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Research Paper

Potentialities, yield and economic assessment of *Jatropha curcas* L. according to rural population in sudano-sahelian area of Cameroon

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Abstract: *Jatropha curcas* L. (Euphorbiaceae) is used and well known in the sudano-sahelian area of Cameroon. Farmers use it as quickset hedge in order to protect the fields against penetration and destruction by animals, in agroforestry to delimit the landed ownerships and the fight against erosion. *Jatropha curcas* is also used in a small-scale production of soap by craftsmen. The oil extracted from seeds serves by candlelight so as to enlighten the houses. The products obtained from the extraction of oil are used as compost, and as such fertilise the soils. *Jatropha curcas* is also used in traditional pharmacopoeia and treats about 28 illnesses. The yield varies from 0.5 $t.ha^{-1}$ to 12 $t.ha^{-1}$ for the first and fifth year respectively. Its substantial economic value is well known by the locals, the price of a litre of oil costs 1000 FCFA in average. It gives to rural women an occasion to make extra incomes and to reinforce their economic position. The uses of the species as biofuel and agroforestry need to be popularised in the rural and industrial area in this Cameroon subregions.

Keywords: *Jatropha curcas*, potentialities, yield, economic assessment, rural population, Cameroon.

Introduction

Jatropha curcas is a shrub which reaches 8 m of height, perennial, resistant to dryness, which can live more than 50 years and grow on poor soils. It is species originating from southern America and which is now widespread in all the tropical arid and semi-arid regions of the world (Anonyme, 2002).The sudano-sahelian area of Cameroon that yearly average precipitations are situated between 600 mm and 900 mm is the favourite area of the exploitation of *Jatropha curcas.* For many generations, farmers used to protect their farm land with quickset hedges made up with *Jatropha curcas*, appearing as the main known use. Meanwhile, *Jatropha curcas* oil is very appreciable since it is used for lamps, for traditional pharmacopoeia to treat some illnesses, and in small-scale production of soap by craftsmen. In some villages, waste obtained from the extraction of oil is used as organic fertiliser. Seeds contain about 35 % of oil which is not edible. The quantity of the oil produced is about 0.8 kg per square meter of quickset hedge, with a yield of 0.17 l of oil (Reinhard, 1994). In 2007, with the increase of petroleum cost, the interest for the species appeared and was considered as biofuel. Oil extracted, after purification, can be used in different types of classic engines. An esterification is necessary for its use in modern engines. Currently, Mali has about 10 000 km of quickset hedges made up with *Jatropha curcas*, with an increase of 2 000 km per year; that represents a potential of 1 700 000 l of oil per year. In the sudano-sahelian area of Cameroon, activities related to the species were launched in ESA project (Water, Soil and Trees), with the technical support of Development Society of Cotton, and the University of Ngaoundere in Cameroon. Before the start of cultivation, the project aimed to know the different local uses of the species by farmers and its socio-economic interest. The main objective of the present work is to know the different local potentiality of *Jatropha curcas* in the sudano-sahelian area of Cameroon in order to improve the livelihoods of the locals. Specially, it is a question of determining the potential uses, the yield and the economic assessment of *Jatropha curcas* in the local milieu.

Martial mad Methods

Study Area

The choice of the site was made up after a prospecting of field done by ESA agents in the villages where *Jatropha curcas* is cultivated as quickset hedge and the easier access (Figure 1).

Preparatory meetings

Five preparatory meetings were realised in order to put in place the team of the mission. The team was composed of the agents of the seeds program service, the managers of the technical support, the agricultural managers, and the ecologists of the cotton zone of Cameroon.

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The Rural Participatory Diagnostic (RPD) (Anonyme, 2001) began by making contacts with the administrative and traditional authorities; that permits to collect the data beside the local communities. The rural participatory diagnostic is based on the accelerated method of participatory research; the target actors are farmers that the total number was 100 persons. With the actors, semi-structured and structured interviews were carried out with the support of questionnaire; this part was completed by some observations on the field.

At the level of each village, two or three persons (Figure 2) were chosen in order determine the ethnobotany and socio-economic potentialities of *Jatropha curcas.* Geographical references for each village or site of study were registered by GPS.

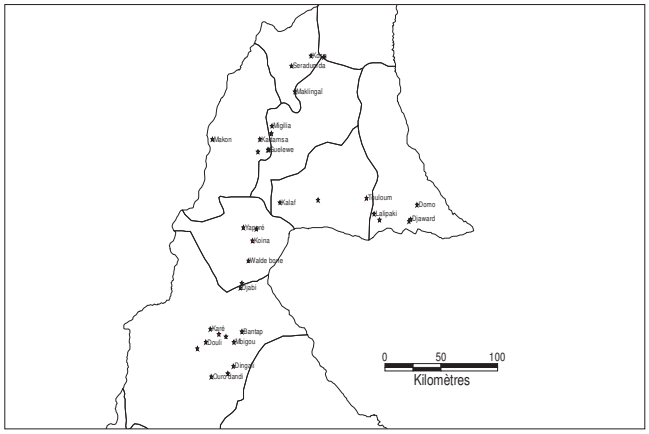


Figure 1. Localisation map of the study site

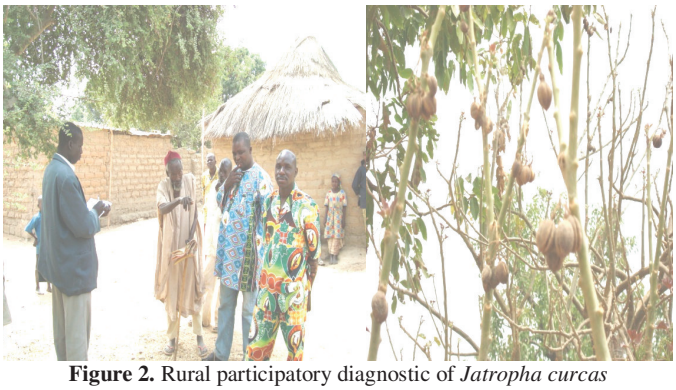


Figure 2. Rural participatory diagnostic of *Jatropha curcas*

Treatment of the data

Photos were treated to the seed program service and the technical support service ESA Garoua.

Excel and Statgraphics softwares were used for the analysis of quantified data.

The map of the villages was realised in the laboratory of geomatic at the University of Ngaoundere, images of ARDESAC/PRASAC project.

Duncan test was used to analyse the results.

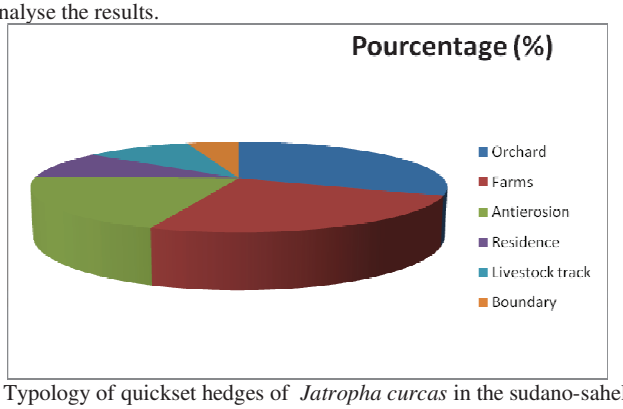


Figure 3. Typology of quickset hedges of *Jatropha curcas* in the sudano-sahelian area.

Results

Typology of the use of *Jatropha curcas* according to the farmers

Jatropha curcas is used by most of the local populations of sudano-sahelian area of Cameroon. The main uses the quickset hedges for the protection of residences, gardens, livestock tracks and the farms, with a percentage of 51.71 % (Figure 2). Oil extracted from the seeds is used in small-scale production of soap. It serves also to enlighten the homes, but that oil is not known by the locals as biofuel (0.03 %). This is new for local people. But traditionally, children and old women used directly oil or seeds of *Jatropha curcas* as a candle and lighting the rooms. They put oil in the glasses tightly closed leaving tufts of cotton or wool for ignition. This oil burns much more slowly than oil and emits less smoke, which is an advantage for the lighting of bedrooms.

Typology of quickset hedges of Jatropha curcas

Jatropha curcas is used to protect the gardens or orchards (31. 15 %), the farms (24. 59%), the antierosion (19.67%), the residence (9.84%), the livestock tracks (9.84%) and the boundary of fields (4.92) (Figure 3).

Table 1. Typology of the uses of Jatropha curcas.

N°	Typology of use	Percentage (%)
1	Quickset hedges	51.71
2	Soap	11.35
3	Candlelight	10.54
4	Shade	6.09
5	delimitation of farms	5.22
6	Ornament	4.1
7	Fertility of soils	4.35
8	Firewood	1.74
9	Pole	1.3
10	Traditionnel pharmacopoeia	1.02
11	Fodder	0.84
12	Insecticide	0.87
13	Child's play	0.84
14	Biofuel	0.03
	Total	100

The figures 4, 5, 6 and 7 illustrate respectively the importance of *Jatropha curcas* for the protection of orchards, farms, homes, rain erosion and livestock track. In order to reduce the damage caused by domestic animals**,** *Jatropha curcas* is propagated by cutting along the track of the livestock.



Figure4. Quickset hedge of *Jatropha curcas* around an orchard in Guidiguis.



Figure 5. Quickset hedge of *Jatropha curcas* around a residence in Siri Touboro

Table 2. Density, length, average spacing of Jatropha curcas as quickset hedge.

Type of quickset hedge of *Jatropha curcas*	Average number of shoots per quickset hedge of *Jatropha curcas*	Average length per quickset of *Jatropha curcas* (m)	Average spacing between the shoots of *Jatropha curcas* (m)
orchard	417±432cd	354.17±316.31d	1.63±3.47b
farms	362±327bcd	150.06±120.83bc	0.65±0.4a
antierosion	803±443d	124.67±93.09abc	0.25±0.11a
residence	113±32ab	70.33±22.37a	0.62±0.03a
livestock track	96±49a	68.33±31.53a	0,76±0,38a
boundary	148±121bc	245.33±187.91cd	1.68±0.2b

Means with common letters are not significantly different at P = 0.05

Density, length and average spaces of Jatropha curcas as quickset hedge

The average number of *Jatropha curcas* shoots for the establishment of quickset hedge varies from 803±443 shoots for the fight against erosion to 96±49 shoots for livestock track as indicated in Table 2. There is significant difference (P = 0.5) between the quickset hedges against erosion and that of the livestock trackl. Concerning the length of the hedges, the orchards have average lengths of 354.17±316.31 m even though the residences have 70.33±22.37 m. There exists a high significant difference at 5 %. The boundary of farms has an average spacing of 1.68±0.2 m. For the whole quickset hedges, there is no significant difference at 5 % with.



Figure 6. Quickset hedge of Jatropha curcas for the fight against erosion in Duleck.



Figure7. Quickset hedge of Jatropha curcas for livestock track in Tchéodé Kaélé.

Compost of Jatrapha curca, the best fertilizer.

Jatropha curcas can develop on all types of soils, but it prefers the sandy soils. It can also develop on rocky soils. The edible crab from the oil extraction is a good compost, and consequently serves as a natural fertilizer for the farmers of the region. The shoot on a soil fertilised by crab of *Jatropha curcas* gives a big ear of millet (Figure8). Humus obtained from the leaves of *Jatropha curcas* is a good fertiliser.



Figure 8. Compost obtained from the remnants of seeds used for the extraction of the oil in Sabéré Zang

Fodder

The trunk of *Jatropha curcas* is flayed by sheep which serves of fodder (Figure 9), but in general this plant is few consumed by domestic animals. Any time the meal of *Jatropha curcas* is a diet rich in protein for livestock (fish, poultry, cattle, Cabrita, etc..) And charcoal briquettes are other advantages offered by this plant.

Traditional pharmacopoeia

According to interviews close by the farmers, 28 illnesses are treated by *Jatropha curcas.* Tandaw (15.25 %) is most popular illness and is highly treated by *Jatropha curcas* (Figure10).

Yield of *Jatropha curcas* according to the age of the plants

The yield of *Jatropha curcas* varies in accordance with the year. Between 6 and 10 years, the yield is important. The cutting gives a weak yield in comparison with the direct seedlings and the transplantation (Table 4).

Oil and soap production and its economic impact on the local populations

The extraction of the oil of *Jatropha curcas* is made up traditionally. It consists of grilling the seeds and pounding in the mortar. The pastry obtained is pressed on the plank in order to extract the oil. In Sabéré Zang, a farmer extracts 20 liters of oil per year. A liter of oil is extracted from 1.5 kg of seeds. According to the interviews, the sale price of one liter oscillates between 600 FCFA and 1500 FCFA. For the making of soap, they husk the seeds which will be pounded in the mortars. The pastry obtained will be mixed with the soda made up with the ash of cereals. The process can about 4 to 5 hours. Table 5 indicates the results of

the investigation carried out close by 100 persons on the economic assessment of *Jatropha curcas*. The production is optimal for the farmers when the plants reach the age of 4 years. The speculation and extrapolation showed that the benefit per hectare of *Jatropha curcas* would be estimated respectively 17500 FCFA, 120000 FCFA and 163000 FCFA for 1-2 years, 4-5 years and 6-10 years.



Figure9. Trunk of *Jatropha curcas* skined by sheep as fodder in Touboro.

Table 3. Yield of *Jatropha curcas* according to the age of plants in ex situ.

Types of implantation of *Jatropha curcas*	Campaigns of production (years)	Yield (kg)	Yield ($t.ha^{-1}$)
Cutting	1-2	0.055	0.1375
Cutting	6-10	0.33	0.824
Direct seedbed	1-2	0.13	0.325
Direct seedbed		0.80	2.00
Planting out	1-2	0.49	1.225
Planting out	6-10	2.94	7.35

Table 4. Economic assessment of *Jatropha curcas* according to the local populations.

Speculations and extrapolation	Quantity	Unity	Price per unit	Total price 1-2 years	Total price 4-5 years	Total price 6-10 years
Cultivation				50000	20000	20000
Seeds	5 kg	1 ha	500	2500	0	0
Manure	5 sacks	1 ha	600	3000	0	0
Drug		1ha		1000	1000	1000
Husking and oil production				2000	2000	2000
Soap production				5000	6000	7000
Tax				1000	1000	1000
Materials	10	1 ha	1000	10000	5000	5000
Transport				12000	10000	12000
Total expenditure				**86500**	**45000**	**48000**
Sale price of oil				80 000	130000	170000
Soap sale price				20000	30000	35000
Sale price of crab, fertilizer				3000	4000	5000
Sales of plant for multiple uses (hedge, firewood, drug)				1000	1000	1000
Total income				**104 000**	**165000**	**211000**
Benefit per hectare (expenditure - income)				**17 500**	**120 000**	**163 000**

Conclusion

Jatropha curcas is generally well known by the local communities of the sudano-sahelian area of Cameroon. It has been for a long time known as a plant with multiple uses.

The quickset hedges of *Jatropha curcas* hinder not only the access to the animals, but also fight against the erosion and the wind. The roots of the plant develop near the soil surface, can then fix the soil as dikes in miniature. These dikes slow down the streaming of water during the strong downpoors, which permit the water to penetrate the soil and increase yield of the harvesting. The density of the shoots, the length of the quickset hedges and the spacing between the roots according to the types of the hedges. The density of the shoots for the antierosive hedges is higher than that of archords, the farms, the homes, the boundaries and the livestock tracks.

In traditional pharmacopoeia, *Jatropha curcas* is used to treat many infections. Oil, leaves and bark are used as purgative. The oil has abortive actions. It can treat rheumatisms and sorts of dermatological infections despite the irritation that it can provoke on the skin. The latex is renowned to treat sores, ulcer, eczema, mycosis, and scabies and also to remediate to the bite of insects. Leaves are used to treat wounds, malaria, and hypertension or to produce milk for women. Roots serve to treat diarrhoea. As in the sudano-sahelian zone. Osoniyi et al. (2003) indicated that *Jatropha curcas* latex treats wounds and notably the time of coagulation. Shetty et al. (2006)) indicated that the latex accelerates the wound healing process, (Faria, et al. 2006) give the evidence of the possibility to use the curcine as cytotoxic on cancerous cells at weak levels of concentration. They found that this protein could inhibate the movement of tumoral cells, and as such could provoke the death of the cells by apoptosy. This effect was also noticed by Mujumdar et al. (2004) which tested the anti-inflammatory effects with root powder and concentrated extracts of methanol. Several types of inflammations were studied and two kinds of treatments were applied: the first in the form of root powder, in pastry spread on the inflamed part, and the second on systemic form by oral way or by injection. The same authors, in 2000 assesed the antidiarrhoeic effect with the same products obtained from *Jatropha curcas*.

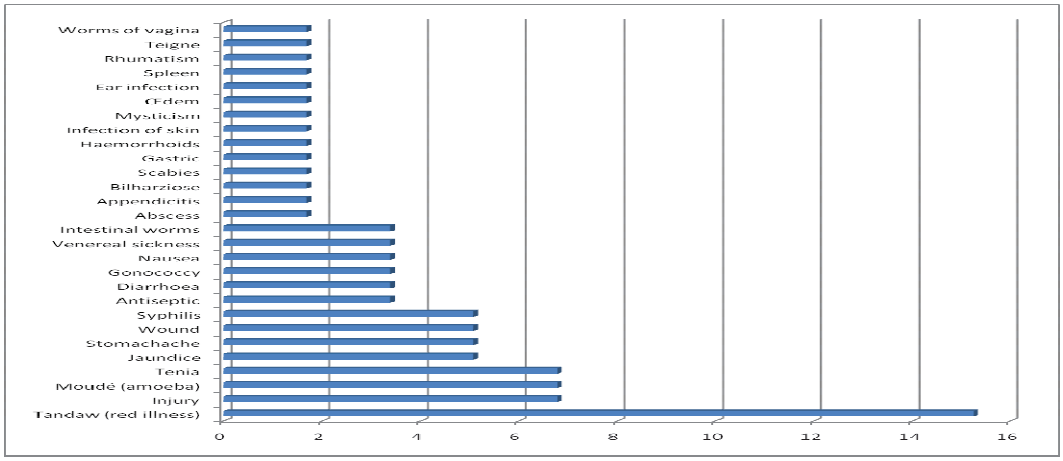


Figure 10. Traditional pharmacopoeia of Jatropha curcas (%).

Jatropha curcas oil serves to the local soap production. A good quantity of oil was produced in Cap Vert ilslands and sent in Europe to be used to make soap (Cuhna da Silveira, 1934). In 1930, about 3 000 t of oil had been exported. Some French colonies produced also that kind of soap called Marseille soap. It is then known by all that *Jatropha curcas* is used as soap in the farms milieu. Our results corroborate those obtained in Mali (Siaka Kone, 1988) where many NGOs supply to the rural women some motorised mills which function with *Jatropha curcas* oil, used as fuel, lubricant and soap. But this kind of soap does not last anymore. Some phenomena of secondary oxidation that can produce rapidly, due to the insufficient licking proprieties and the presence of saponine, toxic substance in the soap. The main physical propriety of that substance is to reduce the water tension. That is the reason why the one should go beyond the small-scale soap production by cratsmen, they should limit at 30 % the proportion of *Jatropha curcas* oil in the initial product (Henning, 2007).

Jatropha curcas crab has a great protein content, and as such is used to feed animals, when the toxic substance is cleared out (Adam, 1974). Several studies have proved the, evidence of the existence of toxicity in the crab when it is consumed by animals (Ahmed et Adam, 1979a; Liberalino, 1988)

Leaves, litter and crab of *Jatropha curcas* give good yield to farmers in the sudano-sahelian area in Cameroon. Furthermore, residues from the seeds used for the oil extraction is an organic fertiliser with a high nitrogen content (Munch, et al., 1986). That crab can be also employed for wheat and maize farm in Cap Vert (Cuhna da Silveira, 1934). In Mali, Henning, et al. (1996) indicated that farmers know well the value of crab as fertiliser. In order to have a concrete appreciation of this value, it would be necessary to take out the trials on maize, millet, on marginal soils of the sudano-sahelian area in Cameroon. The crab which remains after the oil extraction is an organic fertiser of high quality. It has a mineral composition like birds'excrements, and as such permits to improve the fertility of the soils and the increase of the farm production.

Surveys have indicated that the average yield per hectare varies in accordance with the years. For the first and second year, yield was around of 0.5 $t.ha^{-1}$ and 5 $t.ha^{-1}$ respectively. For the third year, the fourth year, it varied for 8 to 9 $t.ha^{-1}$ and for the fifth year it oscillates between 10 and 12 $t.ha^{-1}$. Several studies assess also the *Jatropha curcas* yield, that is the Biomasa project in Nicaragua (1999), where they are 1.200 mm. $year^{-1}$, the average quantity harvested during the ten years of project was: 1.714 $kg.ha^{-1}$ year for fresh seeds, 1.158 $kg.ha^{-1}$ year for dry seeds. That quantity harvested in really less than the yield really obtained, a

part of the fruits is let on the trees. The project carried out on several years (1986-2003) in Nashik region (Inde with 600 mm of precipitation), on a total surface of 8 000 ha indicate that the average yield is less than 500 kg.acre t^{-1}. that is less than 1 250 kg.ha $^{-1}$ of dry seeds, on trees after seven years of production (Gokhale, 2008). The productivity of the tree depends on the precipitation which determines the number of fructifications and then the harvesting. The last observation realised by Henning (2007) in Cambodge indicates 2.8 kg of seeds.plant $^{-1}$harvesting $^{-1}$. This observation was realised on a plantation of 10 ha, aged of three years. With a bisannual harvesting, he estimated 5 kg per plant the annual yield, and more than 5 t.$ha^{-1}$of seeds with of 1 300 plants .ha^{-1}. During the Wageningen conference (marsh 2007), researchers working on *Jatropha curcas* in the entire world agreed on a scale yield of 3 to 5 t.$ha^{-1}year^{-1}$.

It is difficult to give an exact economic assessment of *Jatropha curcas* in the farmers milieu, since the price per liter varies from one village to another, villagers are not unanimous on the price. For example in Sabéré, Mokolo subdivision, an oil producer of *Jatropha curcas* talks of 1000 FCFA. l^{-1} whereas in other villages they talk of 600 to 1 500 FCFA. By favorising the use of *Jatropha curcas*, that can supply direct financial advantages to rural economy. In the case of production cost, the use of *Jatropha curcas* oil is profitable that substitutes the petroleum. Petroleum lamp costs about 2 500 $Ar.l^{-1}$ in rural zone. *Jatropha curcas* oil burns for a long time in comparison to petroleum. The soap can be produced for about 2 000 $Ar.kg^{-1}$, the price depends on the effects of the scale; the average sale price of soap in rural area is about 4 000 $Ar.kg^{-1}$, the price of the diesel is about 3 000 $Ar.l^{-1}$. The inconvenience of the production in small scale is that the oil produced has bad quality (Domergue et al., 2008).

Jatropha curcas can supply excellent quickset hedges. Oil produced from the plant seeds serves to enlighten the residence and to make soap. That oil is sold and as such procures substantial incomes to farms in general and women in particular. The use of oil as biofuel is not widely known well in the area. One should recommend to farmers to integrate that plant in their environment, agroforestry and above all on degraded soils in order to avoid competition with other farmings. *Jatropha curcas* is a source of savings if the population is given for cultivation in large scale since the sale of carbon sequestered in the plant and its oil can bring money to the population to reduce poverty in the Sudano -Sahelian zone of Cameroon.

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