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Techno-economic study of Ethanol production from low grade dates

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In front of the jury:

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1. History and origin

The date palm is one of the formerly widely grown fruit trees. The oldest documents in Mesopotamia (now Iraq) show that its culture is practiced since 3500 BC in the same time date palms were cultivated in Western Iraq, through Saudi and up the North Africa. It is in the middle of the 19th century that the plantations were established in the hot California valleys and the southern Arizona [5].

2. The date palm:

We do not know this species in the wild. It is typically grown in the Saharan oases. There are over 2,600 species of palms. One might think that it is a tree, well it is not: it is a monocot which contains no wood! While a tree has a trunk palm has a trunk. In addition, there are male and female palm. Palm is called a dioeciously plant. This plant usually measures between 15 and 25 meters and can sometimes reach 30 meters high, its life can exceed 100 years [4]. The figure below show the main parts of palm tree.

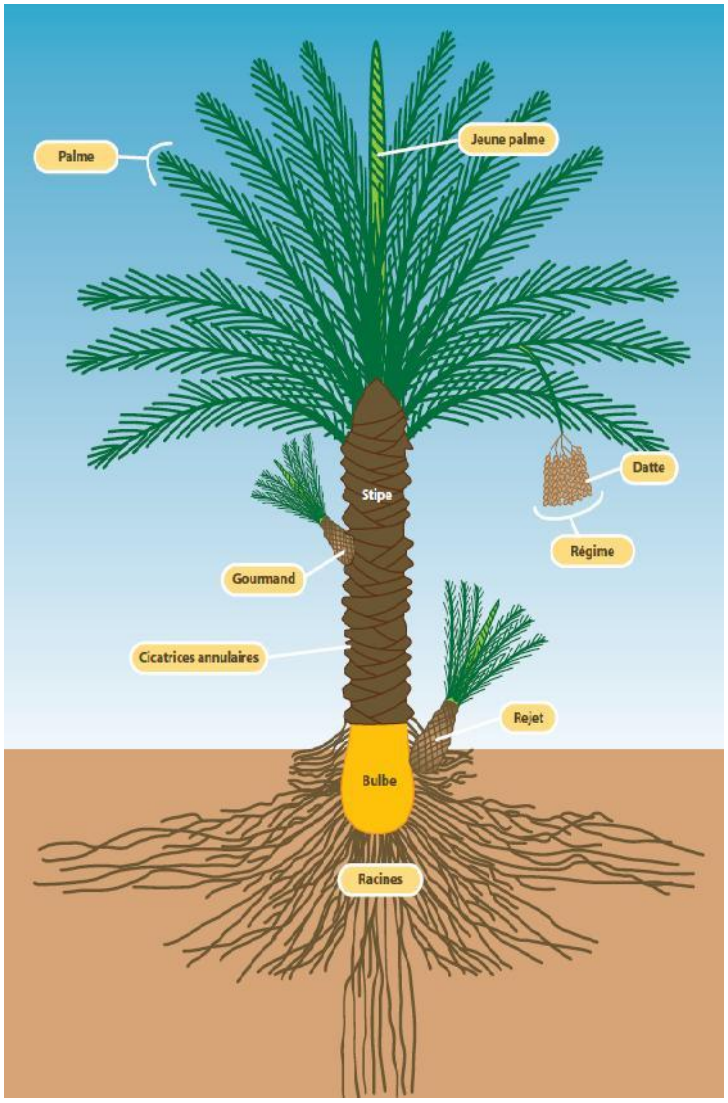


Fig1.1: Date Palm parts [4]

3. Geographical area and importance

The origin of the Date Palm in Algeria comes from the "Arabian Peninsula"; through traders who propagated the palm around the Mediterranean, it was introduced especially in places with water in the Sahara. Thus, it appeared the first palm of Oued Righ and Ziban through the nomadic Bedouin Arab, from the East to trade [3].

The National Heritage phoenicicole focused in all the regions in the Saharan Atlas in the north east and center of the Algerian Sahara concentrated mainly in the south-east. Among these potential areas, namely: Souf, Ziban, Oued Righ, Ouargla Bowl, Zab, El-Golea, Tamanrasset and Illizi Tindouf [3]. Algeria is a major phoenicicoles country worldwide. It is ranked fifth worldwide with a workforce that is around 15 million date palms in an area of over 350,000 hectares; including 11 million productive[6]. For a given country, domestic production may reach 500,000 tons, 240,000 tons representing approximately 47% of Deglet Nour, considered the best variety of commercial dates, allow Algeria to climb the world leader's perspective qualitative; while almost 2600.000 tons or 53% are called the common varieties of these, only 120,000 tons are marketable and more than 14,000 tons are very low marketability [7]. The evolution of surfaces progresses from one year to another; but the production does not follow the evolution of these surfaces. Indeed, tree yields ranges from 19.1 kg to 69.6 kg per region and a national average of 47 kg / tree (DSA 2008) [6].

4. Geographical location of the study area

The valley of the Oued Righ is a specific economic entity comprised of nearly 50 oasis located northeast of the Grand Erg Oriental Sahara and south of the Massif des Aures It extends over a north-south axis of about 150 km between northern latitudes 32 ° 54 'and 34 ° 9' and covers about 15000ha palm groves; the valley of the Oued Righ often simply called Oued Righ begins in the north to Oum El Tiour over 500 km south of Algiers and ends 150 km further south of the palm of El Goug. The Touggourt region that occupies the southern half of the valley along an axis of 70 km starting a commune BlidetAmor south to the town of Sidi Slimane North[2]. The figures below present the geographic location and distribution of palm surface in the study area.

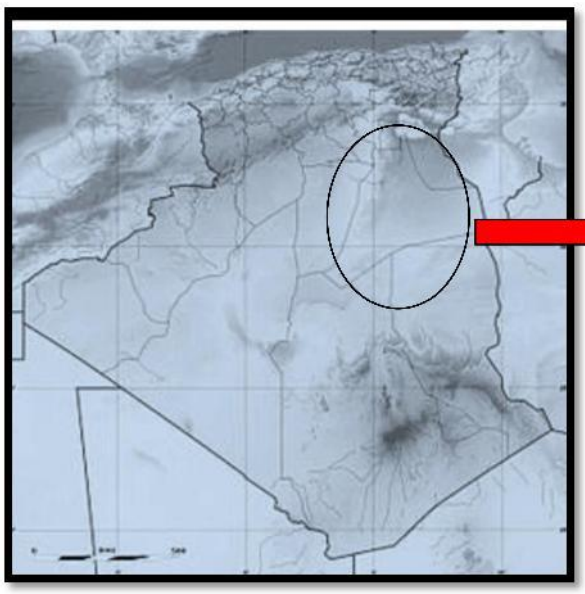


Fig 1.2: Geographical location (web site)

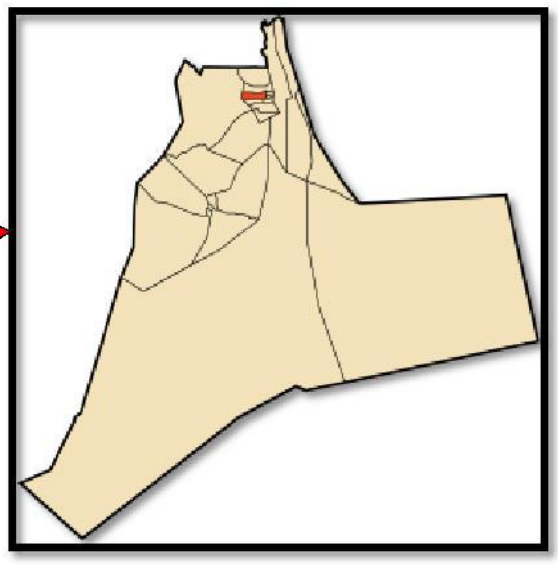


Fig.1.3: Administrative situation of Touggourt (web site)

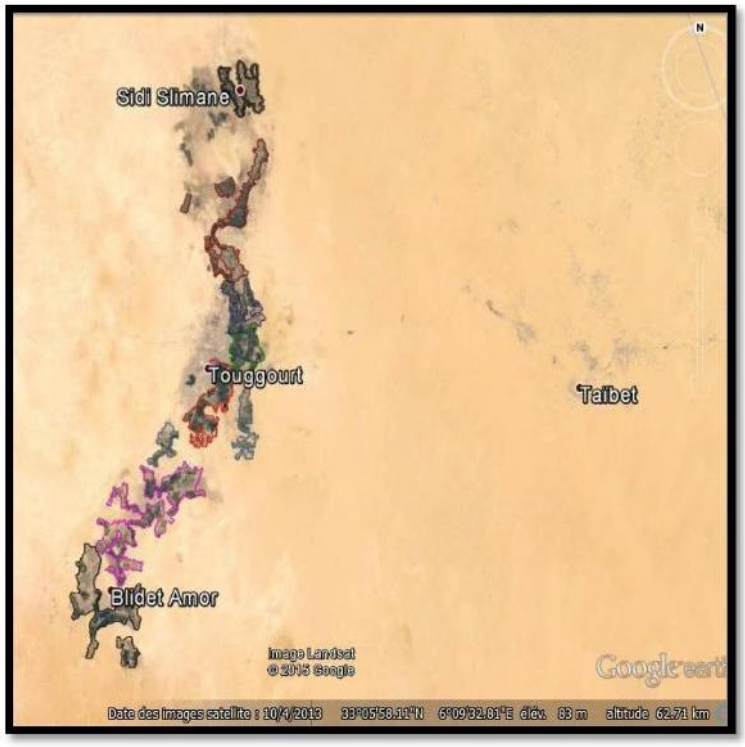


Fig .1.4: Palms surfaces contours (Google Earth)

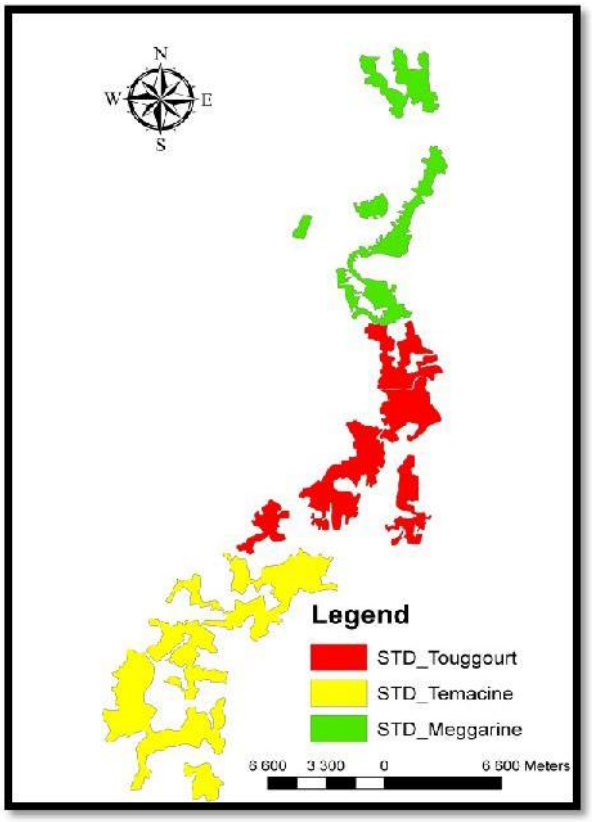


Fig.1.5: Geo-referenced map surfaces (Arcgis)

5. Administrative situation

The city of Touggourt is an oasis of northern Algerian Sahara located in the state of Ouargla; it is divided between three Daïras and eight towns [2] with an area of 216 km^2. The study area is located 160 km north-east of Ouargla, 225 km south of Biskra and 600 km South-east of Algeria. Touggourt is the largest city in the region of Oued Righ; its territory covers the following territorial consistencies: Tebesbest, Nezla Zaouia Al Abidia and Touggourt [8].

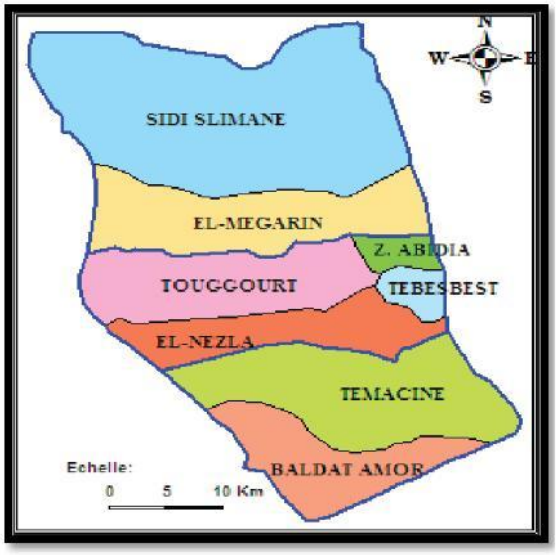


Fig.1.6: Administrative Decoupage of Touggourt region

Commune	Population	Surface in Km^2
TOUGGOURT	37237	172,17
Z. SIDI EL ABED	16200	23,72
TEBESBEST	30597	26,45
NEZLA	42477	120,18
TEMACINE	15802	231,98
BELIDAT AMAR	12345	126,2
MEGARIN	11452	186,78
SIDI SLIMAN	7152	447,13
Total	**173262**	**1334,61**

Tab.1.1: Population and surface by commune [8]

6. The superficies and dates production

Touggourt have an area of 9998.17 hectare that is occupied by palm trees, the total production of this area is about 631154 quintal. Comparing with the other zones in Ouargla (Annex 1) province some date types are produced highly like Deglet Beida which reaches a production of 55772 quintals. The number of palm trees, the superficies occupied and dates productions by zones in Touggourt are classified in the tableau below.

Zone	Dates masses 2 area occupied	Number of existing palm (number)					Number of palm trees in report (number)					Production dates(QX)				
		Deglet Nour	Gharse	Deglet Beida	Other Varieties	Total	Deglet Nour	Gharse	Deglet Beida	Other Varieties	Total	Deglet Nour	Gharse	Deglet Beida	Other Varieties	Total
column	1	2	3	4	5	6=2+3+4+5	7	8	9	10	11=7+8+9+10	12	13	14	15	16=12+13+14+
Touggourt	116.66	8403	1985	3322	110	13820	4137	917	1096	50	6200	3268	477	559	28	4332
Nezla	1404.69	130190	17712	19998	7819	175719	107024	15493	16048	7324	145889	87760	8521	7221	4175	107677
Tebesbest	932.13	76456	34469	11662	13018	135605	62405	29125	9402	12220	113152	51796	15727	4701	6843	79067
Zaouia El-abidia	930	79378	15229	13200	9617	117424	65276	12594	9925	9313	97108	55485	6927	5359	5308	73079
S-T-D Touggourt	3383.48	294427	69395	48182	30564	442568	238842	58129	36471	28907	362349	198309	31652	17840	16354	264155
Meggarine	1655	121767	26097	33332	12727	193923	119821	21054	26714	12112	179701	71893	16843	13357	6662	108755
Sidi Slimane	1706	115194	24529	15743	7480	162946	103403	19594	13984	4246	141227	62042	15675	6992	2335	87044
S-T-D Meggarine	3361	236961	50626	49075	20207	356869	223224	40648	40698	16358	320928	133935	32518	20349	8997	195799
Temacine	1854.89	123041	36373	29265	20696	209375	86571	17559	18640	18795	141565	51942	8779	10811	10337	81869
Baldet Omar	1398.8	137612	17973	14358	10285	180228	111607	17020	11676	10235	150538	68080	8850	6772	5629	89331
S-T-D Temacine	3253.69	260653	54346	43623	30981	389603	198178	34579	30316	29030	292103	120022	17629	17583	15966	171200
Total	9998.17	792041	174367	92698	81752	1189040	660244	133356	107485	74295	975380	452266	81799	55772	41317	631154

Tab.1.2: Superficies and dates production in Touggourt (DSA Ouargla 2013-2014)

6.1. Characteristics of the main varieties in Algeria

There are currently a large number of varieties of date palms scattered on different potential areas phoenicicoles. The list of varieties or cultivars is quite long, that's why we limit the characterization of the main varieties. Deglet-Nour, Deglet-Beida and Ghars are the most important dates produced in Touggourt and are species that underpin this study. For example Deglet-Beida is one of the dry dates kind, it have a spinning shape and a Brown-Blond to beige color, and it contains 74% sugar compared to the dry weight of the fruit. The price of Deglet –Beida is between 50 DA to 100 DA or 0.47 € and 0.95 € for Kg, but the price of low grade one do not exceed 15 DA. Because of the dry consistence of this date, it was not consumed locally and it export mainly to the African Sahel countries (Chad, Niger, Senegal...) where it enters in many transformation and Agro-Alimentary industries.

Ghars Deglet-Nour Deglet-Beida

Fig.1.7: Most coming varieties dates in the study region

6.2. Other varieties

The table below summarizes the main varieties of date palms with some morphological and physicochemical characteristics of dates.

Variety	Consistency and form	Color	Length / diameter (cm)	Maturation	Weight medium (g)	Total sugars (%) MS
Deglet Nour	Semi-soft, tapered to Ovoid	Roux clear yellowish	6/1,8	October - November	12	71,37
Ghars	Very soft	Dark brown yellow	4/1,8	August-September	9	85,28
Mech Degla	Dry, sub Cylindrical	Orange yellow	3,5/1,8	October	6,5	80,07
Degla Beïda	Dry, tapered	Yellow-brown clear Beige	4,5/2	October	7	74
Hamraye	Soft-ovoid	Rouge-noire avec des reflets rougeâtres	4/1,6	October	8	9,02
Tafezouine	Soft, cylindrical, Lying	Jaune-ambrée marron	4,2/2	October	10,6	56,90
Tanteboucht	Soft, rounded	Abricot – ambrée	3	October	10	56,20
Arrechti	Semi-soft, oblong	Jaune orangé, brun	4/2	October	12	66,70
Bent Kbala	Soft, ovoid	Jaune – ambrée	-	August-October	-	10,75

Fig.1.3: Characteristics of the main varieties dates in Algeria

7. Classification and valuation varietal

7.1. Classification of varieties of dates

The varieties of dates are very numerous, but a few are commercially important. Recognition of varieties of date palms and their classifications is delicate it is based on the observation of the whole of the plant including fruit characters which differ by the flavor, texture, shape, color, weight, and dimensions ... etc. Besides are the only stable enough characters for classification of varieties. Currently, we classify the dates according to:

7.1.1 The consistency

Dates are grouped into three categories according to their consistency, this classification was established by the US is valuable for the varieties of Algeria.

- Soft Dates: Ahmar (Mauritania), and Kashram Miskani (Egypt, Arabie- Saoudite), Ghars (Algeria).
- Semi-soft Dates: Deglet Nour (Tunisia, Algeria) Mejhoul (Mauritania), Sifri and Zahidi (Saudi Arabia)
- Dried dates consistency lasts: Degla-Beida and Mech-Degla (Tunisia and Algeria) Amersi (Mauritania) [3].

7.1.2 Date processing

For transformation of dates, the different products which can be obtained by the use of dates all varieties are included are:

a) For culinary use

In addition to its direct consumption, dates are stuffed after coring, with marzipan or peanuts, but that during religious celebrations or weddings. In the kitchen, according to the varieties there are several types of products made from these varieties:

- For soft dates: Dates are crushed and added to sauces, especially the couscous sauce; For the manufacture of biscuits, cakes, juice, date paste, jam, as well as alcoholic beverages such varieties Ghars Tantbouchet. As well, to obtain honey, syrup (rob) and caramel, unreleased soft varieties are used that store well: Ghars Litima (honey), Ammari (syrup). Indeed, these products (syrup, creams, juices and jams) are also made from healthy dates because it is important to avoid fermentation aftertaste.
- For dry to semi-dry dates: They are likely after drying in the manufacture of yogurt and flour.

b) Other Uses

It goes into the manufacture of liquid sugar can be achieved with all varieties.

8. Development of dates scrap

Damaged dates and low-value can be used because of their high sugar content for the production of:

a) Biomass and derived proteins unicellular:

The analysis of the produced biomass shows their protein at 32 to 40% dry weight. Thus, the manufactures of yeast, all unreleased varieties are generally used.

b) Alcohol:

Dates are a substrate of choice for the production of ethyl alcohol that was produced in the laboratory with a yield of 87%.

c) Vinegar:

Dates can be used for the development of vinegar produced by culturing the yeast *Saccharomyces uvarum* on an extract of dates, stadium mainly used in blah dry varieties semi dry and also soft dates.

d) Cattle feed:

Scrap and date stones are interesting by-products for animal feed. Flour dates cores may be incorporated with a rate of 10% in chicken feed without adversely affecting their performance.

As we see above, date fruits enter in many industrials, especially ethanol production which is the most substitute of gasoline. Next, the main studies done in this sense are setout.

9. Bibliography Analyses

The date palm is one of the oldest cultivated fruit trees, where the earliest records show that Iraq's culture has been practiced for 3500 years BC. In desert environment, palm creates a micro-climate conducive to life and their wood can be used as construction materials. Palm fruit (date) is a bay consisting of a single seed, it is usually oval or spherical shape attached to the pedicels) by the perianths, it has varying colors depending on the cultivar and growing conditions. This fruit is considered not only a food base, but its poor quality is used as pet's food. In Algeria, many date species are slightly exploited except Deglet Nour, Ghers and Degla Beida. These rich sugar resources are important substrates to produce many substances such as ethanol. The bio-ethanol, as alternative source, is the most used vehicle fuel in the world and its promotion has significant ecological interests. Indeed, it burns more cleanly than gasoline or diesel. [10]

In Pakistan, A. A. Noor et al. [14] activated strains ASN-3 and HA-4 used them for ethanol fermentation by the bioconversion of sugar from dates. The results revealed that both strains are actively involved in fermentation process but it is concluded that strain HA-4 resulted higher cellular mass when inoculated in Malt yeast extract Peptone Glucose medium supplemented with fructose and yeast nitrogen base and higher yield of ethanol was observed when the activated strain where inoculated in dates syrup as substrate at 120 rpm, having pH 4,5 at 30 °C at 600 nm after 72 h post incubation.

In India, N. Gupta et al. [15] Evaluated various indigenous strains isolated from date palm sap for ethanol production. Isolate strain SCP-1 was found superior showing 12,5% ethanol production, high ADH enzyme activity (4,38 units/ml) and higher alcohol tolerance maintaining cell viability at 12% ethanol in YPD medium up to 48 h.

In Gabes (Tunisa), B. Louhichi et al. [16] studied the bio-ethanol production from three date's varieties (Kunta, Eguoua and Bouhatem). Their all tests showed ethanol production with a concentration around 25% (V/V), moreover the yeast used in the fermentation process is capable of producing alcohol even at a pH of 3.8.

In Saudi Arabia, M. H. Gaily et al. [17] examined ethanol production from date's extract. For obtaining 75 and 90% fructose in sugar, the respective losses in fructose exceeded 39 and 63% and the ethanol yield was at 63% of the theoretical one.

In the same country, A. K. Sulieman et al. [18] studied ethanol production from low-quality dates. The average ethanol yield for all experiments was greater than 71% of its theoretical value. Fermentation at 30°C and 120 rpm gave ethanol yields of 91.3%, 68.7% and 54.8 % for the 10, 15 and 20% initial sugar concentrations, respectively.

In Ouargla (Algeria) B. Dokkar [10] et al presented an overview on the development of ethanol industry using waste dates. Reducing cost of palms agriculture, in particular irrigation is treated. Photovoltaic energy seems to be the most favorable candidate to provide reasonable power for long period with short payback. They found out comparison with 2013 where the bio-ethanol extraction from only three date varieties (Ghars, Deglet-Nour and Deglet-Beida) was estimated about 23,500 liters, can reach 148,500 and 648,500 liters in 2018 and 2038 respectively by using a trend model.

In Adrar (Algeria), A. Boulal et al. [19] Conducted many tests to optimize alcoholic fermentation of three date varieties (Hmira, Tinacer and Kaciene). The comparison of crude alcohol degree of dates showed that for the three varieties are respectively 22°, 19°and 18°.

In El-Oued (Algeria) K. Oussif [1] carried o;ut experimental tests for three date species (Ghers, Bouchaira and Tenessine), they obtained for each specie the following rate of ethanol production: 1.560, 1.1875 and 0.605 ml/g respectively.

Fermentation is the industrial process used to transforming dates to bio-ethanol as mention in the previous studies. This process pass by many steps which will be demonstrate in the next part, in addition to bio-ethanol definition, its generation and its main utilization.

10. Bioethanol

.The bioethanol is made of Segar with big quantities by fermentation and distillation, during this process the glucose transformed to ethanol and carbon dioxide CO_2. Ethanol burning reaction is same just like hydro-carbonate burning in Benzene; where ethanol is interacts with oxygen to produce carbon dioxide, water and caloric. The bio-ethanol, as alternative source, is the most vehicle fuel after mixing with gasoline with deferent percentage used in the world, and its promotion has significant ecological interests. Indeed, it burns more cleanly than gasoline or diesel [10]. Its most used kinds are:

- **E10 (10% Ethanol and 90% Benzene).**
- **E85 (85% Ethanol and 15% Benzene).**

The bioethanol can be producing in tow forms which are:

a) **Wet ethanol:** It produced by distillation from the fermentation of the biomass, it contained 95% ethanol and it's suitable as fuel when it mixes with 15% of petrol fuel.

b) **Dry ethanol:** By drying wet ethanol, high-purity 100% ethanol is obtained on its dry form and it can be used unique as fuel **[20]**.

10.1. Physical and chemical properties

Ethanol has many physical and chemical properties and the most are:

a) **Physical properties:** The table below classifies the mainly physical properties.

Calories	27.3 MJ/kg
Dynamic viscosity	1.2 Pa.s
Density	794 kg/m^3
Boiling point	78.5 ºC
Octane number RON	98.0
Specific weight 15.5 ºC	0.79
Dissolution	Mix with water and benzene

Tab1.4: Physical properties of ethanol [20]

b) **Chemical properties:** Ethanol burn in presence of oxygen fallowing the chemical reaction:

$$C_2H_5OH\ (l) + 3O_2\ (g) \longrightarrow 2CO_2 + 3H_2O$$

In presence of an oxidant ethanol interacts according the reaction:

$$C_2H_5OH + [OX] \longrightarrow CH_3COOH + H_2O$$

Note: Cars motors need some modification and additions in order to be able for work with ethanol. In this sense, cars companies particularly Fourd (USA) and Volvo (Swedish) are working to invent a special model of cars capable to work either with bioethanol and benzene by supply it with motors which can detects the fuel type [20].

10.2 Raw materials used for bioethanol production

As it is clarify in the table below, dates have an advantage in bioethanol production comparing with sugar cane, corn and sugar beet.

Raw materiel	Ethanol extract from 1 tone (Liter)
Sugar cane (seasonal product)	60
Sugar beet (seasonal product)	116
Corn (seasonal product)	375
Dates (perennial product)	280

Table.1.5: Raw materials used for bioethanol production [21].

10.3 Process of ethanol production

The production of ethanol from waste dates includes the following steps:

• Washing of dates.

• Soaking in hot water (extraction).

• Separating the nuclei of the pulp which is crushed and turned into wine that is sent to fermentation.

• Adding dilution water, acid and yeast,

• Distillation.

The diagram in figure.1, shows various stages of ethanol manufacturing [11].

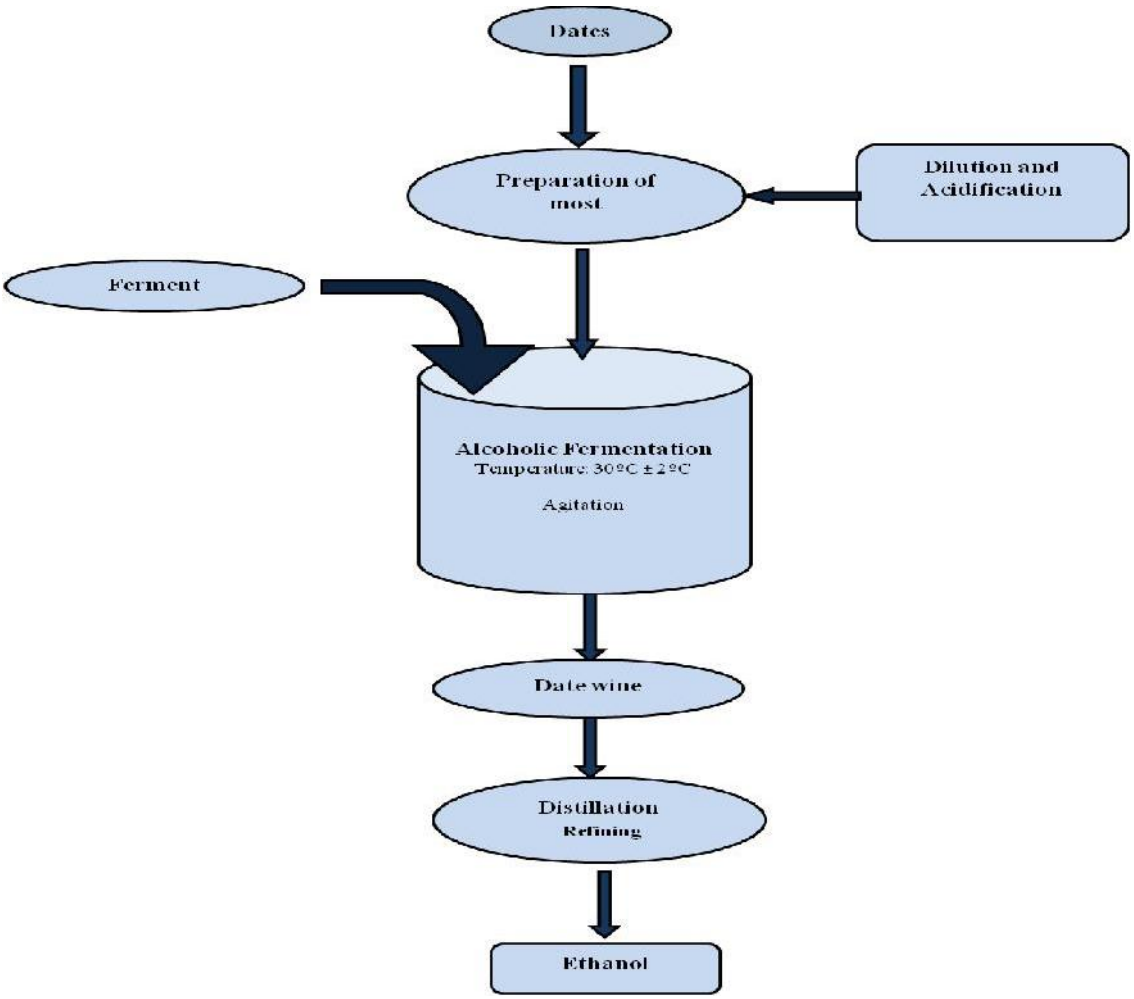


Fig.1.8: Fermentation diagram process

10.3.1 Materials and methods

a) **Vegetal material:** The substrate used for the production of alcohol consists of waste dates and certain varieties of common dates.

b) **Biological materials:** The yeast *saccharomyces pastorianus* or *cerevisiae* are used for the production of alcohol. These strains are isolated locally [11].

10.3.2. Methodology

a) **Alcoholic fermentation:** The alcoholic fermentation is to transform the fermentable sugars anaerobically by yeast into alcohol and carbon dioxide with release of calories according to the following reaction:

Sugars + yeast ==> Ethanol + CO_2 + Energy

Saccharomyces strains generally tolerate high concentrations of ethanol but however are sensitive to glucose effect. It should also be noted that these strains have the peculiarity to settle in the milieu at the end of fermentation. This phenomenon of flocculation is a positive element for the separation of yeast.

When the alcoholic fermentation, can be observed:

- A release of carbon dioxide.
- An increase in the temperature of the environment.
- An accentuation of the color.
- A change in smell and flavor, in the beginning the liquid is sweet and as fermentation, it becomes more and more alcoholic and acidic.
- A decrease in density due to the transformation of sugars into alcohol.
- An increase of volume, due to the increase in temperature and carbon dioxide escaping.

b) **Preparation of fermentation wine:** Fermentation wine must not exceed a concentration sugar greater than 300 g/l. On the other hand, the milieu must be supplemented by salts minerals (ammonium salts) and other growth factors for ensure an optimal progression for yeast. The initial concentration of fermentable sugars is very important because it affects the rate of alcohol at the end of fermentation [11].

c) **Realization of alcoholic fermentation**

Prior the fermentation, the inoculums is obtained by seeding dates juice sterilized by autoclaving at 110 ° C for 20 minutes by the *Saccharomyces pastorianus* or *cerevisiae* strain. Fermentation is conducted into the fermenter filled 2/3 of its capacity (terms of asphyxiation). The intermediate culture is enriched with ammonium phosphate (2.5 g/l). The pH of the medium is adjusted between 4.2 and 4.5. The temperature is maintained at 30 ± 2 °c. Fermentation is conduct anaerobic for 72 hours.

d) **Distillation**

At the end of fermentation, we will be in the presence of wine from dates that need distiller to make the purity of ethanol higher. The distillation temperature is on the order of 78 ° C [11] Distillation is one of the steps of the purifications, which is used to separate two liquid utilizing their different boiling points. However, to achieve high purification, several distillations are required. This is because all materials have intermolecular interactions with each other, and two materials will co-distill during distillation. This means that proportion

between two materials, in this case ethanol and water can be changed, still, there are two materials in both layers, the liquid and the vapor layers [13]. Rectification of raw alcohol (phlegm) requires a second distillation [11].

3.1. Introduction

In 2014, the total of palm trees in Ouargla province is 2562268 trees with 21515 hectares of area planted by date palms and an annual dates production of 1252163 quintals which is divided as 54.43% of Deglet Nour, 30.68% of Ghars, 5% of Degla Beida and 9.89 % of other varieties (this last date kind is not included in this study). Specific productivities of these palm species are respectively 61.8 kg/tree, 67.3 kg/tree and 42.3 kg/tree.

Low grad dates obtained from palms are non-consumable fruits and traditionally intended to livestock. They are composed by different categories, represented primarily by dried dates (H'chef) and unmated dates (Sich). In this study those low grade dates are used to estimate extract ethanol and its progressive production among 50 years.

3.2. Dates production

The production of varieties dates (Deglet-Nour, Ghars and Deglet-Beida) of the actual data 2014 in addition to the production of the low grad dates; where we take an average value of 20% from the total production as low grade dates represented primarily by dried dates (H'chef) and unmated dates (Sich) and the percentage of each variety is presented in the table below.

Varieties	Deglet-Nour	Ghars	Deglet-Beida	Total
Total production (kg)	68164000	38410500	6248400	125216300
Low grade (kg)	13632800	7682100	1249680	25043260
Percentage	54.43%	30.68%	5%	100%

Tab 3.1: Dates production + low grade. (DSA Ouargla 2014)

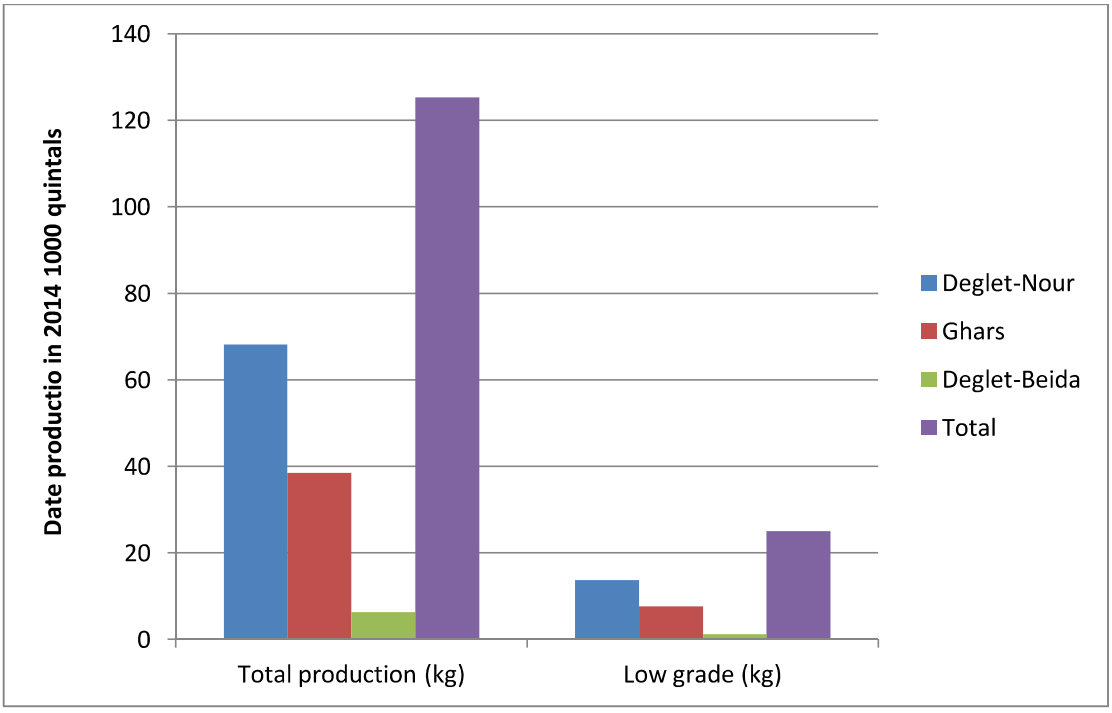


Fig.3.1: Dates production in 2014

Note: the total production contained in addition the other varieties of dates that represented the 9.89% left.

3.3. Ethanol production

3.3.1. Ethanol feedback

Basing on the results of the study done by K.Oucif, the production of bio-ethanol is calculated taking an average value of 50% from the good quality dates feedback. The table 3.2 presents the rate of each variety.

Varieties	Deglet-Nour	Ghars	Deglet-Beida
bio-ethanol feedback (Good quality ml/g)	0.600	0.624	0.300
bio-ethanol feedback (low grade ml/g)	0.3	0.312	0.150

Tab3.2: Bio-ethanol feedback

3.3.2. Bioethanol extraction

For an actual surface of 21515 hectare and waste dates mass evaluated at 225645,8 the total production of the three varieties is about $6{,}657\times10^{6}$ Liters divided on percentage to 61,29% from Deglet-Nour, 35,9% extract from Ghars and 2,81% from Deglet-Beida, the table below show the ethanol extract and mass of existing dates.

Varieties	Deglet-Nour	Ghars	Deglet-Beida	Total
Total mass(kg)	68164000	38410500	6248400	112822900
Low grade dates mass (kg)	13632800	7682100	1249680	22564580
Extraction ethanol(l)	$4{,}08\times10^{6}$	$2{,}39\times10^{6}$	$1{,}87\times10^{5}$	$6{,}657\times10^{5}$

Tab.3.3: Extraction ethanol from low grade date 2014

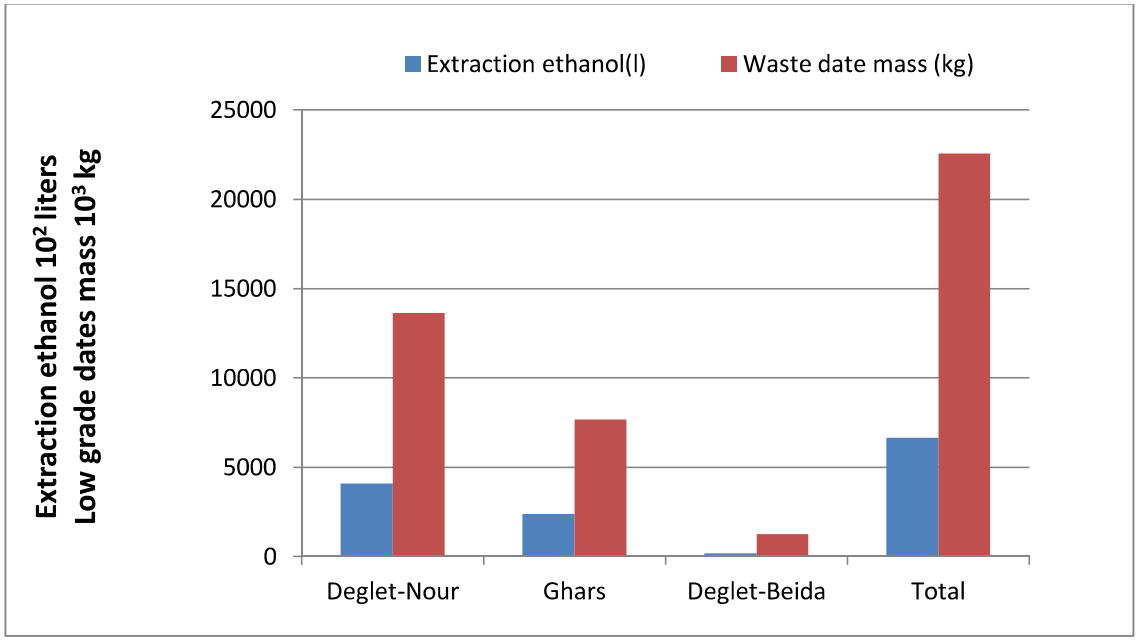


Fig.3.2: Extract ethanol from low grade dates 2014

3.4. Results and expectations

The investigate by using Arcgis software show that the able surface for palm cultivation is 3250398.98 hectare, this surface is divided on an investment of 50 years and ethanol production is calculated adopting a period of 5 years for palm tree to reach an acceptable date production. By using two models:

- Trend model (production of 20%).
- Voluntary module (production of 80%).

3.4.1. Exploiting surface

The figure 3.3 shows the progress of exploiting surface via the tow difference models among the period 2019-2064.

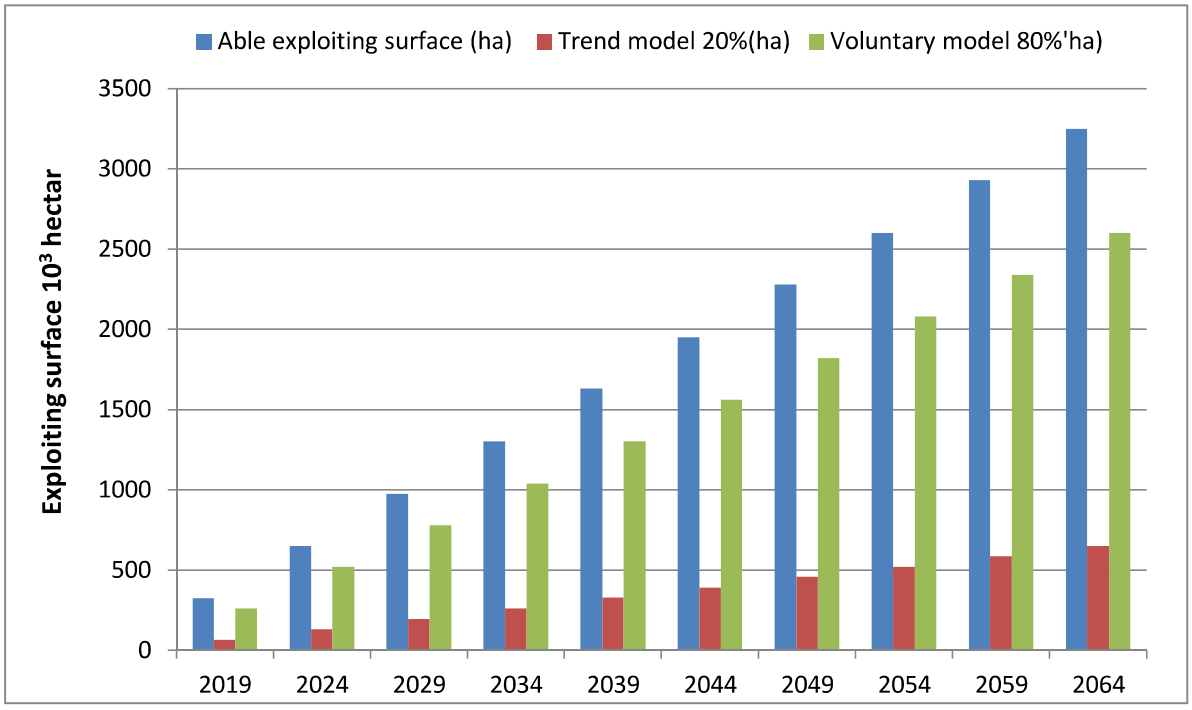


Fig.3.3: Evolution of exploiting surface 2019-2064

3.4.2. Dates production

In reality, dates productions didn't follow the same progressing of exploiting surface, because palm tree need a period of about 5 years to reach an acceptable date production. In figure 3.4 the expecting production by trend and voluntary model of dates and its low quality during the period 2019-2064 is presented.

years	2019	2024	2029	2034	2039
production total(Qx) 20%	3782970	7565939,577	11348909,37	15131879,15	18973048,48
low grade(Qx)20%	681691,2	1363382,306	2045073,47	276044,623	3418943,34
TOTAL PRODUCTION 80%(Qx)	15131879	30263758,31	45395637,46	60527516,62	75892193,91
low grade (Qx) 80%	2726765	5453529,25	8180293,87	10907058,5	13675773,3

years	2044	2049	2054	2059	2064
production total(Qx) 20%	22697818,73	26538988,05	30263758,31	34104927,63	37829697,89
low grade(Qx)20%	4090146,94	4782325,65	5453529,25	6145707,96	6816911,56
TOTAL PRODUCTION 80%(Qx)	90791274,92	105923154,1	121055033,2	136186912,4	151318791,5
low grade (Qx) 80%	16360587,7	1908735,24	21814117	24540882,3	27267646,2

Tab.3.4: Expecting dates production 2019-2064

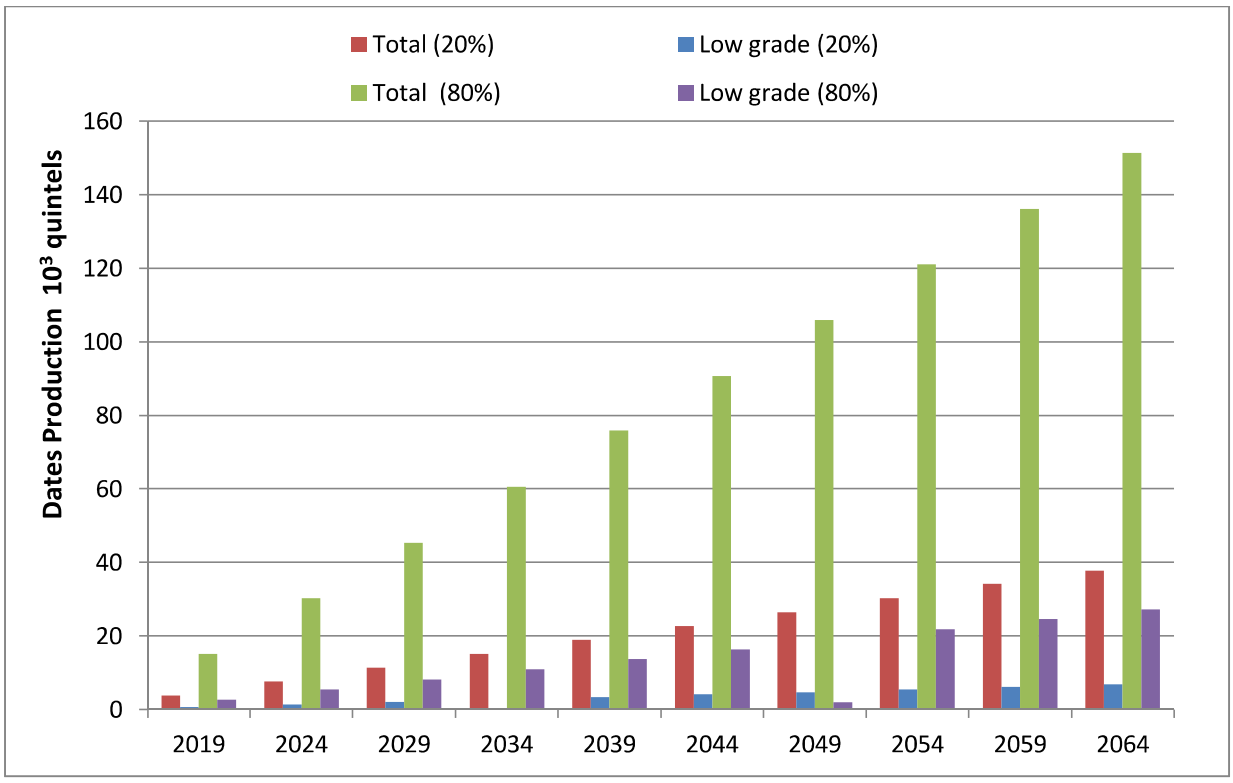


Fig 3.4: Dates production progressing 2019-2064

3.4.3. Extraction ethanol

By using the trend model the results expects an ethanol production of $2{,}12\times10^{7}$ liters in 2019 for 65000 hectare and $2{,}01\times10^{8}$ liters in 2064 for $6{,}5\times10^{5}$ hectare. Where the results of the voluntary model expect an production of $8{,}15\times10^{7}$ liters and $8{,}04\times10^{8}$ liters in 2019 and 2064 for a surface of $2{,}6\times10^{5}$ hectare and $2{,}6\times10^{6}$ hectare respectively. The figure3.2 shows the increase of ethanol production by the trend and voluntary models during the coming 50 years.

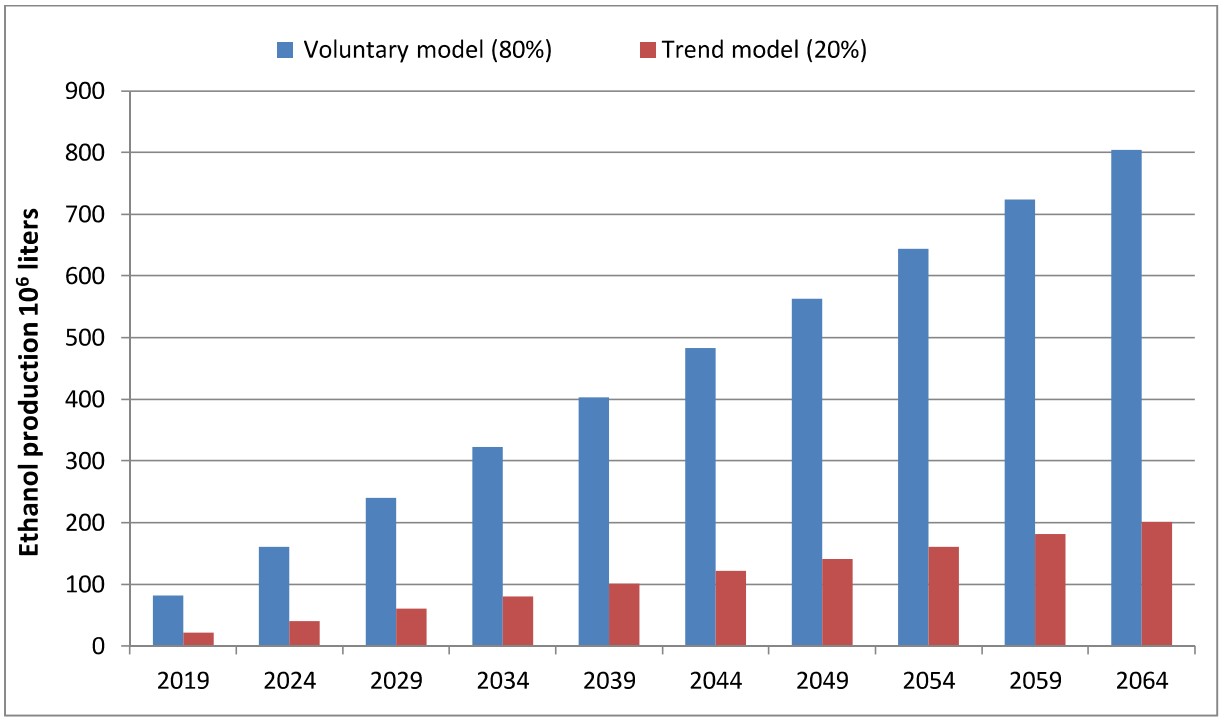


Fig 3.5: Ethanol production evolution

3.4.4. Economic payback

In our calculation the same proportions of existing palms by surface of Deglet-Nour, Ghars and Deglet-Beida and the same productivities by tree of these variety are respected which are respectively 61.8 kg/tree, 67.3 kg/tree and 42.3 kg/tree [10]. In the table 3.5 the whole results are presented.

Dates variety of Deglet-Nour, Ghars and Deglet-Beida are largely marketable and consumable. Although, their price in the Algerian market is between 50 and100 DA or between 0.47 and 0.95 €, the prices of the low grade ones do not exceed 15 DA (0.12€).The cost of ethanol production from dates is about 60DA (0.57€) per 1kg of date (electricity, reagents, raw material, labor etc). The average yield of the three varieties is 253 ml/kg, the price of ethanol 95° in the world market is 10.6 € (1113DA), so the price of 1 kg of these dates when converted into bioethanol is about 3.6€ instead of 0.12€ without transformation. It means a profit of about 3.48€ per 1 kg of this variety of dates [1].

Years	2019	2024	2029	2034	2039
Able exploiting surface (ha)	325×10^3	65×10^4	975×10^3	13×10^5	163×10^4
Surface (ha) (trend model 20%)	65×10^3	13×10^4	195×10^3	26×10^4	326×10^3
Surface (ha) (voluntary model 80%)	26×10^4	52×10^4	78×10^4	104×10^4	130×10^4
Ethanol production (liter) (trend model 20%)	212×10^5	402×10^5	603×10^5	804×10^5	101×10^6
Ethanol production (liter) (Voluntary model 80%)	815×10^5	161×10^6	24×10^7	322×10^6	403×10^6
Years	2019	2024	2029	2034	2039
Able exploiting surface (ha)	325×10^3	65×10^4	975×10^3	13×10^5	163×10^4
Surface (ha) (trend model 20%)	65×10^3	13×10^4	195×10^3	26×10^4	326×10^3
Surface (ha) (voluntary model 80%)	26×10^4	52×10^4	78×10^4	104×10^4	130×10^4
Ethanol production (liter) (trend model 20%)	212×10^5	402×10^5	603×10^5	804×10^5	101×10^6
Ethanol production (liter) (Voluntary model 80%)	815×10^5	161×10^6	24×10^7	322×10^6	403×10^6

Tab3.5: Expecting of exploiting surface and ethanol production revolution (2019-2064)

3.5. Conclusion

In this study, we opted to the wastes of date as row material to produce ethanol. In this production process, we choose three varieties of the most dominant dates (Ghars, Deglet Nour, and Deglet-Beida) in the region of Ouargla. Basing on the characteristics of date species studied by K. Oussif those are big similarity to dates produced in Ouargla region. By choosing the mean value of losses (20%), ethanol production rates become 0.624, 0.60 and 0.30 ml/g for Ghars, Deglet Nour and Degla Beida respectively. For 2014, waste dates mass is evaluated at 225645.8 quintals which can give 6657000 liters of ethanol. So in 2019 ethanol production by the trend model of 20% can reach 212×10^5 liters, from a waste dates mass of 681709.37 quintals. In case of promoting this industry, an optimistic rate of 80% can be taken where the ethanol production will be so significant and it continues increasing over 50 years (se figure 3.4).

Annex 1: Statistic of dates production and occupied superficies in Ouargla, DSA 2014.

Palmier dattier 2013/2014

TABLEAU : A - 2 PALMIERS DATTIERS (Superficie occupée, nombre de palmiers existants et production)

SECTEURS	DATTES en masses 2 Superficie Occupée (HA)	NOMBREDE PALMIERS EXISTANTS Deglet Nour (nombre)	Ghars (nombre)	Deglet beida (nombre)	AUTRES Varietes (nombre)	TOTAL (nombre) 28422	NOMBRE DE PALMIERS EN RAPPORT Deglet Nour (nombre)	Ghars (nombre)	Deglet beida (nombre)	AUTRES Varietes	TOTAL (nombre)	PRODUCTION EN DATTES (QX) Deglet Nour (QX)	Ghars (QX)	Deglet beida (QX)	AUTRES Varietes (nombre)	TOTAL (QX)
Colonne	1	2	3	4	5	=2+3+4+5	7	8	9	10	1=7+8+9+1	12	13	14	15	12+13+14-
Ouargla	1999	60153	172279	0	62807	295239	58178	171264	0	62450	291892	36070	102758	0	34347	173175
Rouissat	961	48761	60285	0	9606	118652	46822	59736	0	9350	115908	29030	35842	0	5143	70015
S/T/D.Ouargla	2960	108914	232564	0	72413	413891	105000	231000	0	71800	407800	65100	138600	0	39490	243190
Sidi Khouiled	691,91	20175	24615	0	9211	54001	11540	20250	0	8350	40140	6343,68	16840	0	5160,3	28343,98
Ain El-Beida	1746,09	114476	60633	1300	40262	216671	86250	52850	450	39460	179010	47450,25	31963	161	24170,7	103745
Hassi Benabdellah	1961,98	121625	48702	1450	4540	176317	34630	15530	600	500	51260	24248,1	10622	215	309	35394,1
S/T/D.S-khouiled	4399,98	256276	133950	2750	54013	446989	132420	88630	1050	48310	270410	78042,03	59425	376	29640	167483
N'Goussa	1732,32	70517	93178	0	10558	174253	47396	77055	0	7917	132368	26067,8	40839,2	0	4275,18	71182,13
S/T/D.N'Goussa	1732,32	70517	93178	0	10558	174253	47396	77055	0	7917	132368	26067,8	40839,2	0	4275,18	71182,13
H,Messaoud	39,6	2761	1288	752	3016	7817	2761	1288	752	3016	7817	1520	773	150	1810	4253
H.Messaoud	432,63	33676	20624	10658	9089	74047	5597	5128	1439	289	12453	3080	3077	288	173	6618
S/T/D.H.Messaoud	472,23	36437	21912	11410	12105	81864	8358	6416	2191	3305	20270	4600	3850	438	1983	10871
El-Borma						0					0					0
S/T/D.El-Borma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Touggourt	116,66	8403	1985	3322	110	13820	4137	917	1096	50	6200	3268	477	559	28	4332
Nezla	1404,69	130190	17712	19998	7819	175719	107024	15493	16048	7324	145889	87760	8521	7221	4175	107677
Tebesbest	932,13	76456	34469	11662	13018	135605	62405	29125	9402	12220	113152	51796	15727	4701	6843	79067
Zaoua El-Abidia	930	79378	15229	13200	9617	117424	65276	12594	9925	9313	97108	55485	6927	5359	5308	73079
S/T/D.Touggourt	3383,48	294427	69395	48182	30564	442568	238842	58129	36471	28907	362349	198309	31652	17840	16354	264155
Meggarine	1655	121767	26097	33332	12727	193923	119821	21054	26714	12112	179701	71893	16843	13357	6662	108755
Sidi Slimane	1706	115194	24529	15743	7480	162946	103403	19594	13984	4246	141227	62042	15675	6992	2335	87044
S/T/D.Meggarine	3361	236961	50626	49075	20207	356869	223224	40648	40698	16358	320928	133935	32518	20349	8997	195799
Temacine	1854,89	123041	36373	29265	20696	209375	86571	17559	18640	18795	141565	51942	8779	10811	10337	81869
Baldet Omar	1398,8	137612	17973	14358	10285	180228	111607	17020	11676	10235	150538	68080	8850	6772	5629	89331
S/T/D.Temacine	3253,69	260653	54346	43623	30981	389603	198178	34579	30316	29030	292103	120022	17629	17583	15966	171200
El Hadjira	751	31275	57075	5830	3735	97915	25750	51500	3550	3440	84240	10506	37904	2540	2940	53890
El-Alia	436,75	33347	17054	1710	2314	54425	28290	15495	1545	2175	47505	11770	10493	968	1709	24940
S/T/D.El-Hadjira	1187,75	64622	74129	7540	6049	152340	54040	66995	5095	5615	131745	22276	48397	3508	4649	78830
Taibet	226	18988	6984	2300	1518	29790	16500	5550	1500	1500	25050	9900	2775	750	900	14325
Bennaceur	194	14325	5336	1300	550	21511	12380	4500	800	500	18180	7428	2250	400	300	10378
M'ongueur	687	32820	14160	3250	2360	52590	26600	12340	2480	2300	43720	15960	6170	1240	1380	24750
S/T/D.Taibet	1107	66133	26480	6850	4428	103891	55480	22390	4780	4300	86950	33288	11195	2390	2580	49453
TOTAL WILAYA	21857,45	1394940	756580	169430	241318	2562268	1062938	625842	120601	215542	2024923	681640	384105	62484	123934	1252163

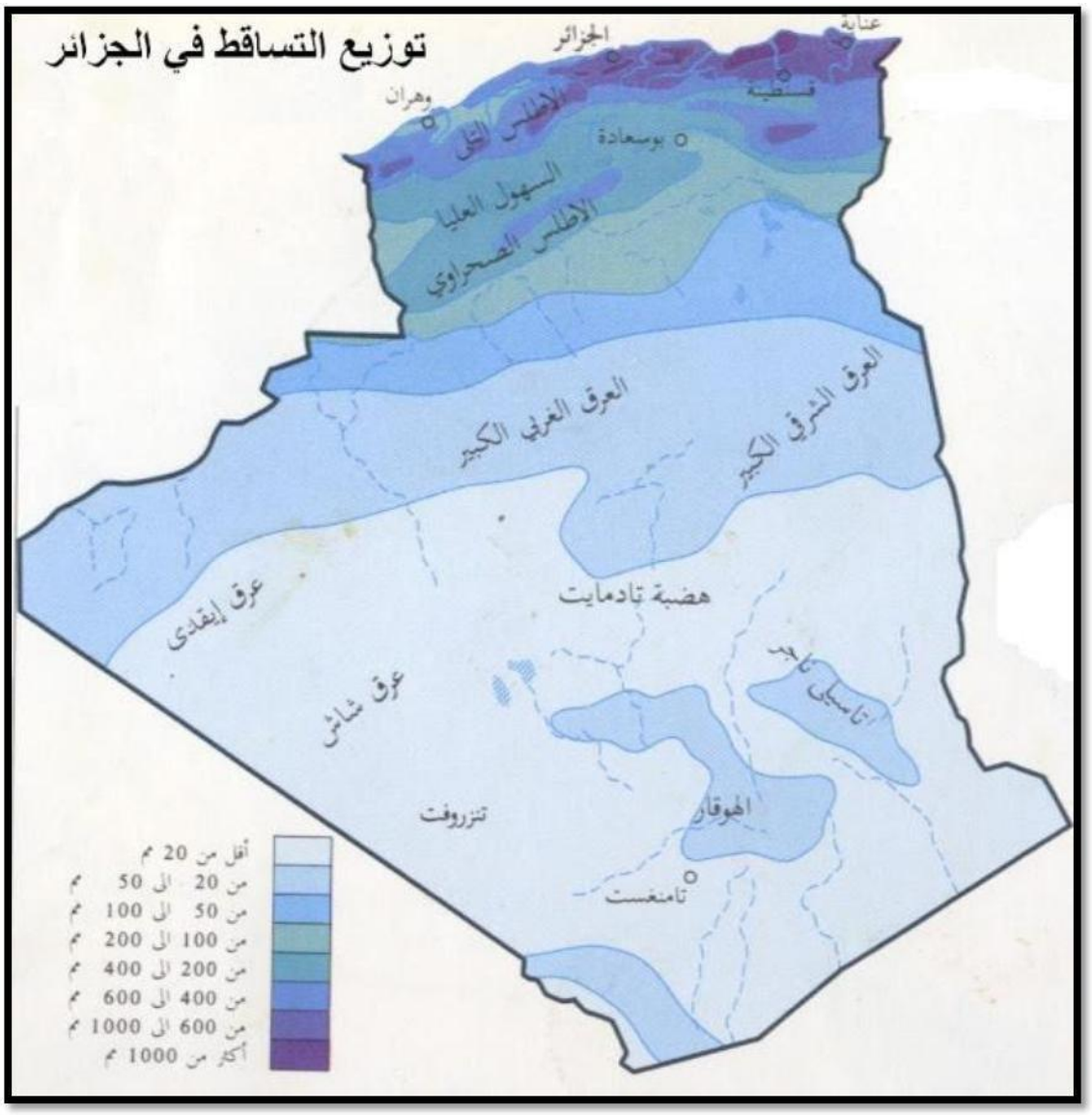
Annex2: Superficies des terres utilises par l'agriculture in Algeria. DSA 2014

SUPERFICIES DES TERRES UTILISEES PAR L'AGRICULTURE 2/2

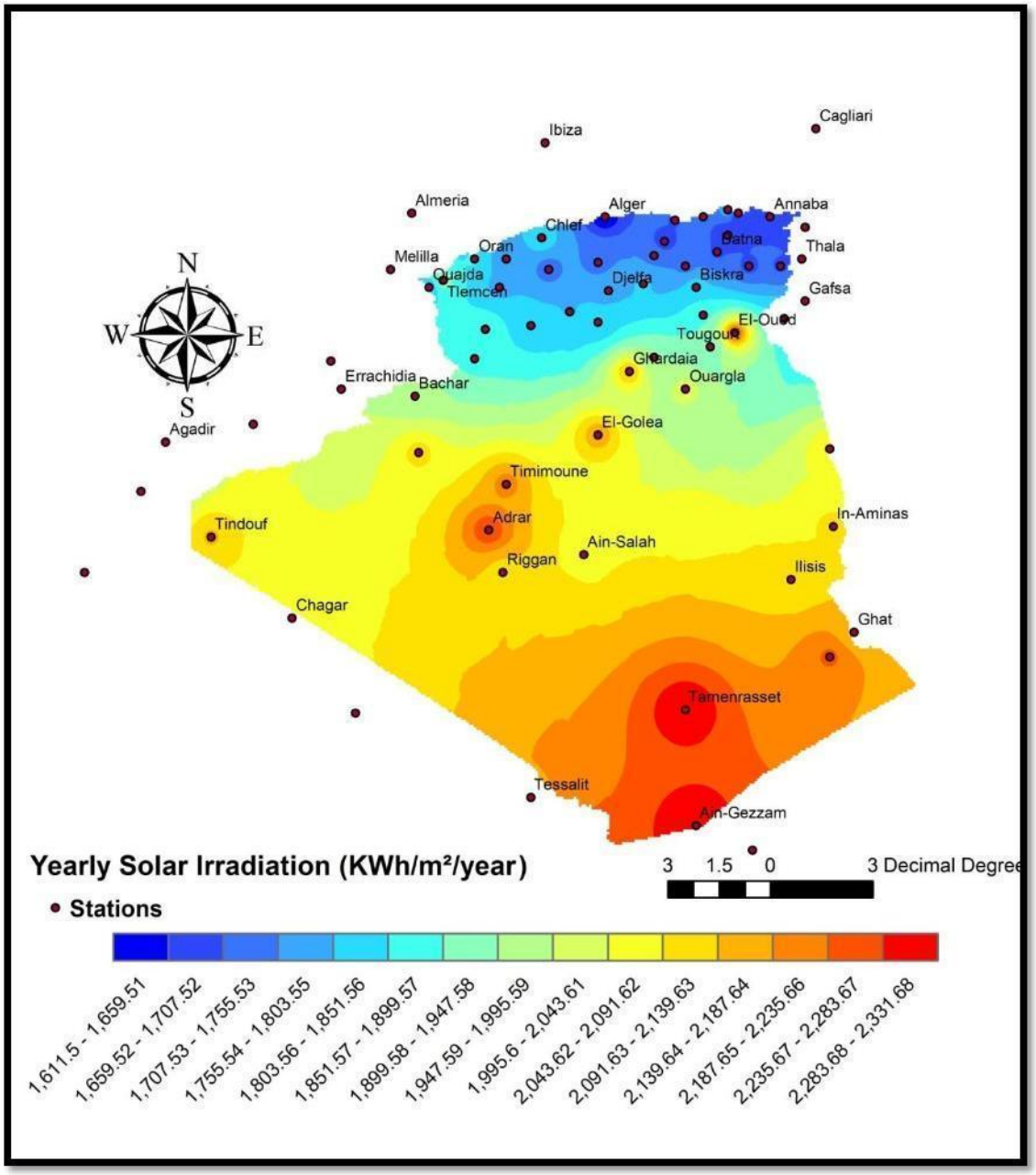
B13

WILAYA	Plantations arbres fruit		TOTAL S. A. U		Pacages & parcours		Terres improductives		TOTAL S.A.T	
	ha	%	ha	%	ha	%	ha	%	ha	%
1 ADRAR	27 804	7,6	35 806	9,8	315 819	86,3	14 452	3,9	366 077	100
2 CHLEF	14 368	5,5	203 230	77,4	25 714	9,8	33 567	12,8	262 511	100
3 LAGHOUAT	6 340	0,4	73 013	4,6	1 529 559	95,4	0	0,0	1 602 572	100
4 O.E.BOUAGHI	2 012	0,4	360 885	70,0	122 565	23,8	32 032	6,2	515 482	100
5 BATNA	18 468	2,5	422 677	56,8	237 426	31,9	83 923	11,3	744 026	100
6 BEJAIA	68 081	41,3	130 348	79,1	30 859	18,7	3 587	2,2	164 794	100
7 BISKRA	50 954	3,1	185 473	11,2	1 399 746	84,7	67 532	4,1	1 652 751	100
8 BECHAR	17 088	1,2	35 167	2,5	1 319 234	92,6	69 834	4,9	1 424 235	100
9 BLIDA	28 761	42,6	56 730	84,1	8 864	13,1	1 880	2,8	67 474	100
10 BOUIRA	37 931	12,9	189 960	64,7	76 686	26,1	26 899	9,2	293 545	100
11 TAMANRASSET	8 221	0,9	11 387	1,3	816 100	92,6	53 888	6,1	881 375	100
12 TEBESSA	10 011	1,2	312 175	38,1	434 088	53,0	72 094	8,8	818 357	0
13 TLEMCEN	26 987	5,0	350 821	65,2	154 271	28,7	32 721	6,1	537 813	100
14 TIARET	21 018	1,9	705 650	62,6	395 387	35,1	26 921	2,4	1 127 958	100
15 TIZI-OUZOU	45 477	31,7	98 842	69,0	25 370	17,7	19 040	13,3	143 252	100
16 ALGER	9 655	25,9	32 496	87,3	2 994	8,0	1 719	4,6	37 209	100
17 DJELFA	17 054	0,7	378 665	15,1	2 122 428	84,9	0	0,0	2 501 093	100
18 JIJEL	15 810	16,0	43 705	44,3	40 428	41,0	14 511	14,7	98 644	100
19 SETIF	29 506	6,4	363 272	79,0	55 492	12,1	41 084	8,9	459 848	100
20 SAIDA	5 536	1,1	308 206	60,3	159 664	31,2	43 479	8,5	511 349	100
21 SKIKDA	20 747	10,7	131 880	68,3	42 977	22,2	18 323	9,5	193 180	100
22 S.B.ABBES	12 971	3,4	363 191	94,0	3 723	1,0	19 640	5,1	386 554	100
23 ANNABA	1 898	3,2	48 177	82,3	7 585	13,0	2 786	4,8	58 548	100
24 GUELMA	11 093	4,2	187 338	70,8	50 875	19,2	26 405	10,0	264 618	100
25 CONSTANTINE	2 109	1,2	131 096	71,9	51 290	28,1	0	0,0	182 386	100
26 MEDEA	21 918	3,5	338 359	53,6	292 507	46,4	117	0,0	630 983	100
27 MOSTAGANEM	20 118	13,9	132 268	91,4	5 110	3,5	7 400	5,1	144 778	100
28 M'SILA	19 533	1,5	277 211	21,2	1 029 945	78,8	0	0,0	1 307 156	100
29 MASCARA	23 444	5,4	312 787	72,0	104 228	24,0	17 118	3,9	434 133	100
30 OUARGLA	21 742	0,4	39 737	0,8	4 750 000	90,6	452 842	8,6	5 242 579	100
31 ORAN	9 693	10,0	88 460	91,2	1 823	1,9	6 735	6,9	97 018	100
32 EL-BAYADH	11 423	0,2	71 702	1,2	5 693 495	98,7	550	0,0	5 765 747	100
33 ILLIZI	1 550	13,3	2 208	19,0	6 000	51,6	3 424	29,4	11 632	100
34 B.B.ARRERIDJ	28 513	11,5	187 847	76,1	48 598	19,7	10 556	4,3	247 001	100
35 BOUMERDES	14 029	14,2	65 010	65,8	18 591	18,8	15 263	15,4	98 864	100
36 EL-TARF	8 189	9,7	74 173	88,3	8 518	10,1	1 340	1,6	84 031	100
37 TINDOUF	491	0,0	872	0,0	6 000 000	100,0	1 628	0,0	6 002 500	100
38 TISSEMSILT	12 643	6,7	145 456	76,7	21 997	11,6	22 297	11,8	189 750	100
39 EL-OUED	39 723	2,5	76 410	4,8	1 444 181	90,7	71 278	4,5	1 591 869	100
40 KHENCHELA	20 355	2,6	232 690	30,0	466 648	60,2	75 373	9,7	774 711	100
41 SOUK-AHRAS	7 417	2,4	253 606	81,4	49 340	15,8	8 546	2,7	311 492	100
42 TIPAZA	14 797	20,4	64 311	88,7	8 157	11,3	32	0,0	72 500	100
43 MILA	10 987	4,0	237 557	86,1	21 956	8,0	16 444	6,0	275 957	100
44 AIN-DEFLA	19 917	8,5	181 676	77,1	38 078	16,2	15 857	6,7	235 611	100
45 NAAMA	5 953	0,3	24 441	1,1	2 178 959	98,9	60	0,0	2 203 460	100
46 A.TEMOUCHENT	10 907	5,4	180 184	88,5	8 104	4,0	15 296	7,5	203 584	100
47 GHARDAIA	14 095	1,0	32 745	2,4	1 337 994	97,6	172	0,0	1 370 911	100
48 RELIZANE	17 809	6,0	281 875	94,8	6 062	2,0	9 450	3,2	297 387	100
TOTAL ALGERIE	865 146	2,0	8 461 775	19,7	32 969 435	76,9	1 458 095	3,4	42 889 305	100

Annex3: Precipitation in Algeria (web site).



Annex 4: Solar irradiation in Algeria (realized by Master student with Arcgis).



Annex5 : Liste des forages NARH 2014. (Échantillon).

Nom du point d'eau	Xdeg	Ydeg	Z(m)	Profd (m)	Année	Nappe	Usage	Etat
Kharfi D47 F26	6° 00' 37"	32° 53' 30	105	.	1997	Mio-plio	IRRI	.
Kharfi Houcine D47 F23	6° 00' 17"	32° 54' 08"	90	84	1993	Mio-plio	IRRI	
Kharfi C185Slimane D47 F17	6° 00' 15"	32° 54' 12"	84,8	82,5	1963	Mio-plio	IRRI	Bon
Chaâb D47 F18	6° 00' 17"	32 54 14	86	90	1964	Mio-plio	IRRI	
Shan (Badidja) D47 F20	6° 00' 21"	32° 54' 26"	84,2	84,7	1969	Mio-plio	IRRI	Bon
AEP Château D47 F24	6° 00' 26"	32° 54' 06"	97	75	1994	Mio-plio	IRRI	
Ftimi Slimane D47 F25	5° 59' 32"	32° 54' 12"	85	93	1995	Mio-plio	IRRI	Mauv
Kharfi Med Laid D47 F22	5° 59' 30"	32° 54' 23"	87	93	1989	Mio-plio	IRRI	Bon
Cheraga D47 F19	5° 59' 37"	32° 54' 32"	87	80	1969	Mio-plio	IRRI	Bon
Badidja Ali D47 F21	5° 59' 38"	32° 55' 56"	87	83	1989	Mio-plio	IRRI	Bon
Bennour GueblaD46 F65	5° 59' 43"	32° 55' 45"	86,2	75	1954	Mio-plio	IRRI	Bon
Bennour D46 F81	5° 59' 32"	32° 55' 43"	83,51	85	1985	Mio-plio	IRRI	Bon
Nouha Hmida D46 F85	5° 59' 17"	32° 55' 44"	85,7	85	1987	Mio-plio	IRRI	Bon
Sayhi Abd El kader D46 F74	5° 59' 14"	32° 55' 46"	88	80	1962	Mio-plio	IRRI	.
Bouya Sayah D46 F66	5° 59' 05"	32° 55' 47"	87	76	1959	Mio-plio	IRRI	Bon
Sassi Barkia D46 F44	5° 59' 03"	32° 55' 46"	85	60	1919	Mio-plio	IRRI	Bon
Nouha Tayeb D46 F86	5° 59' 00"	32° 55' 40"	103	85	1988	Mio-plio	IRRI	Bon
Ferroudj D46 F79	5° 58' 48"	32° 55' 41"	85,8	70,22	1969	Mio-plio	IRRI	Bon
Maktoub 1 D46 F69	5° 58' 37"	32° 55' 36"	84,5	70,6	1960	Mio-plio	IRRI	Bon
Chaïb Lakhdar D46 F100	5° 58' 33"	32° 55' 29"	89	79	1992	Mio-plio	IRRI	Bon
Maktoub 2 D46 F90	5° 58' 24"	32° 55' 28"	89	79	1989	Mio-plio	IRRI	Bon
Puits communal D46 F80	5° 58' 20"	32° 56' 12"	82,9	75	1977	Mio-plio	IRRI	Bon
Chaïb Salah D46 F91	5° 58' 27"	32° 56' 07"	82,7	69	1989	Mio-plio	IRRI	
Kadi Tahar D46 F94	5° 58' 23"	32° 56' 07"	87	135	1989	Mio-plio	IRRI	Bon
Mahboub D46 F75	5° 58' 20"	32° 56' 07"	82,6	70,6	1968	Mio-plio	IRRI	Bon
Kora Djédida D46 F73	5° 58' 14"	32° 56' 15"	81	134	1962	Mio-plio	IRRI	Bon
Bassaci D46 F96	5° 58' 12"	32° 56' 21"	80	65	1989	Mio-plio	IRRI	Bon
Zgag Djédida D46 F51	5° 58' 11"	32° 56' 30"	80	76	1962	Mio-plio	IRRI	Bon
Bouhréra H. D46 F101	5° 58' 19"	32° 56' 38"	79	79,82	1993	Mio-plio	IRRI	Bon
Cheraga D46 F78	5° 57' 59"	32° 56' 55"	80,7	130	1968	Mio-plio	IRRI	Bon
Bouhnik 1 D46 F93	5° 57' 59"	32° 55' 55"	90	131	1989	Mio-plio	IRRI	Bon
Bouhnik 2 D46 F87	5° 57' 50"	32° 55' 45"	87	69	1988	Mio-plio	IRRI	Bon
Naga D46 F77	5° 57' 49"	32° 55' 33"	84	49,88	1968	Mio-plio	IRRI	Bon
Bouhréra Med D46 F99	5° 57' 48"	32° 55' 27"	83	62	1992	Mio-plio	IRRI	Bon
Naga 2 D46 F82	5° 57' 51"	32° 55' 12"	84	65	1985	Mio-plio	IRRI	Bon
Naga1(m.en V.) D46 F84	5° 57' 45"	32° 54' 52"	91,5	90	1986	Mio-plio	IRRI	Bon
Naga 2 (m.en V.)D46 F92	5° 57' 43"	32° 54' 15"	86	84	1989	Mio-plio	IRRI	
Dar Messaoud D46 F53	5° 58' 14"	32° 55' 58"	82,6	40	1965	Mio-plio	IRRI	Bon
Badidja Ali D46 F95	5° 59' 56"	32° 55' 52"	83	87,42	1989	Mio-plio	IRRI	Bon
Ftimi Slimane D46 F98	6° 00' 15"	32° 55' 38"	83	93	1990	Mio-plio	IRRI	Bon
Bennour El Gaïd D46 F83	6° 00' 05"	32° 56' 27"	82	100	1986	Mio-plio	IRRI	Bon

Annex 6: Donnees climatologique de la region d'Ouargla periode 2011 - 2013

	Mois	Moyenne de T MIN EN 1/10 °C	Moyenne de T MAX EN 1/10 °C	Moyenne HUMIDITE MIN EN %	Moyenne HUMIDITE MAX EN %	FORCE DU VENT Max EN KM/H	Cumul PRECIPITATIONS EN 1/10 MM	Cumul EVAPORATION EN 1/10 MM	Cumul INSOLATION EN 1/10 H
2011	Janvier	48	205	40	80	14	0	810	2612
	Fevrier	56	205	33	72	17	0	800	2571
	Mars	97	239	30	76	21	111	1596	2655
	Avril	148	307	24	62	30	17	2152	3062
	Mai	186	337	24	55	16	0	2625	3328
	Juin	232	383	23	51	16	0	3477	2445
	Juillet	277	440	18	45	13	0	4385	3197
	Aout	263	423	20	44	13	0	3864	3577
	Septembre	251	403	21	49	15	1	2452	2701
	Octobre	151	291	37	78	12	50	1259	2651
	Novembre	102	243	36	80	21	0	1058	2591
	Décembre	52	197	47	90	11	0	624	2298
2012	Janvier	35	180	44	86	20	162	616	2490
	Fevrier	34	173	38	79	20	55	808	2730
	Mars	88	245	33	74	13	10	1324	2528
	Avril	145	304	24	59	20	35	2091	2934
	Mai	196	355	19	47	20	0	3123	3281
	Juin	274	432	17	43	14	0	3536	2315
	Juillet	286	448	15	37	32	13	3823	3208
	Aout	270	431	15	41	15	3	3676	3492
	Septembre	217	382	18	48	15	46	3329	2855
	Octobre	182	334	22	55	12	0	2783	2589
	Novembre	119	263	33	74	14	0	1468	2362
	Décembre	37	199	35	80	12	0	906	2397
2013	Janvier	49	202	35	80	25	36	1009	2466
	Fevrier	53	212	30	70	14	0	1129	2675
	Mars	119	286	29	70	19	2	1669	2773
	Avril	154	309	21	58	22	63	1918	2682
	Mai	191	355	11	39	22	0	2278	3307
	Juin	234	398	11	35	22	0	3173	2261
	Juillet	278	435	10	30	16	0	4144	3159
	Aout	261	407	13	36	18	24	3191	3408
	Septembre	232	383	16	47	18	0	2871	2794
	Octobre	195	358	16	44	11	0	2767	2685
	Novembre	100	234	26	66	13	46	1475	2459
	Décembre	63	173	47	92	14	245	559	2050

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Abstract: This work presents a valuation of bioethanol production from date palm in Ouargla region. The natural resources are investigated by using Arcgis software. The potential in Ouargla basin is important; it has huge underground water with high flow rates and low depths. In addition to vast wide plain area allows large agriculture expansion, therefore the dates production can promote this activity. The low grade date is used to develop a profitable bio-ethanol industry. In 2014, the bio-ethanol extraction from only three date varieties (Ghars, Deglet-Nour and Deglet-Beida) is estimates about 145466.22 liters for an area of 21515 hectares. The results show that the possible surfaces for palms cultivation extension is about 62% from the total surface of Ouargla Provence. The investment on 50 years by using a trend model with an exploiting rate of 20% from the new area, show that ethanol extract from low grade dates can reach 212×10^5 liters for an area of 65000 hectares and 201×10^6 liters for 650000 hectares in 2019 and 2064 respectively. The estimation by a voluntary model by taking into account an exploitation rate as 80% of agriculture land, forecasting bio-ethanol production can be at least quadruple.
Key words: palm trees, Arcgis, Low grade dates, Bioethanol, prospection.

الملخص: هذا العمل دراسة تقيمية لإمكانيات إنتاج الإيثانول الحيوي من تمور النخيل في ولاية ورقلة. الموارد الطبيعية تمت معالجتها و تثمينها باستخدام برنامجArcgis ،هذه الموارد تتمثل في مخزونً هائل من المياه الجوفية بتدفق عالي و على عمق معتبر،اضافة الى مساحة سهلية كبيرة تسمح بالتوسع في زراعة النخيل و بالتالي الرفع من انتاج التمور وتعزيز هذا النشاط، التمور ذات النوعية الرديئة تستخدم في تطوير صناعة مربحة للإيثانول الحيوي. في سنة 2014 قدر حجم الإيثانول المستخرج من ثلاث أنواع فقط (دقل نور، غرس و دقلة بيضا) بـ 145466.22 لتر بمساحة قدرها 21515 هكتار. قدرت الدراسة المساحة الممكنة للتوسع في زراعة النخيل بـ 62 % من اجمالي مساحة ولاية ورقلة. بتقسيم هذه المساحة على استثمار خلال 50 سنة و بإتباع نموذج مقيد بنسبة استغلال 20 % من المساحة الجديدة الممكنة فإن الإيثانول المستخرج من الأنواع الرديئة يمكن أن يبلغ 21.2 مليون لتر بمساحة 65000 هكتار و 201 مليون لتر بمساحة 650000 هكتار في سنتي 2019 و 2064 على التوالي. التوقعات بإتباع نموذج تفاؤلي بنسبة استغلال 80 % من المساحة الجديدة أظهرت إنتاجا معتبرا جدا وبينت إمكانية تضاعفه مرتين.
الكلمات المفتاحية: النخيل،Arcgis ، التمورالرديئة، الإيثانول الحيوي، توقعات.

Résumé : Ce travail présente une évaluation de la production de bioéthanol de palmiers dattiers dans la région d'Ouargla. Les ressources naturelles sont étudiées à l'aide du logiciel Arcgis. Le potentiel dans le bassin d'Ouargla est important ; Il a des eaux souterraines énormes avec des débits élevés et de faibles profondeurs. En plus de la vaste plaine large permet l'expansion importante de l'agriculture, donc la production des dates qui peut promouvoir cette activité. Les dates de bas grade sont utilisées pour développer une industrie rentable de bioéthanol. En 2014, l'extraction de bioéthanol seulement de trois variétés de date (Ghars, Deglet-Nour et Deglet-Beida) est estimé environ 145466,22 litres pour une superficie de 21515 hectares. Les résultats montrent que la surface possible pour l'extension dans la culture de palmiers est environ 62% de la surface totale de la Provence de Ouargla. L'investissement sur 50 ans en utilisant un modèle tendance avec un taux d'exploitation de 20% par rapport la zone possible montrer que l'éthanol extrait de dates de bas grade peut atteindre 21.2 million litres pour une superficie de 65000 hectares et 201 million litres pour 650000 hectares en 2019 et 2064 respectivement. L'estimation par un modèle volontaire en prenant en compte un taux d'exploitation de 80 % des terres agricoles, la production de bioéthanol de prévision peut être au moins quadruple.
Mots clés : Palmes, Arcgis, dates de bas grade, bioéthanol, Prospection.