแสดงตัวอย่างเครื่องปลดเปลือกมะพร้าว

All the different selected IPC are treated the same way: patents extraction, patent full text, extraction of the most interesting part of the patent. Then the technology trend per year is analyzed as well as the main companies active in the various sectors selected. If necessary analysis in depth of the patents or certain companies can be done, etc.

4.3 Example

The **Moringa**, [22] is a plant widely used in Burkina Faso, Madagascar and other part of Zfrica as a subsidiary for its high protein and vitamins contain. In different countries the Moringa's products are mainly powders made from the leaves and from the seeds. An oil is also extracted from the Moringa. But, most of the time the local people or the stakeholder of this business do not know all the other possible uses of Moringa. This is important because this may give rise to new ways to valorize the

215 Moringa products or even to make some joint ventures with foreign companies using Moringa crude
216 products.

217 To solve the problem, we performed a search using the term "**Moringaoleifera**" in titles or abstracts,
218 using the world patent database and Matheo Patent as analytical tool. Parts of the results are
219 indicated below.

220 The result of the search is 115 patents and 58 families. The main countries concerned are: China (33
221 families) , India (9 families) , USA (5 families) South Korea (5 families), Japan (2 families). From the
222 tiles and abstracts word, we can select various applications:

Name	Family
leaf(s)	19
oil	12
ipc autre que A	12
root(s)	9
skin care cosmetic	8
filter antibacterial	8
rabbit feed	4
ipc A	9

223

224 **Fig. 12 Main applications described in Moringa's patents**

225 Each the above groups may be analyzed in detail, providing the list of patents, the applicants, their
226 comparison, etc. Some examples are given underneath.

227 Antibacterial filters

Number	Title
+ WO2010104288A2	ORGANIC-INORGANIC COMPOSITE FOR COAGULATION AND ANTIBACTERIALS, AND METHOD FOR PREPARING SAME
- KR20120023928A	ECOFRIENDLY BIOFILTER APPARATUS
KR101172359B1	METHOD FOR FABRICATING BIOACTIVE COMPLEX COMPOSITION AND PRODUCT COMPRISING THE BIOACTIVE COMPLEX COMPOSITION
JP2000229804A	ANTIMICROBIAL AGENT
CN103304014A	METHOD FOR EXTRACTING ALGAECIDE OUT OF MORINGA OLEIFERA OIL RESIDUE AND REMOVING ALGAE IN WATER BY USING ALGAECIDE
CN103155954A	INSECTICIDE
CN102259965B	MORINGA OLEIFERA WATER PURIFYING AGENT
CN101485622A	SHAMPOO CONTAINING EXTRACT OF MORINGA OLEIFERA AND PREPARATION METHOD THEREOF

228

229 **Fig. 13 Lis of patents present in the group**

230 Even if the use of Moringa seed cake (when oil is extracted from the seeds) as water cleaning and
231 purifying agent is known [23], the set of patents present in the above group open the scope of the use
232 of Moringa seeds or roots in various sanitary aspects. This is important since in Africa the water
233 concern is of primary importance and because there is a strong need of drinkable water. This is also
234 important because you access from the full text of the patent to the Applicants and inventors names,
235 and to some protocol of extraction and treatments of the Moringa's crude material.

236

237 **CONCLUSION**

Patent information is an invaluable tool to show the technological trends. Most of the data which are published in patents do not appear elsewhere. Moreover, patents can be used as a link between research and Development and then they open the way to the realization of clusters or pre-clusters. The availability of the patent data in a free mode, as well as the software to process them at low cost, open the way to a systematic used of patent information in developing countries at first but also in all companies and laboratories curious of what is happening in their field and in their area of competences. For this reason we believe that the development of local Competitive Intelligence Units including patent analysis will be very helpfulto animate expert groups and to create new ideas and new development. Because the description of the technology protected is available in patents is available, it is then possible to choose applications with a technological level compatible with the local one. This aspect is particularly important for developing countries[24].

The fact that patent analysis show clearly what can be done with a certain type of knowledge could also induces decision makers to promote in universities subjects of research really relevant with the local needs. This will allow a large lost of competences and money and this will also promote the SRR[25] (Social Research Responsibility) one of the key for developing countries to get the necessary knowledge to integrate technologies and to benefit fully of the FDI (Foreign Direct Investments).

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Available: <http://ir.las.ac.cn/bitstream/12502/2501/1/study%20on%20indicator%20system%20for%20core%20patent%20documents%20evaluation%20%28ISSI%202009%29.pdf>
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