

## Appendix 1. Farm budget analysis of jatropha

The domestic price of fossil fuel diesel in Mexico in December 2009 was 7.09 pesos (US\$0.54) per litre before tax. Although a small environmental subsidy might be considered, it is clear that biofuel competing in this market should not exceed this by a very large margin. Pre-tax prices have varied between US\$1.26 and \$0.65 in Germany and US\$1.14 to \$0.60 in the USA over the period July 2008 to December 2009, so for the export market - taking into account transport costs and a green premium - an average FOB export price of US\$0.70 (9 pesos) might be considered. Industrial processing of jatropha seed to produce biodiesel costs around 2 pesos per litre including profit margin according to key informants surveyed, which means that the maximum price that can be paid to the farmer ranges between 5 and 7 pesos per litre of biofuel produced. The ratio of seed to biodiesel varies, but is typically 3 kilos to one litre. This puts the maximum viable farm gate price per kilo of seed in the range 1.6 to 2.3 pesos, although probable purchasing prices of 4 pesos and 7 pesos were being quoted by technicians in the jatropha programme in Michoacan and Chiapas respectively.

The main cost to the farmer in jatropha production is harvesting. Based on expert information from producers in Yucatan and Michoacan, it was estimated that a labourer can harvest 10 kilos of fruits per hour, which would yield 49 kilos of seeds per 7 hour day. At the standard labour rate of 70 pesos (\$5.4) per day, the harvest cost per kilogram of seeds is 1.43 pesos (\$0.11). As no economies of scale exist for hand harvesting, this will mean that harvest costs represents between 90 and 62 % of our estimated farm gate price of seed.

The attractiveness of jatropha to the farmer however will depend largely on the opportunity costs, which are estimated in terms of maize and peanut production. Farm gate prices for these crops vary greatly, as do yields; returns are estimated at between 1800 and 4000 pesos (US\$139-310) per hectare in smallholder production in Chiapas and Michoacan, two of the the states included in the survey. At 1.6 pesos per kilo of jatropha seeds, farmers would have to generate yields of 1.15 to 2.5 tonnes/ha to match their previous returns. At 2.3 pesos, yields would have to be 0.75 to 1.75 tonnes/ha. At a (subsidized) price of 4 pesos, farmers would, in theory, match their previous returns at jatropha seed yields of only 0.45 to 1 tonnes/ha. Production rates of 2 tonnes/ha at the end of 5 years could probably be achieved under non-irrigated, low input conditions, and they might rise somewhat after that. However the marginal costs of family labour are very low under current production conditions. If labour costs are factored in using minimum wage rates, it is clear from the gross margin analysis below that jatropha will not be profitable unless yields are above 3 tons/ha and the price is at least 2.3 pesos/kilogram.

Gross Margin Mature Jatropha Plantations					
Yield Kg /ha	operating expenses	crop value @1.6 pesos/kg	profit @1.6 pesos/kg	crop value @2.3 pesos/kg	Profit @2.3 pesos/kg
5000	9550	8000	-1550	11500	1950
3500	7405	5600	-1805	8050	645
2000	5260	3200	-2060	4300	-660

From this it may appear that jatropha is attractive compared to currently available alternatives, at prices above 2.3 pesos, provided yields are high enough. Below this price, however, revenues will not cover input costs. Jatropha appears to be much more labour intensive than grains and peanuts, and it remains to be seen if farmers will find it worthwhile (i.e. by valuing labour at less than the minimum wage). However, if producers could gain

other economic benefits through use of the jatropha cake for cattle fodder or fertilizer, or process the oil for their own use, jatropha might become a more viable option, and this may be the key to promoting jatropha more widely in Mexico. Unfortunately, there are no studies available yet to assess how these by-products would affect the overall profitability of Jatropha.