1. Publishable Project Summary

JATROPT aimed to improve jatropha production systems through developing advanced genetics tools for breeding and for development of jatropha agro-systems. The major achievements are:

1. A worldwide germplasm collection of *Jatropha curcas* (from TNAU, Quinvita, Embrapa and DLO/Biocombustibles de Guatemala), showed a high degree of molecular biodiversity in Central America and early growth traits, seed oil content and fatty acid composition. The few non-phorbol ester accessions are genetically very close and genetically separated from the rest. Final results in the Genotype x Environment trials in India, Mali, Madagascar, Cape Verde, Guatemala and Brazil show large variation in early growth and in seed and oil yield. Non-phorbol ester accessions showed lower yield potential than the phorbol ester containing accessions, demonstrating the need for plant breeding. Non-phorbol ester varieties will be the basis for use of seed meal as feed.

2. Four mapping populations (variable for seed yield, oil traits, flowering, morphological traits, phorbol ester) have been created and evaluated. A single QTL was found for phorbol ester that will be very valuable in breeding programs and multiple QTLs for many yield related traits, oil content and fatty acid composition. The world's first public genetic map (over 500 SNPs and SSR) of *Jatropha curcas* has been published by JATROPT (King *et al.*, 2013)

3. Agronomy trials India, Madagascar, Mali, Cape Verde, Brazil and Guatemala (fertiliser, irrigation, plant density, mono/intercrop, hedges) show the possibilities and impossibilities in jatropha production. Nitrogen, irrigation and planting density all affect early growth and seed and oil yield. The data have been used to parameterise a mechanistic crop production model driven by soil and weather data that can be used to assess feasibility of jatropha production for specific sites.

4. Designing farming systems without the food versus fuel dilemma

A quantitative Sustainable Livelihoods Analysis framework for optimising farming and bio-energy production systems was developed to find the optimal allocation of land (of varying soil quality) and of fertiliser to crops (jatropha, maize, grain legume and forage grass) and to analyse the effect of several strategy on economic and environmental livelihood outcomes. This primary production model was combined with a downstream economic and environmental cost/benefit analysis. The model sows it is possible with 30 % of the land allocated to (non-toxic) jatropha to produce as much food on the remaining 70 % as the system without jatropha, at almost the same net farm income.

5. Demonstration of the potential of local/regional use of produced biofuels to increase agricultural and general economic productivity will be investigated.

The potential under practical conditions of jatropha cultivation was studied. In the traditional systems, yields are up to 2500 kg/ha of seed and 1000 kg/ha of oil and the oil extraction efficiencies were high (standard screw press > 90 % of extraction efficiency). Analysis of the cost price showed that labour costs may be a large barrier towards economic feasibility with the standard yields except in when using own labour (as we assumed in the SLA-analysis).

6. High density jatropha yields twice the standard production: a breakthrough

A new production system with an ultra-high planting density was established that is amenable to mechanical harvesting. A new genotype was found (dwarf type with higher harvest index) that is optimally suited to this high density system with oil yields over 1500 kg/ha in the first year, and 3000 kg oil/ha in the second year, in a growing season of over 300 days (with irrigation). This system will cause a breakthrough in jatropha production, as costs of harvesting are very low and efficiency of inputs (water, nutrients, labour) was increased.