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Possible Contributions of *Jatropha curcas* L. to Rural Poverty Alleviation in Senegal: Vision and Facts

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Vision on *J. curcas* possible role in rural poverty alleviation in Senegal

Recent investigations carried out all over the world have demonstrated that *J. curcas* could contribute drastically to the improvement of the living conditions of rural populations in the least developed countries of our planet (1, 2, 3). *J. curcas* is a multiple function hardy shrub which can be used for medicinal purpose, to prevent and/or control erosion, to reclaim land, to produce pesticides, to contain or exclude farm animals when grown as living fence and be planted as a commercial crop. The seed contains a high rate of non-edible oil that can be used for soap making, in the cosmetic industry, as a diesel/ kerosene substitute or extender and as a feedstock for agrofuel production. This latter use may be of importance when examining practical substitutes for fossil fuels to assure energy autonomy of tropical non oil producing countries and to counter greenhouse gas accumulation. Also, like all trees, *J. curcas* fixes atmospheric carbon, stores it in wood and assists in the build up of soil carbon.

As a source of bio-fuel, *J. curcas* can have positive impacts in rural areas where poor people have limited options to meet their energy needs. Using Jatropha oil as primary household energy can help to decrease deforestation and increase energy efficiency. If combined with appropriate technologies, it can also allow sustainable, low-cost, off-grid electricity generation, with the added benefits of reducing women's domestic chores and increasing opportunity for rural industry and employment. Energy markets are much larger than the food markets. The emerging markets for biofuels offer an unparalleled opportunity to benefit the poor on a large scale through agriculture. In this view, *J. curcas* production can be especially beneficial to poor producers living in remote areas that are far from the consumption centres, where inputs are more expensive and prices lower, making food production, non competitive. In these areas, the challenge of providing poor rural people with meaningful income generating opportunities remains largely unaddressed. The niche products that are often proposed as alternatives to the usual agricultural commodities (apiculture, medicinal and aromatic plants, etc.) have usually limited demand, long marketing chains and low producer prices.

If adequate mechanisms are developed to ensure that a fair share of the value generated by *Jatropha* business goes to the farmers, the development of *J. curcas* production chains can stimulate rural economic growth through additional capital inflows, create demand for goods and services that provide employment, reduce rural-urban migration and create linkages and synergies between development actors.

Economies of scale are necessary for farmers to take advantage of *J. curcas* opportunity. Small scale farmers face obstacles in accessing supply chains, transporting harvests to processing plants or selling through middlemen. The creation of cooperatives or producer companies can bundle the interest of the poor, accumulate and attract capital and partnerships for the necessary investments, organize feedstock supplies in large quantities and, in turn, create a countervailing power to the larger firms operating in the energy market.

However, for several reasons, both technical and economic, the full potential of *Jatropha* is far from being realized. The growing and management is insufficiently documented and there is little experience in marketing its products.

To overcome the constraints that limit the full exploitation of *J. curcas* potentialities in rural poverty alleviation, Durabilis foundation, ADG, and GAU have decided to join their forces to carry out concerted action research activities at all stages of the *Jatropha* chain.

These actions concern the quantification of the real yield potential of *J. curcas* in the different agro-ecological regions of Senegal, the selection and the multiplication of high yielding ecotypes adapted to the local growing conditions, the development of improved production practices suited to pure stand cultivation and intercropping systems involving *J. curcas*, the quantification of cost and returns for all the steps of the *Jatropha* chain value, the development of sustainable organisational models of local production chains that can be appropriated by small-scale *Jatropha* growers in order to allow them to benefit fully of the potential of the crop, and the research of profitable outlets and marketing arrangements for *Jatropha* products.

Best practices identified so far for Jatropha production in Senegal

We present here the most interesting factual data we gathered in Senegal since 2006 regarding the determination of the best practices for Jatropha cultivation. These data are issued from the work we achieved so far on the field and from the confrontation of our results to the information available in the literature (summarized in Achten *et al.* (1)). The data presented here were collected from the following investigation sites: the Durabilis experimental site of Dagana (Lat. 16°35'N, Long. 15°27'W., 250 mm year-1, 2 months rainy season, production under irrigation in a sandy soil (diery type)), and the rural community of Dialakoto (Lat. 13°21N, Long. 13°23W, 900 mm year-1, 5 months rainy season, production in rainfed conditions

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in different types of soil) where ADG carries out a pilot project aiming at assessing the constraints to the adoption of the *J. curcas* cultivation in the traditional farming systems of the region.

Site requirements
J. curcas prefers well-drained sandy or gravely soils with good aeration. It doesn't withstand heavy clay soils and all soils with risk of even ephemeral water logging. Soil depth should be at least 45 cm. Investigations are in progress to assess the yield potential of the crop in the different agro-ecological zones of Senegal. According to the preliminary results obtained on the field and the data mentioned in the literature, a minimum annual rainfall of 500 mm seems to be necessary to obtain a profitable seed yield in rainfed agriculture conditions.

Propagation and plantation establishment
Direct seeding can give good results when it is carried out with good quality seeds at the beginning of the rainy season in a place where the rains last longer than 4 months. The sowing of three seeds per hole is recommended with an early refilling of the missing holes. In case of direct seeding, regular weeding operations are compulsory to avoid the complete disappearance of *J. curcas* plantlets due to the heavy concurrence of the weeds during the growing season. Intecropping *J. curcas* with annual crops (peanut, pearl millet, okra) helps achieving this goal.
An efficient solution to succeed the establishment of a *J. curcas* plantation at a low cost is to pre-cultivate seedling during two months (till the plantlets reach the fifth true leave stage) in seed beds under nursery conditions and to extract and transplant bare root seedlings in the field. The best results for nursery bed preparation were obtained by mixing in equal volumes sand and local soil found under trees.

Tending practices
As flowering occurs at the terminal portion of the branches, adequate pruning practices are useful to increase the number of inflorescences per tree and to enhance good fruit setting and seed yield. The pinching of the terminal bud of the main stem at transplantation time or when the plant reaches a height of about 45 cm in case of direct seeding induces secondary branches. The pruning of secondary and tertiary branches induces more ramifications. The optimal number of branches at the end of the second year in local growing conditions has not yet been determined. In India this number varies between 25 and 36 according to the authors
Investigations are in progress to determine the best time for pruning for plants grown under irrigation. In rainfed agriculture, the best time for pruning is at the end of the dry period after the trees have shed their leaves. These canopy management practices result in a lower and wider tree shape, induce earlier seed production and facilitate manual harvesting.

Harvest
According to the preliminary observations made in the Dialakoto area, *Jatropha* mature fruits produced by the local ecotypes don't shed before the end of the dry season that follows their production. This should permit to carry out the harvesting of the crop after the end of the rains. Complementary investigations are however still necessary to assess the possible influence of a delayed harvest on the seed quality and on its oil content. In rainfed agriculture being able to postpone the harvest of *J. curcas* till the beginning of the dry season (during the best time for pruning) would avoid concurrence for labour requirements between *Jatropha* and the other crops that would be cultivated with it. This should facilitate greatly the introduction of the new crop in the local farming systems and the development of new intercropping systems involving *J. curcas*.
When water is available all year long in the soil, as in the Senegal River area when the crop is cultivated under continuous irrigation, *Jatropha* fruits are constantly ripening and have to be harvested regularly. A preliminary test carried out in Dagana to induce a controlled ripening of the crop by stopping the irrigation for a while was not successful.
The possibility to use local peanut thresher to decorticate *Jatropha* mature fruits should decrease drastically the labour requirements to obtain clean seeds and make the crop more profitable for the farmers.

Conclusion

J. curcas is still a wild plant with a wide variation in growth, production and quality characteristics. A lot of investigations remain to be carried out in order to improve the performances of the crop in a way that is economically, environmentally, and socially sustainable. We are however very confident that the integrated approach of investigation followed by Durabilis foundation, ADG and GAU will permit to overcome the constraints that limit the full exploitation of *J. curcas* potentialities in rural poverty alleviation in Senegal.

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