JATROPHA CURCAS

Extent of adoption

A study by Janske (2006) on transition towards *J. curcas* biofuels in Tanzania, shows that farmers had planted *J. curcas* as a live fence. Farmers around Dar es Salaam were very enthusiastic about planting *J. curcas* and selling the seeds to a specific dealer. Their main crop has been cashew, but the price of cashew nuts has fallen and they are looking for another crop to plant.

Economics of production

A study by Tewari (2000) on the economics of biodiesel production from jatropha in India found that the highest yields are attained after the seventh year.(Table 1)

Table 1: Yield and Income per hectare of Jatropha Cultivation in Kg and USD

Year	Seed yield per tree	No of trees/ha	Seed Yield/ha (kg)	Price of seed per kg	Income for seed sale
3	0.5	1500	750	0.18	135
4	0.5	1500	750	0.18	135
5	1	1500	1500	0.18	270
6	1.5	1500	2250	0.18	405
7	2	1500	3000	0.18	540
8	2	1500	3000	0.18	540

Source: Tewari 2000 (1 USD= 44.7 Rupees in 2000)

Tewari (2000) also estimated the profitability of growing jatropha and gave the cultivation costs for year 1, 2 and 3 as USD 367, 114, 85 respectively and maintenance cost of USD 45 from year 4 onwards. The crop starts earning profit from year 3 onwards (Table 2)

Table 2:Profitability per hectare of Jatropha cultivation.

Year	1	2	3	4	5	6	7	8
Cultivation cost	367	114	85	45	45	45	45	45
Income from seed sale @ USD 0.18/kg			135	135	270	405	540	540
Profit from seed sale @ USD 0.18/kg	-367	-114	50	90	225	360	495	495

Source: Tewari 2000 (1 USD= 44.7 Rupees in 2000)

Openshaw (2000) carried out a review of *J. curcas*, the study gives figures from India, it shows that the cost of establishment and management of jatropha is about USD 580 per hectare (Table 3). The study also indicates that from year 1 to year 5 income derived from the specie is USD 598 while from year 6 onwards is USD 585 per hectare (Table 4)

Table 3: *Jatropha curcas*: establishment, tending and harvesting costs (units; USD per hectare)

Year	Labour	Fertilizer	Seed	Plough hire	Fruit	Wood	Total
1 - 5 (sum)	55	153	3	9	59	59	338
6 and onwards	21	102	0	0	48	68	239
Total 1-6	76	255	3	9	107	127	577

Source: Openshaw 2000

Table 4: J. curcas: estimated yield and income from the fruit and wood (USD per hectare)

Year	Coat	Shell	Seed	Sub-total	Wood	Total
(price $/t)	16	25	117		25	
1 - 5 (sum)	44	56	498	598	0	598
6 onwards	36	45	485	485	100	585
Total	80	101	1083	1083	100	1183

Source: Openshaw 2000

Chen et al (2008) examines the costs of seed production on both normal and marginal lands over a six year period in India. After six years, the costs and yields stabilize and remain constant. There are many inputs required for planting and maintaining a jatropha crop. These include plowing, digging the pits, applying fertilizer, seeding, filling the pit, and weeding. Likewise, there are also many inputs required for harvesting and preparing the seeds. These include collecting, removing the coat, and shelling. The total costs of seed production on normal and marginal lands per hectare are shown in table 6.

Table 6: Total cost of seed production

	Normal Land		Marginal Land	
Year	Costs	Present Value	Costs	Present Value
1	91.6	91.6	805.71	805.71
2	26.62	24.2	201.43	183.12
3	42.03	34.74	201.43	166.47
4	84.36	63.38	201.43	151.33
5	168.43	115.04	201.43	137.58
6	282.34	175.31	230.98	143.42
Total	695.39	504.28	1842.39	1587.62

Source: Chen et al 2008

According to Chen, the dry seed yield of jatropha planted on normal land after 6 years is estimated to be on average 3.45 tonnes per hectare. On marginal land, this value drops to 1.8 tonnes per hectare (Table 7).

Table 7: Jatropha dry seed yields

	Normal Land			Marginal Land		
Year	Seed Yield	Cost / tonne	Present value	Seed Yield	Cost / tonne	Present value
1	0.3	302.75	302.75	0.44	1814.7	1814.66
2	0.76	35.17	31.97	1.11	181.3	164.82
3	0.91	46.27	38.24	1.33	151.11	124.88
4	1.06	79.56	59.78	1.56	129.45	97.26
5	1.23	137.31	93.79	1.8	111.9	76.43
6	3.45	81.84	50.82	1.8	128.32	79.68
Total yield	7.71	-	-	8.04	-	-
Average	-	113.82	96.22	-	419.46	392.95

Source: Chen, B. et al 2008

Chen et al (2008) argue that there is great uncertainty in the yield of *J. curcas*. The production parameters that are not known include the amount of seedlings planted per hectare, how close they are planted, how often trees are pruned, how many fruitings occur per season and how many seeds are produced per plant.

In a study by Moraa et al (2009) on jatropha for biodiesel production intercropped with oranges and maize in Kwale district inKenya, a cost benefit analysis gives yield per plant as 0.5kg. In this analysis yields per acre were 100 kg for jatropha, 2122 kg for oranges and 681.92 kg for maize. Oranges were found to yield the highest revenue of USD 349 annually followed by maize with average revenue of USD 314 per acre per season. Revenue from maize in the study area could be double this amount when maize is planted twice in a year. However, due to rainfall irregularities, farmers plant once during the long rains. Revenue for jatropha is the lowest among the three crops with revenue of USD 65.79 per acre (table 8). Revenue for jatropha and oranges are obtained after the second year while maize being an annual crop yields output in the same year. Maize can yield double this revenue depending on the rainfall.

Table 8: A comparison of yields per acre and their prices in year 2009

	Yield per acre	Price	Total revenue
Crop	Kg	USD	USD
Jatropha curcas	100.00	0.66	65.79
Orange	2122.13	0.16	349.03
Maize	681.92	0.46	314.04

Source: Moraa et al 2009

1 USD = Ksh 76

Moraa et al (2009) also compared the costs of production for the three crops and found that jatropha had the highest total fixed cost and the lowest variable cost. Farmers could not recall the costs of establishing orange trees. Therefore fixed costs for oranges and maize refer to the cost of land and farm implements (Table 9)

Table 9: A comparison of costs of production per acre

Crop	Cost of production in USD		
	TFC	TVC	TC
Jatropha curcas	585.45	44.66	624.92
Orange	398.03	55.78	519.59
Maize	398.03	79.97	478.00

Source: Moraa et al 2009

Moraa et al (2009) also compared gross margins for the three crops and found that, jatropha has the lowest gross margins (Table 10)

Table 10: Gross margins (GM) analysis for the year 2009 (USD)

Crop	Cost	Revenue	Gross margins
Maize	79.97	314.04	234.07
Orange	55.78	349.03	293.26
Jatropha	44.66	65.79	21.13

Source: Moraa et al 2009

Tomomatsu and Swallow (2007) examined the market feasibility of a jatropha-based biodiesel production chain and its profitability for smallholder farmers in Kenya, and concluded that jatropha is not a viable cash crop under current economic conditions.

Wahl et al (2009) evaluated the costs and benefits of *J. curcas* in Northern Tanzania and indicates the main costs in jatropha production are; investment costs, annual costs and harvest and post harvest processing. The study also shows that a yield of less than 1000 kg/ha/year of jatropha seed production is not viable even when neglecting investment costs and lower yields until trees reach maturity (table 12).

Table 12: Influence of yield on profitability of a ≥5 year old jatropha plantation

Yield(Kh/ha/year)	**1000**	**2000**	**3000**
Seed Price (USD/kg)	0.13	0.13	0.13

Fixed annual costs (USD/ha)	99	99	99
Variable harvesting costs (Usd/kg)	0.07	0.07	0.07
Total harvesting costs (USD/ha)	72	144	216
Total cost	129	259	388
Gross margin	**-42**	**16**	**73**

Source: Wahl et al. (2009)

Wahl et al (2009) looked at the NPV of jatropha using different scenarios. In scenario I the economic indicators were calculated over a period of 5 years based on a 2000 kg ha-1 seed yield, and average input-output prices. The study looked at mono-cropped jatropha and jatropha intercropped with sunflower. The study noted that under the current conditions and the assumptions made neither jatropha as a sole crop nor intercropped with sunflower is economically viable. Profits from sunflower partly compensate for losses from jatropha in the first three years but not fully, which is why until the fourth year losses incur. Profits of USD 57 /ha/year from jatropha are only witnessed in the fifth year. The NPV for mono-cropped jatropha discounted at 12 % was -261USD/ha and -65 USD/ha for intercropped jatropha.

In scenario II a 50% higher jatropha seed yield is assumed, i.e. 3000 kg/ha. The study assumes that, with progress in management practices and with new varieties, a yield increment of 50% in the medium term is possible. Under the assumption of a 3000 kg yield, jatropha cultivation intercropped with sunflower becomes economically viable with a net benefit of USD 114/ha and NPV of USD 9/ha/yr for a period of five years. The study concluded that jatropha production is not economically viable.

Further reading

Chen, B. etal (2008), Jatropha curcas L.: Biodiesel Solution or All Hype? A Scientific, Economic and Political Analysis of the Future Energy Crop. Energy and Energy Policy.

Moraa, V. et al (2009) Food or *Jatropha curcas* for biodiesel production? A Cost Benefit analysis in Kwale district. ICRAF.

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Tewari, D.N. (2000) Economics of Bio-diesel Production from Jatropha; In Jatropha & Biodiesel. Ocean Book Limited. New Delhi, India

Tomomatsu, Y. and Swallow, B. **(**2007) *Jatropha* curcas biodiesel production in Africa: economics and potential value chain development for smallholder farmers. WP 54. Nairobi. World Agroforestry Centre. 33 pgs.

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