



Endogenous knowledge of *Jatropha curcas* in the province of Tandjile in southern of Chad

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Abstract

Investigations were carried out during the first half of 2016, as a prelude to the experimental installations, with a view to promoting the farming of *Jatropha curcas* in the Sudanian zone of Chad. The aim was to identify the uses of *Jatropha curcas* in agriculture, the environment, the economy and the pharmacopoeia (traditional medicine). A structured survey, containing open, closed and oriented questions, was carried out to analyze the system of production and exploitation of *Jatrophas curcas*. Four hundred and fifty operators were interviewed. The results obtained showed that *Jatropha* is used in the pharmacopoeia (25.57%) and in the agroforestry systems (83.37%). Farmers are mainly men (88.07%) aged 20-45 (77%) mainly engaged in agriculture (81.07%). The most widely used propagation method is cuttings of stem (80.76%). Little is known to the population about the biofuel and bio-insecticide use of *Jatrophas curcas*.

The cultivation of *Jatropha curcas* is well established in the habits of the populations of the province of Tandjile, with appreciable endogenous knowledge. The use of *Jatropha* oil as a biofuel and bio-insecticide and seed cake as biofertilizers would constitute an important alternative for the use of fossil fuels, insecticides and chemical fertilizers reputed to be very polluting. The use of the products of this plant would fight against environmental degradation and climate change. The development of the oil sector of the *Jatrophas* would bring obvious advantages on the medical level and increase the economy of the operator of this plant. Considering the in-depth knowledge of *Jatrophas*, raising awareness, above all, as the biofuel use of oil and cake products from oil extraction is of great importance. Optimizing production can involve the use of organic fertilizers for sustainable agriculture.

Keywords: *Jatrophas curcas*, endogenous knowledge, agroforestry, Sudanian zone, Province of Tandjilé-Tchad.

Introduction

Since a few years, the green-house gases emission, particularly the carbon dioxide (CO₂) produced by the massive combustion of the fossil fuels constitute a real danger to the climate and the populations health in the earth. It is the principal cause of the climate change (Minengu *et al.*, 2014). To limit these emissions of CO₂ and to reduce the dependence to fossil energies, the industrialists seek sources of fossil fuel substitution. Thus research is currently directed towards the nonfood vegetable species able to produce biofuel, without entering in competition with the food plants production. According to Tchuenteu (2013) and Kabe *et al.* (2019), the *Jatropha curcas* could allow the biofuel development and help to achieve the objectives of sustainable development. In the soudanian area of Chad, *Jatropha curcas* is rather known by farmers (Tchobsala, 2013). Indeed, *Jatropha curcas*, plant of the Euphorbiaceae family, is a vegetable species able to solve the energy problems. The plant produces oleaginous seeds able to give oil until more than 40% of its total mass, which one can use like biofuel. It is used at the manufacture of artisanal soap and pommade. This oil contains toxic diterpenes, the esters of phorbol, exploited to use as insecticides and nematicides to protect the crop plants against various flies species (Penjit, 2012; Abdoulaye, 2018). Being toxic, the plant is edible neither by the man nor by the animals. Because of its strong content of therapeutic gasolines, this plant is well used in the pharmacopeia. (FAO, 2010). It is introduced into the agroforestry systems, as a life-fence of fields and windscreens. It is used to fix agricultural soils (Abdoul *et al.*, 2013; Dona *et al.*, 2018). Also, the seed cake obtained after oil extraction is an excellent organic manure for the cultures and constitutes after

detoxication a good fodder for the breeding animal livestock (Kasuya, 2013). In addition to these multiple uses, the plant develops easily on various types of grounds and supports long periods of dryness (up to 3 years) with very little maintenance. But its optimal production requires a soil well drained and fertile. It also has a potential of carbon sequestration, reducing the carbon dioxide of the air, principal gas for purpose of greenhouse in atmosphere (Tchobsala *et al.*, 2013).

The objective of this work was to index the uses of *Jatropha* in the agricultural systems of the Province of Tandjile and to determine their effects on agriculture, the environment, the economy and the medical care.

Material and Methods

Characteristics of the area of study

The Province of Tandjile, situated at the South-west of Chad between 9th and 10th degree of North latitude and 15th and 18th degree of East longitude, has a climate of the soudanian type with a long dry season (6-7 month) and a short season of rain (5-6 month). It includes three savanna units: forested savanna, shrubby savanna and raised savanna (Kabé *et al.*, 2019). Various type of grounds characterize the area of Tandjilé and they are variable by place (vertisols, tropical ferruginous deepy grounds and hydromorphic soils), favorable to agriculture and breeding (Anonyme, 2011). The area of Tandjilé presents 3 departments (Eastern Tandjile, Western Tandjile and Center Tandjile). It is located in the vast zone of the basin of Logone-Chari. The population is estimated at 800 000 people (Anonyme, 2014).

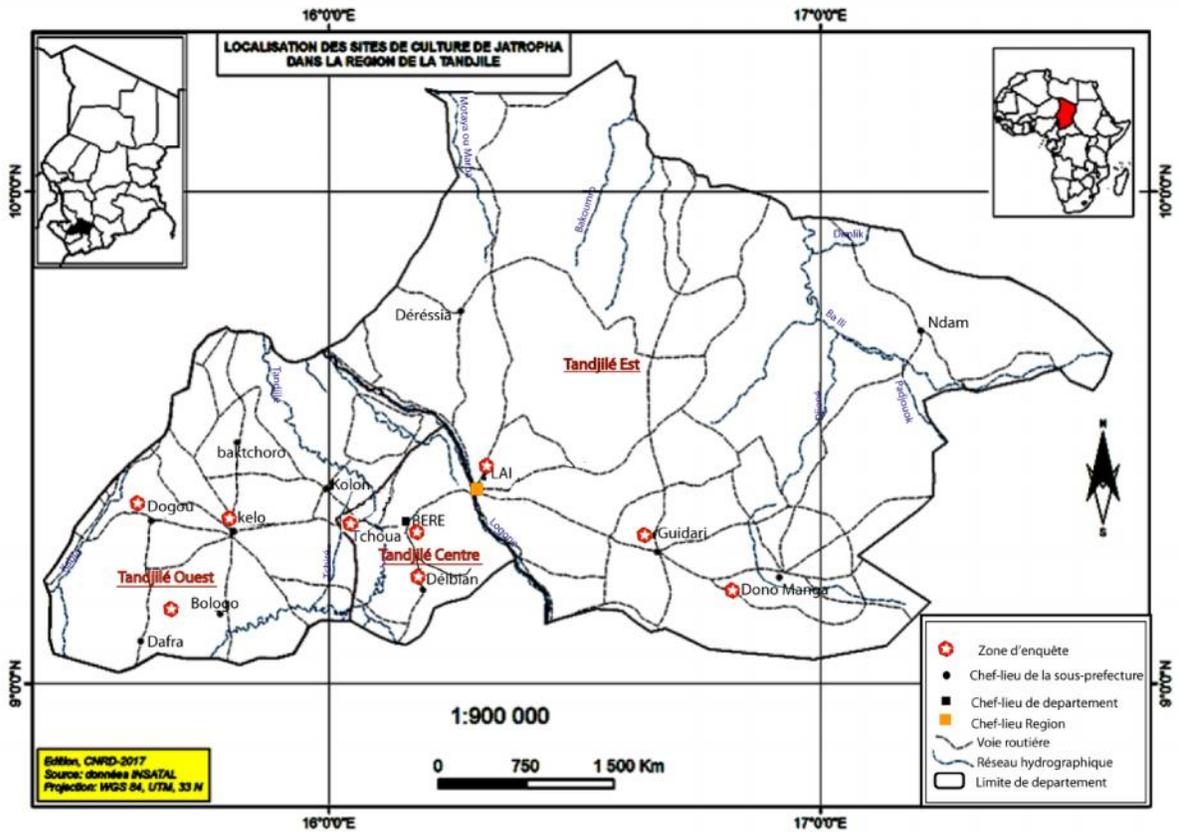


Figure 1: Map of the study area.

Methods

All the three departments of Tandjilé were the subject of investigations and three sub-prefecture by department were selected randomly to operate sampling. A sample of survey was consisted a simple random pulling of 50 farmers among the famers of a each sub-prefecture having at least a plant of *Jatropha curcas*. On the whole 450 participants answered the questions consigned in a card of investigation. The investigation was made face to face.

The data obtained were calculated by the method of average and percentage by using Excel of the Word program.

Results and Discussion

Socio-economic characteristics of the population.

Ages of the farmers

The percentages of the farmers by age and department are presented in Table 1. It is deduced from this table that 53,52% of the famers have an age ranging between 30 and 45 years. The farmers whose age is

lower than 30 years come in second position (24,09%) then the age bracket from 45 to 60 years (14,61) and finally those whose age is higher than 60 years (7,77%). These results approach those of Anguessin (2009) and Dany (2010) obtained respectively in Northern Cameroon and the South of Chad. Also, more than 50% of the persons planting *Jatropha curcas* are in the age bracket 30-45 years. These results could be explained by the recent introduction of the pourghère into the agroforestry systems of the surveyed localities. *Jatropha curcas* has been cultivated more and more for a few years by the youngest farmers of this province because of its advantages express in particular in the improvement of the cultures and the environmental protection. The renewed interest for this culture is due to its popularization by the "Réseau *Jatropha*" of Chad and the ONG such as the GIZ in the province.

Tableau 1: Percentage of the farmers according to the age and the Departments

Age (years)	Departments			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
< 30	31,03	14,15	17,09	24,09
30-45	37,92	59,03	63,63	53,52
45-60	17,24	23,41	13,18	14,61
> 60	13,79	3,42	6,09	7,77

Sex and matrimonial situation of the farmers

The results of table 2 showed that 88,07% of the farmers were men and 11,93% were women. The women thus do not take part enough in the management of the farms or the land businesses as well as the men. The women farmers were generally widows. This state of affairs could be explained by the

customs and habits which turn into to men the heads of household and implicitly heads of exploitations and also by the lack of initiative of the women in this field as reported by Passannet *et al.* (2017) in its work on the farms in the south of Chad. These same authors also mentioned that the rare operating women were either of the widows or of orphan having inherited their father.

Table 2: Percentage (%) of the farmers by sex and department

Sex	Departments			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
Masculine	87,56	85,53	91,14	88,07
Feminine	12,44	14,47	8,86	11,93

The matrimonial situation of the farmers of each department is presented in table 3. It is deduced from this table that 61,06 % of the farmers are monogamists and 19,66 % of the polygamists. This high rate of monogamy is observed in the three departments of the province of Tandjilé. These results would be explained by the high cost of living, the increase in the

educational level, the christianization and the economic crisis of these last years. These various combined factors contribute to the increase in monogamy and the reduction in polygamy in this province. Finally the proportion of the single people and that of the widows farmers are not very high.

Table 3: Matrimonial situation of the farmers

Matrimonial situation (%)	Departments			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
Single	10,42	14,25	18,18	14,28
Monogamy	60,33	64,51	58,33	61,06
Polygamy	23,71	18,61	16,66	19,66
widows	5,53	2,62	6,82	4,99

Number of persons in the farmer families

The results of table 4 show that farmers having 5 to 10 people by household are represented (47,77%) followed families lodging less than 5 people (27,08%) and those having moreover 10 members (25,14%). These results approach those of Salbaï (2001) at Belel. These authors reported that the households including 5 to 10 members were represented. These results would be explained by the fact why generally in the rural mediums, the reputation of a head of family is proportional to the size of its family, therefore function of the number of his wives and his children. Thus, the efforts made by the government in favour of

family planning are not respected strictly in spite of the number of the monogamists very represented in the social class. It should be noted that the households of size higher than 10 people are those of the dignitaries in particular heads of village or head of tribe or relatively fortunate people. This report was also raised by Hamawa (2005) with Galim-Tignère in Cameroon. On the other hand, these results differ from those obtained by Magin (2001) and Dany (2010) in the south of Chad. These authors reported that the low size of family of the farmers could be allotted to the practice of the monogamy and the respect of family planning.

Table 4: Distribution of the farmers by size of family.

Number of persons to the load of the farmers (%)	Departments			Averages
	Eastern Tadjile	Center Tadjile	Western Tadjile	
< 5	29,37	28,56	23,31	27,08
5-10	52,12	43,69	47,5	47,77
> 11	18,5	27,74	29,18	25,14

Principal activities of the *Jatropha curcas* owners

The principal activity of the growers of *Jatropha curcas* is agriculture, 81,07% (Table 5). This result would be explained by the fact why the ground and the climate of the zone are favourable to agricultural activities. The attachment of the population to agriculture makes area of Tandjilé one of the attics of Chad. Even Peuhls formerly recognized as the

stockbreeders only practise today more and more agriculture in this zone. The remainder of the owners of *J. curcas* group are tradesmen and other works. The tendency for the dominant activity is maintained on the levels of the three departments. There are also groups exploiting of the nonwoody forest products. This diversity of activities which are added to agriculture in the soudannian zone was noted by Magin (2001) and Dany (2010) in the south of Chad.

Table 5: Distribution of the farmers by principal activities.

Principal activities of <i>J. curcas</i> owners (%)	Departments			Average
	Eastern Tadjile	Center Tadjile	Western Tadjile	
Agriculture	85,52	77,56	80,14	81,07
Breeding	13,63	16,45	15,03	15,04
Nonwoody forest products	6,56	5,35	11,45	7,78
Other works	4,28	10,63	3,37	6,10

Study level of the farmers

The results of table 6 show that 21,47% of the farmers were not at the school, 40,83% have the primary education level, 35,22% the secondary level and only 2,46% made the higher studies. These results are different from those obtained by Passannet *et al.* (2017) in their work completed in the south of Chad. They showed that 43,66% plant growers have only the

fundamental level, 21% the secondary level, 8,33% the higher level and 26% are illiterate. These differences would be explained by a disparity of the rate schooling between the various provinces in the south of Chad. Under-schooling would be due to several factors in particular with the illiteracy of the parents, with the distance of the school establishments of certain villages, with the lack of determination of the parents and their indigence.

Table 6: Distribution of *Jatropha curcas* owners according to their educational level.

Educational level (%)	Departements			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
No education	19,26	28,51	16,64	21,47
Fundamental level	48,45	34,53	39,52	40,83
Secondary level	29,73	35,43	40,51	35,22
Higher studies	2,55	1,52	3,32	2,46

Mode of acquisition, origins and vernacular names of *Jatropha curcas* L.

In the area of Tandjile, *Jatropha curcas* is well-known by populations. They arrive at well distinguishing the two species from the *Jatropha* by the color of the leaves. *Jatropha gossypifolia* has violet leaves (Figure 2A), on the other side, *Jatropha curcas* has green leaves (Figure 2B). These two species are thus described as "red *Jatropha*" and the other of "white *Jatropha*" or "green *Jatropha*". The last is more represented and developed. These observations were also made by Tchobsala (2008) and Anguessin (2009) in the north of Cameroun. The origin of the plant remains far from known in spite of its seniority. The

response compared to its source varies from a *Jatropha curcas* owner to another and even within an ethnical group. Broadly 41,17% of the plant owners obtained it neighbors while 23,36% inherited their parents. Approximately 22% of the owners are unaware of is his source or took it in the bush. For the Peuhls stockbreeders, *J. curcas* is a wild plant. However some exploiting allot the introduction of the plant into the area to Europeans and confirm his Latino-American origin. This level of knowledge of the source of *J. curcas* by the farmers would be related to the multiple formation and public awareness campaigns carried out by the Réseau-*Jatropha*/Tchad and the ONG on the use of this plant.



Figure 2: *Jatropha* species exploited in the area of Tandjile. :*Jatropha gossypifolia* (A) and *Jatropha curcas* (B).

Table 7: Origin of *Jatropha curcas* by Departments

Origin of <i>J. curcas</i>	Départements			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
Inherited	20,32	22,34	27,42	23,36
Neighbors	47,52	33,56	42,45	41,17
Savage	19,9	35,84	13,04	22,92
Ignored	22,25	18,25	27,07	22,52

Vernacular names of *Jatropha curcas*

Table 8 presents the vernacular names of *J. curcas* in the various dialects of area of Tandjile. The existence name of this plant in the vernacular dialectal lexicon

of the various people of the area is an irrefutable proof that this plant is exploited since decades in the area and its surroundings. All these vernacular names do not have a particular explanation and all are inherited the parents, affirm the farmers.

Table 8: Names of *Jatropha curcas L.* in the various dialects of the province of Tandjile.

N°	Ethnies	Vernacular names of <i>Jatropha curcas</i>
01	Kablaye/ Baguirmi	Kague kouma
02	Marba/Moussaye	goumbâ
03	Gabri	Djimdjeré
04	Mesmé	Agoum
05	Peulh	colcolwadje
06	Arabe local	Kongolon
07	Gambaye	Konkouma ; kouma

Botanical characteristics of *Jatropha curcas L.*

Phenology of *Jatropha curcas L.*

The *J. curcas* owners reported that the plant is not very demanding with respect to the quality of the ground. This plant flowers generally at the same time as foliation at the beginning of the rain season and can relate to the same foot of the ripe and nonripe fruits (Figure 3A).The *J. curcas* flowers generally twice during the same season. The second flowering proceeds approximately two months after the first. The plant starts to lose its leavess at the beginning of dry season gradually (November), and defoliation is complete in dry season (Figure 3B). It is possible to

have, in certain hedges of the broken into leaf and not broken into leaf plants.

On the whole of questioned people, 76,55% say that the plant bears fruit only once per year and 23,45% affirm that this plant bears fruit the year twice. These unmatched and disparate answers over the time of fructification would be due to progressive fructification on the branches. The majority of the farmers (67,65 %) affirms that the plant bears fruit one year after plantation by vegetative multiplication (cutting of stem). These results agree with those reported by Reinhard and Henning (2007), Tchobsala (2008) and Anguessin (2009).



Figure 3: Phenologic state of *Jatropha curcas* L. : Plant carrying fruits (A) and plant having lost leaves in dry season (B).

Propagations and maintenance of *Jatropha curcas* L.

The propagation of *J. curcas* is done by cutting of stem, direct seedling and by transplantation the young plants (Table 9). It arises from table 9 that the propagation by cutting stem is the most used technique (80,76 %) follow-up of the direct seedling (9,93%) and transplantation of young plant (9,3%). Generally, the propagation by cutting stem is less hard and more

rapid than by sowing. However, the farmers reported significant losses of plants resulting from the cuttings stem by the attacks of the termites and fungus. These results are in agreement with those of Kobilke (1989) and Heller (1992) in Rwanda. They showed that the slip ensures an easy installation, inexpensive and an early productivity thus accessible to the average peasant. The recourse to the vegetative multiplication can allow a fast multiplication of the clones selected by the peasants.

Table 9: Propagation technics of *Jatropha curcas* L.

Propagation modes	Departments			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
Direct seedling	4,54	12,02	13,22	9,93
Transplantation	12,34	5,24	10,32	9,30
Cutting stem	83,11	82,73	76,45	80,76

Pruning remain the technic the most used for the maintenance of this plant (Table 10). These maintenances generally carried out at the end of the rainy seasons make it possible the plant harmoniously

to develop. On the other hand, the cutting of the branches apex, often at the end of the dry season, allowing an early ramification in order to increase the production of seed. It is however slightly used.

Table 10: Distribution of *Jatropha curcas* L. maintenance

Plants tehcnics maintenance	Departments			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
Pruning	95	91	88	91
Cutting of the branches apex	22	12	14	16
Lopping	97	93	87	92

Uses of *Jatropha curcas* L. in the area of Tandjilé

The principal uses of this plant in the area of Tandjilé are presented in Table 11. It is deduced from this table that the plant is used for the crop protection, the delimitation of the grounds or fields and in the pharmacopeia. The protection of culture and the land

use constitute the principal valorization of *J. curcas*. The uses of the plant in the area of Tandjilé depend on the objective fix by each farmer. These results differ from those obtained by Tchobsala (2008) and Anguessin (2009) which raised a significant use of the plant in traditional medicine.

Table 11: Principal uses of *Jatropha curcas* L. in the area of Tandjile.

<i>Jatropha curcas</i> uses	Departments			Averages
	Eastern Tandjile	Center Tandjile	Western Tandjile	
Protection of soils	6,54	10,42	12,32	9,76
Protection of cultures	72,34	85,24	90,32	82,63
Limit of grounds or fields	83,11	82,73	86,45	84,11
Traditional medicine	25,36	15,23	36,14	25,57

Almost all the parts of *J. curcas* in particular the leaves, the stems, the roots, the fruits, the seeds and the sap are used in traditional medicine. In the province of Tandjilé, this plant is used to cure the dermic diseases. According to Fezan *et al.* (2008), this plant is used in the treatment of arterial hypertension and the diabetes in Côte-d'Ivoire. The mistletoe (*Tapinanthus* sp.) is also used for the treatment of the gastric pain. Melanie and Rupel (2000) and Fézan *et al.* (2008) reported that the mistletoe (*Tapinanthus* sp.) of *J. curcas* protects from the mystical evils and poisoning in particular at Frofro baka in Côte-d'Ivoire and Goiés in Haiti.

The treatment of many infections by the various parts of the plant is announced everywhere. The principal modes of preparations are the maceration, the decoction and the infusion. To heal the dermic diseases or skin diseases, the owner of *J. curcas* mixes the oil of this plant obtained by seeds pressing with the oil of *Vitellaria paradoxa* or *Arachis hypogeia* before application. Rug and Ruppel, (2000) and Jongschaap *et al.* (2007) indicated the antifongic properties of the oil of *J. curcas*. It is also used as laxative, against cough and antiseptic.

An infusion dringings of the leaves, decoction of the roots treats the intestinal worms particularly the yeasts of the children. The massage of the anus by the leaves treats the "tandaou". The seeds crushed and mixed with the pap or hot water treat the gonorrhoea (infections sexually transmissible). The sap and the leaves are used as antiseptics and allow the cure of the wounds. The roots are used to treat the children

gastroenteric diseases. The infusion of the leaves and the stem treats the jaundice. This information given by the farmers is similar to those of Tchobsala (2008) and Anguessin (2009) in northern Cameroon and comparative to those noticed by Laoukain (2008) and Dany (2010) in the southern Chad.

Jatropha curcas is strongly integrated in the system of agropastorale production in the Province of Tandjilé. It constitutes one of the exploitation major factors of the rural areas. It contributes thus to the fertilization, the protection of the grounds against erosion, the fight against the climate changes, the deforestation and the turning into a desert. The agroforestry systems integrating *Jatropha curcas* was reported by several authors in particular Minengu *et al.* (2014) and Molénar & Kessler (2008) in the area of Democratic Republic of Congo and its around, by Tchobsala *et al.* (2013) and Anguessin (2009) in north of Cameroun and by Laoukain (2008) and Dany (2010) in the south of Chad. The populations integrate this plant in the antierosive fight, the life-fences and the land limit.

The farmers plant *Jatropha curcas* around their houses to enclose and protect the dwellings against the winds. The plant is used here like windscreen and curtain-shelter (Figure 4D). *J. curcas* is usually used in the Province of Tandjilé to prevent animals in divagation from penetrating in the fields (Figure 4A; 4C) of sorghum (*Sorghum vulgare*), maize (*Zea mays*) and manioc (*Manihot esculentus*). It is also used (only or associated with other species vegetable) like encloses for the protection of the gardens of boxes or the orchards often made up of the mango trees

(*Mangifera indica*), papaw trees (*Carica papaya*), lemon trees (*Citrus* spp.), palm trees (*Borassus* spp), neem (*Azadirachta indica*), Eucalyptus (*Eucalyptus* spp) (fig. 4D). Others farmers also use it for the shade and to mark the sites (fig. 4B). This practice using of *Jatropha curcas* as life-fence is well-known in central Africa, in West Africa, in Madagascar and in austral Africa (Üllenberg, 2007;Molenar & Kessler, 2008).

The peasants use *Jatropha curcas* to mark the limit of their fields and their landed properties. It is also used as barrier to protect the cultures from the animals like

plantation of life-fence. These results corroborate those of Mapongmetsem (2006) and Kossouma (2008) in Cameroon. These authors reported the integration of the trees as bases land in the country medium.

The stockbreeders transhumants often use *J. curcas* like enclosures of their cattle. These plants generally testify their passage in a medium and are confused with wild growths. These observations were also reported by Kossouma (2008) in Cameroon, Mineugu *et al.*, (2014) in Democratic Republic of Congo and Rahariseheno *et al.*, (2014) in Madagascar.

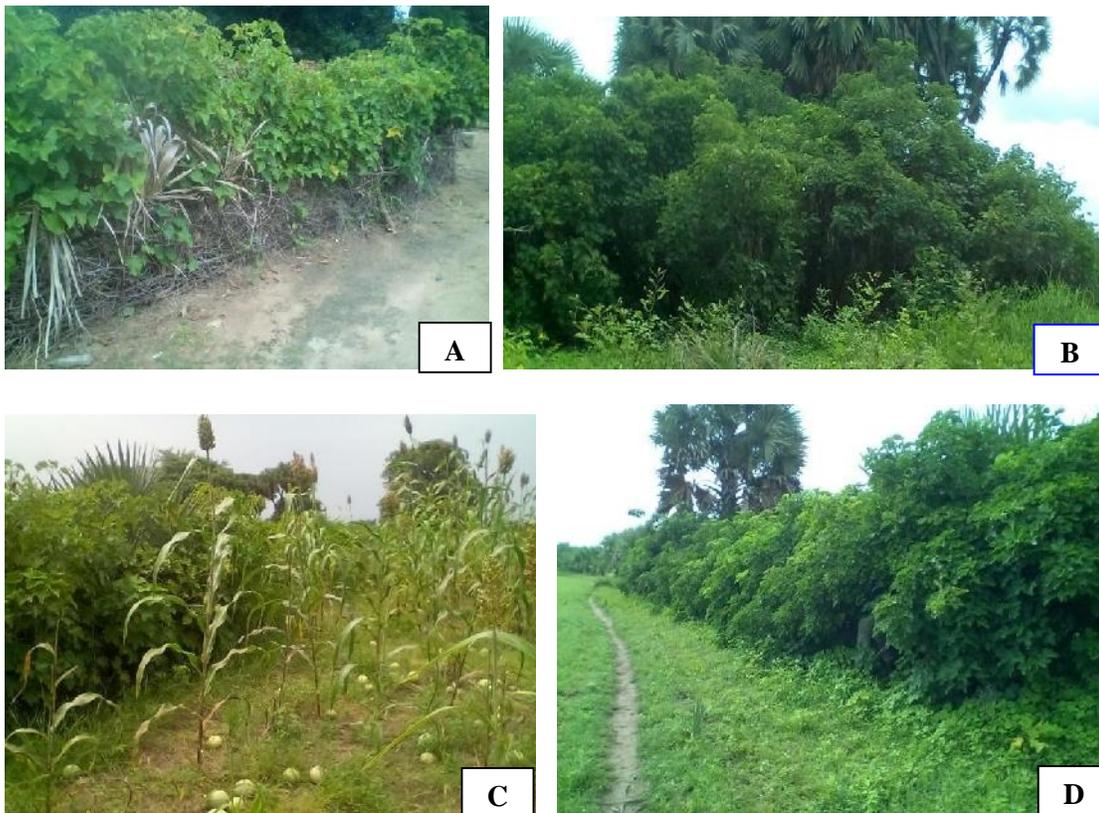


Figure 4: Various uses of *Jatropha curcas* L. in the agroforestry systems : Enclose reinforced with cut of jujube tree (A), sacred site (B), Enclosure of sorghum field (C) and life-fencing and breaks wind (D).

***Jatropha curcas* used for the conservation of the grounds and as source of energy**

Jatropha curcas grows surface roots which fix the grounds like dams. Thus, at the time of the strong rains, the streaming of water is slowed down on these grounds allowing a significant water infiltration in the ground. It fixes the ground and reduces the erosion and the organic losses of matter and the nutritive elements, very useful for an increase in the agricultural output (Tchobsala *et al.*, 2013). The plant has a high percentage of water content, thus it is used to prevent

the fire hazard in sensible zone (Diedhiou, 2012). The pourghère is also used in the domestic energy production. After pruning, the wood obtained are used for cooking foods. However the wood of *Jatropha curcas* release much harmful smoke and embarrassment the housewife. Some rare people, especially in Western Tandjile use the hull and the pulp of the fruits to heat theyself during the moment of cold (December-January). Others still superimpose seeds, through a stem in the forms of chain.

This kind of candle burns slowly without smoke during several hours and allows night lighting. The use of this candle makes it possible to reduce the financial expenditure and the energy dependence related to the acquisition of the kerosene (Figure A and 5B).



Figure 5: *Jatropha curcas* L. uses in domestic lighting : Combustion of the superimposed seeds (A) and *J. curcas* oil used like candle (B).

Conclusion

Two species of *Jatropha* (*Jatropha curcas* and *Jatropha gossypifolia*) are planted in the province of Tandjile. However their origins are not well known and their propagation is done primarily in this zone by cutting of stem. It makes it possible to obtain adult plants quickly. The use of *Jatropha curcas* is very diversified and developed in the agriculture exploitation systems. This plant is used as life-fence of fields and dwellings, limit of landed properties, antierosive fight and biofuel. It also has several medicinal virtues and treats in particular the gonococcie, the wounds, the parasitoses intestinal, the cardiac disorders, and the mystical diseases. All the parts of the plant and its mistletoe are important to the medicinal use. The most used modes of preparation are the infusion, the decoction, the maceration, and the extraction of the sap and its application on the sick part.

Lastly, *Jatropha curcas* is a very utility plant and its popularization would contribute to limit the effects of the climatic change, because its seeds are an excellent source of clean energy or green energy. Its development also would bring obvious advantages on the medical and agricultural level.

Taking into account the multiple uses of this plant in the Province of Tandjilé, it is recommended the public, private sectors and researchers to:

widen this work in other zones and to look further into the investigations on the uses of the oil of *J. curcas*;

sensitize on the biofuel use of oil and use of products resulting from the oil extraction; optimize the production by using biological fertilizers.

Conflict of interest statement

Authors declare that they have no conflict of interest.

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