Appendix 2.3

Project Report

Title: Marula in Namibia: Commercial Chain Analysis

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MARULA IN NAMIBIA: COMMERCIAL CHAIN ANALYSIS

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1) Introduction

In the agro-silvo-pastoral farming systems of the north-central regions (NCRs) of Namibia, marula (*Sclerocarya birrea* subsp. *caffra*) is by far the most important indigenous fruit resource, and the one that has been commercialised to the largest extent. During a household survey conducted in the area (Den Adel 2002) 100% of households reported consuming alcoholic and non-alcoholic marula drinks, as well as using the kernels and oil. On average 40% of households also reported selling marula cider (but this varied from 0% in one area to 87% in another), while 62% sold marula kernels. This pattern of nearly universal use held true regardless of whether a household owned marula trees, or not.

This paper attempts to elucidate the distribution of the benefits derived from the commercial use of marula products by analysing the commercial chains involved. The analyses exclude the very important household subsistence use and non-commercial production for sharing with friends and neighbours, as well as production of non-alcoholic marula drinks (which are currently not commercialised). Although marula jam, jelly and cordial are produced and sold on a very small scale, this is currently almost exclusively done as a form of training-with-production by development projects and is therefore not analysed here.

The following commercial chains are described:

- Manual juice extraction and cider production for sale in local and national markets
- Juice extraction with small hydraulic presses and cider production for sale in local and national markets
- Manual kernel extraction for sale in local and national markets
- Manual kernel extraction and traditional oil production for sale in local and national markets
- Manual kernel extraction and cold-pressed oil production for the international cosmetics markets

2) Background

2.1) Marula in the NCRs

One of the most remarkable features of traditional marula use in Namibia is the extent to which it is culture-specific, and consequently varies between regions.

In the four NCRs (the Oshikoto, Ohangwena, Oshana and Omusati regions), where the vast majority of people are members of various Oshiwambo-speaking groups, marula is so important and its utilisation so universal (see above) that a whole set of traditional laws and customs have evolved around it. For example, in the marula season it is forbidden to carry weapons, traditional courts are in recess, and people who break traditional laws at this time are punished with double the customary fine once the courts re-open. Elaborate ceremonies are held at some Owambo royal homesteads to officially open and close the marula season (although nowadays these are sometimes combined into one marula ceremony around the middle of the season). At a more prosaic level, skilled traditional producers of superior marula cider or oil can accumulate considerable personal fame locally and even outside their home districts.

In the north-eastern Kavango and Caprivi regions, by contrast, marula is traditionally not used to any significant extent, and it is quite common to find an entire season's fruits rotting untouched under the trees. This is probably due to the fact that these regions have a much wider variety of indigenous fruit resources than the NCRs, sometimes available in much larger quantities (due to lower settlement densities and more extensive woodlands). While marula is fairly widespread in

Kavango and Caprivi, it does not occur in the same high densities, or in such invariable association with human settlements, as in the NCRs (specifically those parts that were included in the former Owamboland).

In the NCRs, moreover, virtually all marula trees are tenured to individual households (sometimes through a system of royal patronage in which the king nominally owns the trees but delegates their care and use to his subjects through traditional authorities such as senior and village headmen – see Botelle 2001). This "ownership" system is largely a function of the close association between marula trees and the relatively deeper and more fertile soils suitable for cropping. Soil depth and micro-elevation are extremely important abiotic factors in the agro-ecology of this landscape, which is a very flat ancient floodplain underlain by saline hardpans and shallow saline water tables. The combination of high temperatures, low unreliable rainfall and shallow sandy soils means that many plants species, including marula trees, only grow in those areas that have deeper soils with a higher clay content (see Verlinden and Dayot 1999, 2000). While the staple grain crop of the region (mahangu or pearl millet, *Pennisetum glaucum*) will also grow in some soils that are too shallow for marula trees (and some soils that are too deep and too sandy to be good for either), the presence of marula trees is a very reliable indicator of relatively superior soils. This, and of course the multiple uses of marula, result in marula-growing areas being highly preferred sites for settlement and cultivation, most of which have been occupied and farmed for at least several hundreds of years (Mendelsohn *et al* 2000).

There are reasons to believe that the relationship between human settlements and marula distribution works both ways: people preferably establish homesteads and fields on sites where marula already grows, because these have good soils; conversely, people settle on other cultivatable soils and introduce marula trees to sites where they can grow, albeit not as well, by carrying in seeds from existing marula-growing areas (for their kernels), losing some seeds in the sandy soils and then protecting adventitious seedlings from livestock (actively with thorny branches, or incidentally inside homesteads). Under these conditions the concept of a "wild" marula tree is almost meaningless – the only places in the central NCRs where marula trees occur outside farmsteads are on road verges and in towns (but these trees are all mature, very often occur in homestead-sized groves and were probably established through human agency before the areas were converted to their present uses)[1].

It is consequently not surprising that marula commercialisation in Namibia is concentrated in the heartland of the NCRs, where it has been steadily increasing in significance as an additional source of household income in the past decade. In Kavango, Caprivi and the marginal parts of the NCRs commercial use – such as it is – is more recent and limited to a handful of enterprising individuals (although this is changing under the impact of post-Independence migration to these areas by Namibians originating from the "former Owamboland" part of the NCRs).

The commercial chains analysed here are therefore specifically those that originate in the central communal farmlands of the NCRs. This is an important factor to bear in mind because it entails a socio-economic context for commercialisation which has the following distinguishing features:

[1] The margins of the NCRs (south-eastern Oshikoto, extreme western Omusati, Kalahari woodlands of eastern Ohangwena region, southern saline grasslands) do not share all the elements in the combination of extremely flat topography, thin saline soils and long history of intensive human settlement that prevail in the central Cuvelai floodplain. In the first two of these areas marula occurs in much lower densities in thinly populated rangeland (i.e. somewhat like in Kavango and Caprivi) – a notable exception is the area around Tsumeb, which has long been occupied by human populations attracted by the rich copper deposits formerly found there. In the Kalahari woodlands marula is an uncommon species almost always associated with quite recent human settlements. The southern saline grasslands are virtually treeless.

a) The area is one of the most marginal in the world where crop production is nevertheless still a mainstay of local livelihoods systems. In response to the unfavourable agro-ecological and agro-climatic conditions, traditional farming systems are based on the most drought-resistant crops (pearl millet, sorghum, cowpeas, bambara groundnuts and hardy cucurbits) with strong diversification into livestock and tree-based elements (hence their characterisation as "agro-silvo-pastoral" systems). An important corollary is a tradition of frugality and thrift which manifests itself as a tendency to harvest surpluses when they are available and store relatively large quantities of food in the homestead (e.g. many households prefer to keep enough grain stocks to survive for four to six years without rain, and are often reluctant to sell these stocks; when they do the oldest grain is sold first).

b) In addition to these highly diversified farming systems, overall livelihood strategies are also traditionally diversified to the largest possible extent. Very few (and only the poorest) households in the area can manage, or will even attempt to, earn their sustenance through land-use alone. Common livelihood diversification strategies include formal employment by one or more members of the household (historically as migrant labourers on the farms and mines of central and southern Namibia), sharing of government old-age pension, small businesses (typically retail operations based on a long cultural tradition of trade), cottage industries based on value-adding to local resources (beer brewing, food preparation, basket weaving), harvesting wild foods (e.g. mopane worms, edible weeds and indigenous fruits), fishing during the periodic seasonal floods that fill the low-lying areas, and local migration to take advantage of seasonal resources (especially grazing).

c) Despite a strong emphasis on the household as the primary vehicle of economic organisation (with most resource-use decisions made at household rather than communal level and household size the most reliable indicator of economic status), most people actively pursue socio-economic alliances through a well-developed system of mutual support, gift exchange, common work, strategic inter-marriage and extended-family childcare. The non-commercial exchange of marula products (including allowing neighbours access to fruit and sharing the work of processing them) plays an important role in this alliance-building. Another manifestation is the observed practice of "giving" a marula tree (i.e. usufruct of its products) to a relative or friend – as a result of this practice it is quite common for women to "own" marula trees in several districts, occasionally 100 km or more from their own homes.

2.2) Opportunity cost of labour in the NCRs

As explained above, households in the NCRs employ very diversified livelihood strategies. This is partly a response to the very low income opportunities associated with the traditional farming systems of the area. On the other hand, unemployment rates are very high (more than 40% nationally, and higher in the communal areas), and underemployment rates even higher. In calculating the opportunity cost of labour we have considered the following:

- An unskilled and marginalised farm labourer (e.g. an illegal immigrant from Angola or a San person) can be paid as little as N$3/day plus food and accommodation – say a total of N$5/day
- The going rate for unskilled piece-job agricultural labour varies between N$10 and N$20 a day
- One person can cultivate (using traditional methods) around one hectare of traditional crops over the six months of the growing season – at an average mahangu yield of 300kg/ha/a this amounts to an income of around N720, or N$120/month of work, or N$60/month yearly average

- Someone who is lucky enough to get a piece-job in an urban area can expect to earn between N$20 and N$35 a day
- The Government rate for casual labour is N$33.50/day
- The Government old-age pension is N$250/month
- Den Adel (2002) surveyed marula users and established an average household income of N$800/month shared between 12 people including children (but almost half of the households had an income of less than N$250 a month)
- Income opportunities are most restricted for rural women (the marula users and sellers)

On this basis (and to make calculations easier) we decided to use a figure of N$16/day or N$2/hr for the opportunity cost of the (rural, female) labour involved in marula processing.

2.3) Farming marula

As was pointed out above, virtually all the marula trees in the NCRs grow in farmers' fields or homesteads, and are therefore subject to at least the passive management decision not to chop them down. While customary law generally forbids felling fully-grown fruit trees, the same does not apply to newly germinated seedlings. And for good reason, because a farmer who already has marula trees is sometimes confronted with hundreds of seedlings germinating in the fields come the rainy season. It is neither practical nor in keeping with the general cultural preference for diversification to allow an entire field to become a marula grove.

Farms in the NCRs are usually between two and ten hectares in size (averaging about four hectares) and allowing too many marula trees to grow to maturity will have a negative impact on crop production through competition for space, light, water and nutrients. Pearl millet planted under a marula tree is usually etiolated, prone to falling over and has a lower yield than would be achieved in open fields. Nevertheless, it is a very common practice to plant mahangu under trees, partly to maximise the use of limited growing space and partly because – under certain conditions, e.g. a long hot dry spell shortly after germination – such plants can actually survive better due to a more favourable (cooler, moister) micro-environment. This is yet another example of the strategy of spreading risk through diversification.

The major human agency at work in the propagation of marula in the NCRs is undoubtedly the traditional practice of extracting the juice under the tree and then taking the nuts into the homestead to dry before they are decorticated (this is a job that is done mainly after the mahangu harvest, i.e. in the dry agricultural "off-season"). Especially significant is the customary arrangement of allowing neighbours who helped to extract juice to take home the nuts of the fruit they processed – this "seed dispersal mechanism" introduces marula into places where it would not (in the absence of elephants or other large game) naturally spread. Within the roughly circular palisade fences that surround traditional Owambo homesteads, those seeds that are lost in the sandy soils can germinate and grow safely – it is very common to find several young marula (and other indigenous fruit) trees inside an *egumbo*.

As Erkkilä (2001) showed, the traditional practice of periodically moving the homestead to another part of the farm results in the establishment of groves of fruit trees, with the oldest groves typically at the centre of the farm (where the first homestead was located). This is also the reason why marula trees in the NCRs are very often found in homestead-sized clumps or groves (typically of two to six trees) of more or less similar age. An additional advantage to the establishment and early growth of these groves is of course that former homesites are more fertile than the surrounding soils (as a result of the accumulation of ash and other household and human wastes). Nowadays more and more people are constructing permanent buildings and consequently not moving their homesteads.

This is causing a shift in marula recruitment – when the issue was raised with farmers they agreed that more permanent settlement had changed the way they looked at marula and stated that they were now more likely to protect seedlings that germinated in fields and to remove them inside the homestead (because it is not really desirable to live right under a mature fruiting marula tree).

There are also many observed examples of more active marula management practices, including:

a) Using thorny branches to protect seedlings that germinate in fields against livestock (this strategy is employed by farmers who want to have more marula trees, and such trees are commonly named after the person who discovered the seedling).

b) Transplanting seedlings to more convenient locations on the farm.

c) Using large marula truncheons in palisade fences, where they sprout and grow.

d) Selecting and planting truncheons from genetically superior marula trees – this vegetative propagation (which is still quite rare but definitely on the increase) sometimes involves transporting truncheons for considerable distances and – especially when daughter trees are named after their mothers – constitutes a simple form of selecting cultivars.

e) Pruning marula trees in the dormant season to remove mistletoe-like plant parasites (probably *Erianthemum dregei* and/or *Pedistylis galpinii*) that would otherwise reduce production and eventually kill the tree.

f) Cutting large branches to encourage coppicing and a denser canopy.

g) Removing surplus male trees (the marula sex ratio in the NCRs is 80% female).

h) Removing – usually with the permission of traditional authority – very bad female trees (which produce neither useable fruits nor good kernels – some trees with bad fruits are retained because their kernels are of acceptable quality).

i) Building a pig sty under and around a young marula tree to protect it against browsing and to fertilise the site.

j) Only allowing livestock into fields to graze stover after young marula trees are dormant – the trees are sometimes damaged but resprout when the rains come.

3) Marula fruit juice commercial chains

3.1) *Omaongo*

Omaongo (literally "water of the marula") is the Oshiwambo name for fermented full-strength marula juice (there is still some debate as to whether this is best described as beer, wine or cider in English – in this paper cider is used). While the addition of water to *omaongo* is frowned upon by traditionalists, some informants have reported that dilution prior to fermentation is on the increase among commercial producers[2]. Interestingly enough, although marula fruits are eaten to a limited extent, marula juice is traditionally never consumed unfermented – some traditional users have even

[2] After the first-run juice has been extracted for *omaongo* production, the pips with their adhering fruit pulp are collected in a second container. A variable quantity of water is added and the mixture is agitated to release the remaining juice and some pulp. This is allowed to ferment overnight and is known as *oshinwa* – a low- or non-alcoholic "marula-ade" drunk in large quantities by women and children, given away but never sold.

taken issue with efforts to develop a commercial fresh marula juice product, claiming that it is not healthy (and a few people have reported upset stomachs after drinking the unfermented juice).

As can be expected from a drink produced in small batches from the fruits of open-pollinated hybrid trees, *omaongo* is hugely variable in quality. At its best it can compare favourably with any alcoholic drink in the world: superior *omaongo* has an aroma that combines fruity accents with resiny bass notes, a smooth almost oily mouthfeel (sometimes with a slight effervescence), a good balance between sweetness and acidity accentuated by strong tannins with a hint of bitterness, and hugely complex tropical fruit flavours. It also produces a very pleasant intoxication and is no more likely to cause hangovers than any other drink when consumed in excess[3]. In the NCRs many people who never drink any other form of alcohol relish *omaongo* in season, and some people with the means to do so go to great trouble to store enough *omaongo* for the whole year.

Not all *omaongo* is of superior quality, of course. People with Western tastes often find the brew too acidic for their liking, and even some locals will only drink it diluted with lemonade, or not at all. Many factors contribute to the quality of the final product, one of the most important being the quality of the fruit used to produce the juice. In this regard people have detailed local expertise about which trees produce the best *omaongo*, to the extent that the fruits from some trees are never used for this purpose (although they might be collected later for kernel extraction) while some other trees are reserved for making the special *omaongo* that is delivered to the king or headman as a tribute. The usual practice is to make *omaongo* from the fruits of a single tree and it is rare to find producers who blend juice from different trees, unlike in South Africa, where Shackleton (2002) reported producers deliberately mixing different fruit types.

The duration of fermentation also plays an important role in determining quality. Most brews reach a peak after two to three days (exceptionally, with very sweet fruits, after five days) when they are not yet fermented completely dry; at this stage some sugar remains to offset the natural acidity and the *omaongo* still has a slight fizz. Most commercial producers aim to get their product to market at this stage, as it is then preferred by most consumers. However, some experienced *omaongo* drinkers like their brew to be bone dry, possibly because it then has a higher alcohol content. *Omaongo* is sometimes stored (traditionally in covered clay pots, nowadays more often in plastic cans) by burying it in the ground and keeping the soil wet to cool it. Stored in this way the drink can be kept for up to a year, during which time it develops a much stronger, slightly sulphurous taste.

3.2) Making *omaongo*

Marula fruits abscise while still green, ripen under the tree over a two to four-day period and remains in reasonably good condition for juice extraction for a week or more (depending on various factors such as temperature, rainfall and infestation by insect and/or fungal pests). Each tree produces fruits for between four and eight weeks, during which time the rate of fruit drop increases gradually, peaks for one to three weeks and then declines. The distribution of fruit drop over the fruiting period has not been quantified systematically, but has been observed to vary widely between trees (i.e. some trees have a more intense peak than others).

To avoid a situation where rotting early fruits and green fruits end up in a chaotic mix, the observed practice is to collect fruits into small heaps under the tree. Young children often help with this chore. When the collection is done by hand, damaged or sub-standard fruits are not collected – the first step in selecting only higher-quality fruits. In a variation on the theme, some people (especially

[3] Non-traditional users sensitised to the mind-altering effects of various psychotropic substances have reported experiencing a "high" or "buzz" that goes beyond what can be ascribed to alcohol alone, but there is currently no known scientific basis for this claim. At a subjective level *omaongo* does seem to act faster than most alcoholic drinks, with intoxication and sobriety both occurring more rapidly than after consumption of, say, beer.

those with many trees, or limited labour and a highly productive tree) sometimes rake fruit into heaps indiscriminately, and then sort them immediately prior to juice extraction. The heaps are usually on the eastern side of the tree, because this is the shady side in the afternoon, when omaongo is usually extracted.

During the early and late stages of fruit drop, when the quantity of fruit under a tree is limited, one or two female members of the household can process omaongo without needing help. However, at the peak of their annual production many marula trees fruit so prodigiously that household labour can no longer cope with the work. For this reason (and for maintaining social alliances, as discussed above) the bulk of a tree's production will be processed during one or more work session to which neighbours are invited. While these omaongo work parties are common in all parts of the NCRs there is no standard system of reward – in all areas neighbours are allowed to take home the pips from the fruits they processed (to make oshinwa and extract kernels), but in some areas they also receive half the juice they extract, while in others they only get to share the omaongo when it is ready (although women drinking omaongo is reportedly a post-Independence phenomenon). Nevertheless, omaongo making is a popular social activity in which girls and women participate enthusiastically (for more details see Botelle 2001 and Den Adel 2002).

The traditional way of extracting marula juice is to use the sharp end of a short cow horn to puncture the skin of the fruit over a container, into which the juice is squeezed (aided by a skilled twist of the horn). The nut with its adhering pulp is then squeezed out of the skin into a second container, the skin is given a final squeeze over the first container, the empty skin is dropped to one side and the process is repeated. Skilled juice extractors usually pick up a few fruits at a time in one hand and move them along from the little finger/palm towards the thumb/forefinger as they are being processed.

Since the effort involved in juice extraction is basically the same whether the fruits are large and juicy or small and dry, the quantity of juice produced varies greatly (e.g. in trials with a hydraulic press juice yields varied from less than 20% to more than 40%). Furthermore, there are so many variables involved (fruit size, condition and juice content, personal skill, level of reward expected etc.) that calculating a statistically valid average juice yield per hour of labour would take a larger number of samples than this analysis was resourced to carry out (and such an average would in any event still be misleading for analysing commercial chains in which a proportion of the omaongo traded is produced by neighbours). As an indication, a reasonably skilled juice extractor can produce as little as 0.5 litre of juice an hour from mediocre fruits, and (exceptionally) up to 5 litres per hour from superior fruit.

Leakey *et al* (in press) calculated a mean flesh mass for Namibian marula fruit of 13.37 g. Assuming traditional omaongo production recovers only 30% of this as juice, each average fruit will yield about 4 g of juice, and 250 average fruits will yield 1 litre. Assuming it takes 5 seconds to puncture the skin, twist the horn around the nut, squeeze the fruit, expel the nut, squeeze the skin again and drop the skin, 720 fruits can be processed in an hour. If they are average fruit the juice yield will be 2.88 litres/hour. In reality how long it takes to process one fruit depends on the work pressure felt by the juice extractor. Since omaongo production is a social activity that is carried out in the afternoon after a morning of hard work in the fields, accompanied by story-telling and conversation, real yields per hour are probably lower (say 2 litres/hour), and theoretical maximum yields higher (e.g. if it takes only 3 seconds to squeeze one average fruit the yield will be 4.8 litres/hour). On this basis we consider 3 litres an hour a fair average to use in calculations.

Using a small pedal-operated hydraulic press designed and disseminated by CRIAA SA-DC/Katutura Artisans Project, marula juice can be extracted at a much faster rate (benchmark trials

indicated an average yield of 10-12 litres per hour, but some operators managed as much as 20 litres per hour under field conditions) – see further discussion below.

Once the marula juice has been extracted omaongo production is simply a matter of leaving the juice to ferment and skimming off any scum that forms (rapid fermentation is usually assured by the natural yeasts present on the skins, but some producers add a little omaongo from the previous brew, or use a clay pot that has contained omaongo before). It is unusual (but not entirely unheard of) for water and/or sugar to be added. Some brewers "top up" the omaongo with fresh juice during fermentation. On the whole, however, the juice is just fermented for two to three (exceptionally five) days, and the major skill involved is judging when it is ready to consume.

There is undoubtedly a short period during fermentation when omaongo is just right, before it start going downhill, as can be deduced from the following anecdote: A European technical advisor in the NCRs relates how – soon after his arrival in Namibia – he set off with a local counterpart to do a crop survey. At one homestead quite far from the road several vehicles and many more pedestrians had gathered – all men, and all patiently waiting, for no apparent purpose. Somewhat ignorant of local customs, the TA hesitated to ask for an explanation and set about his business, but two hours later his curiosity got the better of him and he enquired from his partner what the gathering was about. It turns out that the woman of the house was known far and wide for the quality of the omaongo she produced, and the generosity with which she shared it out. Word had got out that the first batch of omaongo from her very best marula tree was being fermented – and the crowd was waiting for the moment when she would pronounce it ready for drinking.

3.3) Marketing *omaongo*

Omaongo is sold locally, regionally and nationally. It is transported to the market in 20-25 litre plastic cans. For immediate consumption at the market it is typically retailed in one-litre batches, which are decanted from the plastic can into plastic jugs or glass bottles and then poured into traditional wooden cups for serving. Sometimes a customer will purchase a whole can, or bring a smaller bottle for a "take-away". As far as can be established no producers currently package omaongo into smaller containers, but many have expressed an interest in doing so.

Den Adel (2002) found that:

- 17% of sellers sell only in the main urban centres of the NCRs, spend N$10-20 on transport and take from 5 minutes to a whole day to sell 25 litres for N$4/litre
- 29% of sellers sell only in local markets, spend nothing on transport and typically sell 5 litres a day for N$2/litre
- 21% of sellers sold only from home, on request, sometimes 25 litres at a time, but usually smaller quantities, for N$2/litre
- 33% of sellers sell in all of these markets

She also reported that omaongo is not purchased for resale inside the NCRs (although it is sometimes sold on behalf of a neighbour without mark-up or commission being charged). However, at least some of the omaongo that is sold in 25-litre batches finds its way to urban markets in other parts of Namibia, where it is sold for a premium price (up to N$8/litre in 2002). This national trade has not been quantified, although observations of buses running south from the NCRs suggest that it could be substantial (some buses carry more than 200 litres at a time). At this stage there is no direct evidence to suggest that this trade involves wholesale and retail markets – it appears to be mainly based on extended family ties. However, given the intensely entrepreneurial character of people from the NCRs, and the fact that migrants from Windhoek were occasionally observed to buy a 100 litres of omaongo at a time just before leaving the NCRs, it is possible – in fact, likely – that such a

trade is developing. If and when omaongo production increases dramatically (due to the availability of hydraulic juice presses, and the improved varieties of domesticated marula currently under development) such a trade is almost guaranteed to become a significant factor in at least the national markets for marula products.

3.4) Manual juice extraction and omaongo production for local and national markets

Since there is no evidence that omaongo is currently being bought wholesale in the NCRs and then retailed in urban areas further south, the commercial chains described below are short and involve traditional in-kind rewards to labour as the main production cost. No allowance is made for small equipment like buckets – neighbours usually bring their own and most homesteads already own suitable containers.

3.4.1) Scenario 1: Marula owner, average tree, Endola area, Oshakati market

Assumptions: Tree bears 600 kg of fruit a year, but only one third is ready for processing. Four neighbours join one household member in processing 200 kg of fruit (7 400 fruits). It takes 30 minutes to sort the good fruits into piles (i.e. 2.5 hours total). Each person processes 1 480 fruits at a rate of 720 fruits/hour (5 sec/fruit) – say two hours each (i.e. 10 hours total). It takes each neighbour 30 minutes to walk to the tree and back home (2 hours total). The tree owner therefore spends 2.5 hours, and each neighbour three hours.

The total yield is 29.6 litres of omaongo – say 30 litres – and 30 litres of oshinwa (to bring total juice product yield to 30% - actual oshinwa yield depends on the quantity of water added), and 33 kg of nuts. In this area the custom is that the tree owner get 50% of the omaongo and the neighbours get all the pips (with adhering pulp) from the fruit they processed (Den Adel 2002). The owner therefore gets her own 6 litres of oamongo, and another 12 litres from her four neighbours, or 18 litres in total, plus 6 litres of oshinwa (which has no commercial value), and 6.6 kg of nuts. Each neighbour gets 6 litres of omaongo, 6 litres of oshinwa, and 6.6 kg of nuts.

The owner has enough omaongo to justify a trip to the market in Oshakati. She spends N$15 and two hours on the trip there and back, and half a day selling her omaongo at N$4/litre. Her gross income is N$72. Her direct costs are N$15 and her effective income therefore N$57. To earn this money she has spent 2.5 hours processing, 2 hours travelling and 4 hours selling – a total of 8.5 hours. At an opportunity cost of labour of N$2/hr she has therefore "earned" N$17, and further made a net profit over labour costs of N$40. Her family also has 6 litres of oshinwa to drink, and she will later extract around 675 g of kernels (worth between N$5.40 and N$11.48) from the 6.6 kg of nuts she kept[4].

The neighbours who helped do not have enough omaongo to justify a trip to the market. In reality the omaongo they produced is probably consumed at home, but its value in local markets (at N$2/litre) is N$12. For three hours of work they therefore earned N$12, or N$4/hr, plus 6 litres of oshinwa, plus a chance to extract 675 g of kernels each (which will take them an additional 4.5 hours and earn them N$11.48 if they are members of the Eudafano Women's Cooperative, or N$5.40 if they sell in local markets – see kernel commercial chains below).

Effects on the five forms of capital:
Natural capital – marula trees are valued and protected; seeds are dispersed to neighbouring homesteads; neighbours who do not have trees of their own might try to plant some, especially if and when they can no longer get fruit for free

[4] Based on average extraction rates achieved during a timed decortication trial – see 4.2 below.

Social capital – a win-win situation that strengthens neighbourly relations and leaves everyone better friends
Human capital – a valuable traditional skill is practiced and perpetuated
Financial capital – the neighbours have earned about double the opportunity cost of labour and the tree owner has made N$40 clear profit (which she can spend or invest as she thinks best)
Physical capital – no significant effects

If the whole annual production of this one tree is processed under the same arrangement the distribution of benefits will be the same but the quantities three times larger. In reality most or all of the neighbours probably also own marula trees and the overall relationship is much more reciprocal.

3.4.2) Scenario 2: As above, Windhoek market, employed vendor

Instead of selling her omaongo in the open market at Oshakati, the tree owner gives it to a migrant member of the family to take to Windhoek. Since this family member is already travelling to Windhoek the only additional cost is a charge of N$25 for the can of omaongo. In Windhoek the migrant has to go to work, so he pays a young female member of the urban household N$20 to sell the omaongo at the nearest open market for N$8/litre. The gross income is N$144 and the direct cash costs N$45 – the owner of the omaongo eventually gets N$99. Under this scenario she only spent 2.5 hours processing, which represent an opportunity cost of N$5. She therefore makes N$94 profit over and above labour costs (or the equivalent of more than a week's labour).

Effects on the five forms of capital:
As above, but with greater gains in social capital (creates one additional day of paid employment for the vendor and strengthens economic ties within the extended family) and significantly greater (+235%) gains in financial capital.

3.4.3) Scenario 3: Marula owner, 3 good trees, Ondangwa area and market

Assumptions: Three good marula trees easily produce 6 tons of useable fruit a year. At an average fruit mass of 40 g this represent 150 000 fruits; at 5 sec/fruit processing time 208 hours of processing is required. In this area the tree owner keeps all the omaongo, but has to invite neighbours to drink and eat at her home – she does this three times. Processing is done by three household members and seven neighbours, each of whom therefore spends an average of 20.8 hours processing. The omaongo that is not consumed at the parties is sold in Ondangwa open market for N$4/litre.

The total omaongo production is 900 litres, all of which accrues to the household that owns the trees. The household also gets 270 litres of oshinwa and 297 kg of nuts, from which it can extract around 33.5 kg of kernels. The seven neighbours each get 90 litres of oshinwa and 99 kg of nuts, from which they can extract 11.1 kg of kernels later.

To each of the three parties, which are also attended by 10 adults and five children from the household, seven neighbours each brings four adult relatives and 5 children – that is 80 guests per party, or 240 guests in total. Each adult (120 total) drinks an average of 2 litres of omaongo (240 litres) and each person (240) eats N$1.50 in cereals and vegetables (N$360 total). A goat (N$200) is slaughtered for each party. The total entertainment cost is therefore N$960's worth of omaongo, plus N$600 (three goats), plus N$360 – a grand total of N$1 920, or N$960 in food alone. The time spent by the neighbours (7 x 20.8 = 145.6 person-days) is "remunerated" at a rate of N$13.19/day (plus the oshinwa, nuts and social interaction, but excluding time walking to the processing site).

The 660 litres of omaongo that is not consumed socially is worth N$2 640, or N$1 680 more than the food consumed. Selling 660 litres in Ondangwa market (at 22 litres/4 hours average) requires an additional 120 hours, or 15 days (but since the homestead is located within walking distance from the market no additional transport costs are incurred). The household spends 62.4 person-days making omaongo, 15 person-days selling and three person-days preparing food for the parties – a total of 80.4 days – therefore earning N$20.90/person-day. At an opportunity cost of N$16/day the net profit/person-day expended is N$4.90, or N$394/season.

In reality the income is probably considerably higher, since the parties will not be attended by so many people and only one of them will be lavishly catered. If the household additionally markets a part of its production in urban markets outside the NCRs (Windhoek, Walvis Bay etc.) it can make around N$3/litre (or N$1 980/year) more.

Effects on the five forms of capital:
Natural capital – marula trees are valued and protected; seeds are dispersed to neighbouring homesteads; neighbours who do not have trees of their own might try to plant some
Social capital – positive influence not as clear as in scenarios 1 and 2 above, but still enough to strengthen ties of obligation and appreciation
Human capital – a valuable traditional skill is practiced and perpetuated
Financial capital – family labour is employed at more than the minimum wage for around one third of a person-year; neighbours have earned substantial quantities of oshinwa and nuts for decortication
Physical capital – no significant effects

3.4.4) Scenario 4: Widow, no trees, 4 daughters, Ohangwena area, Oshikango market

Assumptions: A household with five female members but no marula trees of its own (e.g. a widow dispossessed of her land under customary law after her husband died) spends as much time as possible – assume 6 hours a day six days a week – processing marula for people who do own trees (the area has the highest density of marula trees in the NCRs), and selling it in the open market at Oshikango (which, by the way, is located under one of the biggest marula trees in the NCRs). They are allowed to keep 33% of the omaongo they produce (the quantity is negotiable in this area). One of them is always selling (8 hours a day, 7 days a week).

Four women can produce 12 litres of omaongo an hour on average, or 72 litres over six hours. If they are allowed to keep a third of their production they can "earn" a litre an hour each, or 24 litres in six hours between them, plus around 72 litres of oshinwa (more than they can use but with no commercial value), plus 79.2 kg of nuts (from which they can later extract 8.92 kg of kernels). To produce this they must process around 80 kg of fruit an hour, which will take them about an hour to sort into heaps (15 minutes and 20 kg each per hour of processing, i.e. 1.5 hrs and 120 kg each over six hours of processing, or 6 hours and 480 kg in total). Since they have to go quite a distance to access this much marula, assume they each spend another 1.5 hours a day walking to the trees and back home. They therefore work 9 hours/day, six days a week, for 12 weeks of the year, and spend an additional 56 hours and N$140 in transport a week on marketing.

As a household, therefore, the five women will earn N$4/litre x 24 litres x 6 days x 12 weeks – a total of N$6 912. They will spend 12 weeks x N$140 (N$1 680) on transport, leaving a gross income after direct costs of N$5 232. For this income they will work 4 women x 6 days x 12 weeks x 9 hours (2 592 woman-hours), plus 12 weeks x 56 hours (672 woman-hours) – a total of 3 264 woman-hours per season. Their effective hourly earning rate is therefore N$1.60 (daily rate N$12.80) – 20% less than the calculated opportunity cost of labour, but still a lot better than being destitute (or prostitute), especially since they do not actually have other opportunities to labour, and

28% higher than the rate typically paid for agricultural piece-work by such socially marginalised people. This amounts to an average monthly household cash income of N$436 from omaongo production for other people alone (which puts them in the top 40% of NCR households in terms of cash income, but still leaves them desperately poor, since they have no land and therefore not much in-kind income).

In addition they would earn 642.24 kg of kernels (6 days x 12 weeks x 8.92 kg of kernels/day), which would require an extra 5 266 hours (or 658 woman-days, or 131 days each) of labour to extract (as calculated under kernel commercial chains below) and would theoretically be worth between N$5137.92 (at N$8/kg in local markets) and N$10 918.08 (at N$17/kg, if they were EWC members and could sell all their kernels through the cooperative, which they can't under current market conditions).

Effects on the five forms of capital:
Natural capital – marula trees are valued and protected, even by people who do not own any trees and have no land to plant any
Social capital – a social safety net is created for marginalised members of the community in a way that also benefits their benefactors
Human capital – a valuable traditional skill is practiced and perpetuated
Financial capital – the landless household earns cash that it might invest in other income-generating activities (e.g. informal brewing or food preparation); the tree owners earn a higher income than they could through the efforts of their own family labour; total benefit depends on marketing opportunities
Physical capital – no significant effects

3.5) Omaongo production using small hydraulic presses

Through its work on the commercialisation of marula oil CRIAA SA-DC was made aware of a desire by marula producers for a technology that would mechanise juice production, free women from the tedium of producing omaongo in the traditional manual way and enable marula owners to use the glut of fruit they were unable to process effectively and efficiently during the agriculturally busy marula season.

In May 2000 the Katutura Artisans Project (a technology R&D and service-providing project administered by CRIAA SA-DC) demonstrated marula juice production with an imported "kitchen-scale" grape press at the SADC Women in Business Trade Fair at Ongwediva to assess public demand for such a technology. The response was very positive and KAP consequently developed and produced a small cage-and-plate bridge press that uses a pedal-operated 6-ton hydraulic jack to press around 30% juice from about 13 kg of marula fruit in about 20 minutes.

Nine copies of this press were sold to the marula producers' association members of EWC and their use and performance was followed up and monitored in the 2001 and 2002 seasons (although they were disseminated too late to have much of an impact in 2001). Benchmark trials at KAP established a baseline production of 10-12 litres of juice an hour and an average yield of 30% juice (ranging from 20% to 42% depending mainly on fruit quality and degree of ripeness). Under field conditions – where operators had more fruit but restricted access to press-time – real yields were typically higher (averaging 15 litres an hour and reaching 20 litres an hour in some cases).

An interesting phenomenon was that, although the presses were initially sold exclusively to women's organisations, most of them ended up being operated by young men. This is probably due to them being seen as mechanical tools – a traditional male preserve. Mostly the operators were employed by the women owners, but in a few cases where the associations decided to rent out the

press the main customers were men. Many men also showed serious interest in buying their own press, although most of them framed this interest in terms of the social cache of having lots of omaongo to share with friends, rather than as a business opportunity. Nevertheless, this new technology clearly has the potential to subvert traditional gender roles around marula ownership and use (in which the king nominally owns marula and delegates it use through a system of traditional authority to the – male – heads of households, but women in practice and in fact control and manage the marula resource). It is too early to tell whether and to what extent men will attempt to "reclaim" the marula resource now that they have a processing technology that provides a viable alternative to female labour, and to what extent women will be able to resist such appropriation if and when it occurs.

The technical and business performance of the presses was also monitored as part of Promoting Indigenous Fruit (PIF) project funded by the Ministry of Agriculture, Water and Rural Development. Main observations included:

- The availability of easy credit played a big role in uptake – EWC helped its member association to pay the deposit, and CRIAA SA-DC required no collateral (because of its established and on-going relationship with the buyers); without such credit only one association ordered a second press, but many people expressed a need for more presses to be made available on credit; nevertheless some private investors were interested (often after renting and using a press) in buying presses outright for their own use, and were even willing to pay a deposit to cover material costs and then to wait for delivery.

- Technical problems were almost exclusively due to the hydraulic jacks rather than the press itself. The recommended solution is to keep a spare jack ready at all times for a quick field exchange (6 ton jacks cost less than N$200 a piece in Oshakati – when they are available, that is) and to repair or replace broken jacks as soon as possible. Another option – using more expensive jacks of higher quality – is being investigated, but could end up more expensive than changing cheap jacks more frequently. Having said that, some presses got through the entire season without technical problems. The harder a press worked, the more likely it was to break down – but at least some of these problems (e.g. oil leakages) were due to the press being transported more frequently, rather than to the workload itself.

- The presses employed in central locations as service-presses were under-utilised. This is directly related to the problem of transporting fruit to the press, and juice and pips back to the homestead. Stationary service pressing of marula is apparently not a viable business model. A well-run mobile pressing service might be viable, especially if it took payment in the traditional coin (i.e. a percentage of the juice produced) instead of cash, and could market its "payment" successfully. Controlling transport costs would be crucial to the profitability of such a service business.

- The busiest presses were those that were rented out. It is unclear how chances to rent were distributed, but some associations rented only to members, while other also rented to outsiders. Daily rentals were N$40 to N$50/press/day. Some associations charged on a per-use basis (N$3 to N$5 per 20 litres of juice produced) but had no monitoring and control measures in place – it is not clear how well this "honour" system actually worked. Renting a press was only an option if transport could be organised. It is also unclear how effectively rentals were collected, especially when presses were retained longer than arranged, or broke down during use.

- Although it is perfectly possible (but not easy work) for two or four people to carry the press quite some distance, this only happened to a very limited extent, and mainly between nearby trees belonging to whoever had access to the press that day. Most producers took the press to

the tree, where it was operated by one person with one or two helpers (often children) to collect, sort out and pile up fruits ready for pressing. As in traditional processing fruit were usually not washed before pressing. Only one producer (a relatively wealthy household with many members) set up a "production line" system, in which children brought fruits from the trees to a central processing area, where they were washed and allowed to drip dry before being pressed.

- None of the press users bothered to press fruit twice, as was done with the limited quantities of fruit available during initial trials at KAP – in a situation where fruit is much more abundant than press-time, a single pressing is probably the correct option. As a result, real production yields were usually higher than the benchmark (10-12 litres/hour) set at KAP. The highest production actually measured was 15 litres per hour, although at least one user was observed to be on his way to exceeding this, having produced around 50 litres in what he estimated was less than two hours (time unfortunately did not allow accurate measurements). The highest daily production reported was more than 200 litres (on a long day). Juice yields vary considerably (25% to 42% w/w) between different types of fruit at different stages of ripeness, and average figures are therefore potentially misleading.

- Assuming a press owner can maintain 200 litres/day for a 50-day season, and sell the entire production for a wholesale omaongo price of N$1.50/litre, the potential gross income is N$15 000/season. To do so will require access to 33.33 tons of fruit – some, but not many, people probably have that much fruit on their own farms. If an entrepreneur has to buy fruit the price that is negotiated will be crucial (there is not yet a set price for marula fruit in the NCRs). The other obvious factors in determining how profitable such a venture will be are the costs of transport and labour. An enterprise that is located close to an urban market, owns many marula trees, has paid-off capital in the form of a press and bakkie, and uses family labour, could easily earn an income in the region of N$5 000 or more a season. If the enterprise additionally used family labour to retail its production in urban markets the potential profit could be several times higher.

During the 2001 and 2002 marula seasons, which by common consensus were not good ones, and before most of the small KAP presses were working smoothly, temporary surpluses of omaongo were occasionally observed in informal markets in the NCRs (too many sellers, too few customers), even though most sellers said they always sold everything they took to market. The substantial interest in the marula press would suggest that many potential processors still see an opportunity in local (or national) markets. The possibility of buying a press only to find that the market is fully supplied was mentioned to a number of producers who had expressed an interest, and they were unanimously of the opinion that this would not be a problem. Namibia's Indigenous Fruit Task Team has recommended that CRIAA SA-DC disseminate as many copies of the presses as people are prepared to buy, and let the market sort out performers from non-performers.

It is likely that an important effect of the presses on marula production systems will be that those people who own many marula trees now no longer have to rely on neighbours to process their fruit, which disrupts the traditional system for distributing nuts evenly between homesteads. It is still too early to assess the effect of this change on the decortication and availability of kernels – people with many trees might end up decorticating more nuts (and even hire labour to do so) or they may still allow neighbours to take away the nuts after they have been processed, or they may sell the nuts to neighbours for decortication.

It is already clear that oshinwa production systems are changing in places where the presses are used – since the press does not open up the skin and express the nut with its adhering pulp, this now has to be done separately. Press users reported that they did so manually when they wanted oshinwa, but obviously this is done to a lesser extent, as there are now much larger quantities of

processed fruit. A theoretical impact on the nutrition of especially children can be postulated (oshinwa is an important source of Vitamin C), but there is no evidence of such a development at this stage.

The effects on marula's main "seed dispersal mechanism" and consequently on recruitment are also hard to predict – fewer marula nuts are being carried away by humans, but the perceived value of the resource is increasing and interventions to promote active planting of selected marula trees are underway. It seems likely that marula trees in the NCRs will in future be established much more actively and selectively than before.

Because mechanical juice extraction is still in its infancy, the commercial chains described below are more speculative (although based on credible figures). The major unknown at this stage is the price for fresh marula fruit – there is currently no trade in fruit in the NCRs, and consequently no set price (yet). At the moment the dissemination of the presses is still quite limited (and chances to use them are therefore not available in unlimited quantities), but it has been assumed that this situation will change rapidly and people will soon be able to rent a press as often as they need and can afford to do so.

3.5.1) Scenario 5: Tree owner, renting press, public transport, local and urban markets

Assumptions: A household owns 12 marula trees with an average annual production of 600 kg of useable fruit each – a total of 7.2 tons of marula a year. The fruits are of average quality and yield 30% juice when pressed. The production is spread out evenly over the main season, from end-January to end-April (12 weeks). Adult household labour is mainly tied up in agricultural production (and marketing omaongo) and can only afford to spend a few hours each day on marula, but children are available in the afternoon to help collect fruit into heaps. Some cash is available from a migrant member of the family to use as working capital – this money is used to buy buckets and plastic cans, rent a press, employ a young man to operate it and pay transport to the market (N$20 per return trip).

Sorting marula fruits into heaps is hard work (it has to be done in a bent-over position) and on average (based on experience) it takes about a minute to sort and pile one kilogram. The total labour required for this task is therefore 7 200 minutes, or 120 hours, or 15 days. In practice this labour is very often delegated to young children and probably takes longer. What is not known at present is the extent to which the press will be moved from tree to tree (it seems to be the preferred system, but requires additional labour to carry the press), or the fruit will be carried to the press (which takes more work but might be more efficient if many children are available to help). We have assumed that the press will set up in one position near the homestead and that children will bring fruits to the press. A child can probably carry at least 10 kg of fruit at a time (i.e. 720 trips) and each trip will take about 10 minutes (farms are small enough for this to be a reasonable figure, and maybe even an over-estimation). We have therefore doubled the sorting and collection time requirement to 30 days in total over the season.

Employed agricultural labour in the NCRs does not usually work a full 8-hour day – instead work in the fields starts early and goes on until the heat becomes unbearable – usually around 11h00, but on a cloudy day obviously longer. After a rest over mid-day, the afternoon is devoted to chores (including traditional omaongo processing). Since the marula season is in summer and rural life here proceeds according to daylight, not the clock, a working day is probably nearer ten hours in total. If a family rents a marula press it will obviously want to use the press for as long as possible. Marula pressing is also done in the shade of a tree, so heat is not such an issue. We have therefore assumed that an employed press operator will work a 10-hour day, but because it is relatively skilled labour he will be paid N$30/day.

If there are no disruptions to the workflow (e.g. mechanical problems, not enough fruit sorted) a press operator can produce about 15 litres of omaongo an hour. To produce 150 litres a day at 30% average yield he must process 500 kg of fruit. This implies that the family will have to rent a press 15 times during the season (i.e. on average once every 6 days, which is also feasible, since marula remains suitable for juice extraction for at least that long). We have used the higher rental figure of N$50/day. The press operator will obviously also need to be employed for 15 days. We have also assumed that the hydraulic jack will need to be replaced at least once during production, and that this will cost an additional N$250 (including a return trip to Oshakati). We made further provision for down-time and repairs by adding an additional two day of press rental and operator hire.

For the actual brewing of the omaongo we assumed that each batch of 25 litres would require about an hour of attention during production (skimming, decanting etc.) – 86.4 hours for a total production of 2 160 litres – say 9 days. Since omaongo production at this scale is currently very rare in the NCRs (in 2002 we found only one family that produced anywhere near this quantity, using a rented KAP press) we are not sure if this is an accurate figure, but it seems reasonable. We also assume that buckets and cans are replaced yearly.

Capital costs are:

7 x buckets @ N$20 ea.	140
7 x 25-litre plastic cans @ N$40 ea.	280
Funnel	20
Sub-total capital equipment	440

The annual production cost structure of this family enterprise will be as follows:

7 200 kg marula fruit		free
Collecting and sorting fruit	30 days @ N$16	480
Press rental	17 days @ N$50	850
Operator's wage	17 days @ N$30	510
Brewing	9 days @ N$16	144
Sub-total production costs		1 984

It is further assumed that a family member will travel by public transport to the nearest urban market to sell 50 litres of omaongo at a time and will take a whole day to do so – but 160 litres of omaongo will be consumed at home, so only 40 trips are needed. Marketing costs are calculated as follows:

Return trips to market (seller)	40 days @ N$20	800
Transport omaongo to market	40 x 2 cans x N$10	800
Sub-total marketing costs		1 600
Total production costs		4 024

Assuming the seller can sell half of the production at the full retail price (N$4/litre) and must sell the other half at the "rural" price of N$2/litre so that she can get home in time, we used an average price of N$3/litre. The income therefore is:

2 000 litres @ N$3/litre	6 000

The net profit over actual and opportunity costs is therefore N$2 024.

Of the total income, the following accrues to household labour:

Collecting and sorting fruit	30 days @ N$16	480
Brewing	9 days @ N$16	144
Return trips to market (seller)	40 days @ N$20	800
Net profit		2 024
Total household income		3 448

This amounts to a fruit price of N$0.48/kg. The income can be increased significantly by either holding out for the full retail price on the entire production, or by sending omaongo to urban markets in other parts of Namibia.

Effects on the five forms of capital:
Natural capital – marula trees are valued and protected, but seeds are no longer automatically dispersed to neighbouring homesteads; an incentive to plant more trees is created
Social capital – not as beneficial as common-work systems described above
Human capital – a valuable traditional skill is no longer practiced, but is replaced by a single individual skilled in operating mechanical equipment
Financial capital – processing creates 17 days of employment; the households creates self-employment and generates profits equal to more than four months of average cash income
Physical capital – the rental paid for the press helps to pay off its cost; the household generates sufficient income to buy its own press should it want to

3.5.2) Scenario 6: Press owner, buying fruit, own transport, local urban markets

This is a contra-factual model – we do not currently know if people will sell substantial quantities of marula fruit, or at what price. What we strongly suspect is that they will sell fruit of lower quality (rather than see it rot due to labour shortages). They would probably want to retain their own nuts (a topic people felt quite strongly about during interviews with key informants). Assumptions about sales are highly speculative, since there is currently no wholesale market and it is not sure that one seller can retail 200 litres a day. We have therefore calculated the costs and likely income first, and then the price such an entrepreneur could afford to pay for whole fruit in order to still make a reasonable enterprise income.

Furthermore, while it is hard to imagine the Namibian Government ever clamping down on traditional omaongo production (not least because the NCRs is the heartland of its support base and many of its senior members are enthusiastic omaongo drinkers) the informal production of alcoholic drinks is technically illegal and it is not so apparent that a commercial omaongo brewer such as the enterprise described here will be allowed to operate unhindered (especially if it starts seriously competing with individual women producers), unless it complied with all the regulatory controls applicable to commercial breweries.

Assumptions: An entrepreneur based in Ongwediva owns a pick-up truck and buys a KAP press. S/he operates with a 50 km radius of town and uses unemployed family labour to process 667 kg of marula a day on-site, and to sell 200 litres of omaongo a day in the urban market (six days a week for 12 weeks). The entrepreneur takes the seller to the market early in the morning and then drops the processor, two assistants and the press at that day's processing site. They work very hard for 10 hours a day to produce 200 litres of juice. In the evening the entrepreneur collects the press and the

day's production and then picks up the seller on the way home. Another family member supervises the brewing, decanting etc. on a full-time basis.

The press is bought cash (@ N$4 000) and is paid off over 4 years, at a financial cost of 20% per annum. Since the press itself is very durable and its lifespan is not known, no provision is made for replacement. Plastic production equipment is replaced annually. Premises are budgeted at the opportunity cost of renting out a single room in the NCRs for 3 months.

Capital costs:		
4x4 pick-up truck		paid, replacement in running costs
KAP press		1 400 (annually for 4 years)
7 x 200 litre plastic drums		2 100
16 x 25-litre plastic cans		640
Miscellaneous small equipment		300
Sub-total capital costs		4 440
Production and marketing costs (excluding fruit):		
Press operator	72 days @ N$ 35	2 520
Pressing assistants	2 x 72 days @ N$25	3 600
Seller	72 days @ N$30	2 160
Brewer	72 days @ N$20	1 440
Transport	av 60 km/day x 72 days x N$2/km	8 640
Premises	N$400 x 3 months	1 200
Cleaning materials	N$10/week	120
Sub-total production and marketing costs (excl. fruit)		19 680
Total costs (excl. fruit)		24 120
Potential income	200 litres x 72 days x N$4/litre	57 600
Gross profit (excl. fruit costs)		33 480
Desired enterprise income (25% of income)		14 400
Money available for fruit purchases		19 080

To reach the projected level of production the enterprise will have to process 72 x 667 kg of fruit – or 48 024 kg in total. The maximum price it can pay for fruit is 39c/kg (compared with an effective fruit price of 47c/kg calculated in Scenario 5 above). Since the production assumptions are quite optimistic it would probably be advisable to offer considerably less, at least initially.

The main risks are that people sell such sub-standard fruit that the juice yield is far below the projected 30% and/or the daily production is much lower than 200 litres (the maximum reported during 2002) and/or the quality is so bad that the premium price of N$4/litre cannot be realised, and/or the transaction costs of negotiating and securing an adequate fruit supply on a daily basis are higher than the projected enterprise income. On the other hand, if the quality is acceptable and the enterprise can access urban markets outside the NCRs, the income might be considerably higher.

Projected effects on the five forms of capital:

Natural capital – marula trees are valued and protected, but nuts are not automatically distributed to neighbouring homesteads; an incentive to plant more trees is created
Social capital – relations of production are placed on a commercial footing
Human capital – entrepreneur and employees acquire additional business acumen
Financial capital – tree owners have a market for surplus fruit that might otherwise have gone to waste; entrepreneur earns considerably higher-than-average cash income
Physical capital – the enterprise can afford to cover its recurrent capital replacement costs

4) Marula kernel and oil commercial chains

4.1) *Omahuku* and *ondjove*

Omahuku is the Oshiwambo name for marula kernels, and *ondjove* is the traditional oil extracted from this (ondjove is prepared with added salt and usually retains a significant proportion of nutmeat, so that it often resembles a very oily nut sauce, rather than a pure vegetable oil). The oil cake left in the mortar after ondjove production is known as *eedi* and is relished as a snack and a food additive, but is currently not commercialised to any significant extent.

The high-protein, oil-rich kernels are an extremely important source of supplementary nutrition in the cereal-based diets of the NCRs, especially during the "hunger gap" of the late dry season and early rainy season. But marula kernels and their oil are much more than this: they are among the very few real luxuries that a poor rural family can prepare for guests. Another such luxury is meat, and the dish that is traditionally served to honoured guests in the NCRs is chicken cooked with ondjove. This tradition is also a primary driver of the local informal trade in omahuku and ondjove. The fascinating cultural traditions and folklore associated with omahuku and ondjove are discussed at length by Botelle (2001).

Den Adel (2002) found that 100% of NCR households used omahuku and ondjove in various ways, and that the commercialisation of marula kernel and its products was more socially accepted (62% of households sold omahuku and 38% of them started selling more than 10 years ago) than that of omaongo (only 40% of household sold omaongo, 46% of these had only started selling in the past two years and only 25% of sellers have been doing so for more than 5 years).

She also found that the production of omahuku was much more of a household-level activity – often involving the children to a significant extent after school hours – than making omaongo (only 20% of households occasionally – usually when they were preparing for a wedding or other big event – received help from neighbours, who had to be rewarded with food and drink). This stands to reason, as marula fruit for omaongo production is most conveniently produced in the shade of a marula tree, but the nuts are then taken into the homestead (of whoever helped to process the fruit), dried in the sun, and only processed later (traditionally in the agricultural off-season after the main harvest, but actually at any time that kernels are needed). Most households prefer storing the nuts and decorticating them as required. As pointed out above, this practice of drying and storing nuts in the homestead plays an important role in the seed dispersal and propagation of marula.

Nuts are never sold, but sometimes given away for decortication. Most of the nuts decorticated are those from the fruit that had been processed for omaongo, but nuts from rotten fruits are also sometimes collected from under the trees (especially from those marula trees that have sour, dry fruits but big kernels). Women have an intimate knowledge of the fruit and nut properties of the trees under their management, or in their area.

4.2) Extracting o*mahuku*

In the former Owamboland there are hardly any stones. Unlike in some other parts of Southern Africa, where marula nuts are cracked between two stones (sometimes after being boiled and dried), the traditional way to extract omahuku in the NCRs (and in parts of Zimbabwe) is to cut the nut open on an axe blade. This done by sitting down with the axe under the legs and the blade sticking up between them, holding the "head" (operculum side) of the nut on the blade and striking it with a short, heavy stick – two or three blows are usually enough for an experienced cutter. The kernels are then dug out with a flattened nail or needle (*oyuvela*).

Den Adel (2002) reported that the cutting was usually done in the morning by an experienced member of the household (or even by a hired worker with special skill in this task) and the kernels extracted in the afternoon with the help of school-age children (who were allowed to snack some of the kernels while they worked). All households sometimes extracted kernels, but those that had more female labour available and were more involved in kernel sales did so more often, and in larger quantities. The average quantity extracted per household was 36 kg (SD+/- 26 kg).

In a controlled test to determine the productivity of the traditional extraction methods, six women were asked to decorticate 5 kg of marula nuts each. The results are tabulated below:

Table 1

Name	**Time to cut 5 kg nuts**	**Time to take out kernels**	**Total time to extract kernels fom 5 kg nuts**	**Kg of kernels from 5 kg nuts**	**Calculated time to extract 1 kg of kernels**
Johanna	1h45	2h24	4h09	0.528	7h51
Selma	2h00	2h15	4h15	0.512	8h18
Aino	2h19	2h41	5h00	0.597	8h22
Otilie	2h27	2h14	4h41	0.554	8h27
Ina	2h05	2h31	4h36	0.576	7h59
Leticia	2h22	2h39	5h01	0.609	8h14
Average	2h10	2h27	4h37	0.563	8h12

Since there are so many variables in the time-efficiency of omahuku production, a figure of 8.2 hr/kg for extraction (using the Namibian method) is regarded as fairly reliable.

4.3) Selling *omahuku*

Among the households surveyed by Den Adel (2002) 14% sold only from home, and 37% only in local markets – in both instances the price is fixed (by local custom) at N$2/500 ml oil tin, or about N$8/kg. Almost exactly the same percentage of households (52%) sometimes bought kernels, but usually only a few tins at a time. On special occasions 23% of households have bought larger quantities (10-100 tins). On 20 tins or more it was sometimes possible to negotiate a lower price of N$1/tin. Only one household – consisting mainly of small children and headed by an elderly woman who could no longer see well enough to extract kernels – reported buying kernels regularly.

The transaction costs of selling in local markets were not quantified, but personal observations suggest they are high – unlike omaongo, which has a festive air around it and is consumed in large quantities, omahuku is delicious but a little goes a long way. In local urban markets in the NCRs omahuku was often for sale along with other local products (e.g. dried *Berchemia* fruits, mopane

worms or *evanda* – dried patties of local greens). By contrast, all omaongo sellers seemed to be completely specialised.

Among the surveyed households 35% sold omahuku only to the Eudafano Women's Cooperative (EWC). The current EWC price is N$17/kg (N$4.25/tin). To access this market sellers must be members of one of EWC's marula producers associations. Marketing through EWC (primary intakes are actually handled by producer association in 12 localities in the NCRs) is time-efficient, but is controlled by a household/member quota (due to a currently limited market for the newly commercialised cold-pressed marula oil) and has the drawback that there are only two intakes a year and payment is delayed.

Fourteen per cent of sellers sold to EWC and locally. For these producers the lower price in local markets was offset by the fact that the money was available immediately. It is also likely that they had exceeded their EWC household quota.

An obvious question is whether EWC members do not use their greater market access to buy kernels from their neighbours at the local price and resell for a quick 100%+ profit to EWC. The simple answer is that they can make more money selling their own kernels, and – as Den Adel (2002) found – the idea of profiting from one's neighbours is almost universally rejected in the NCRs (at least, it still is at this stage). What sometimes happens – and this is virtually impossible to quantify – is that a relatively cash-flush EWC member will "buy" kernels from another member who needs cash urgently, but as far as can be established this is done at the market price, as a form of social security and mutual assistance.

4.3.1) Scenario 7: Kernel production for local and national markets

Assumptions: Nuts are available as a by-product of omaongo production and are taken to the home to produce oshinwa, therefore no direct costs are incurred for raw materials. Sellers are already travelling to the markets to sell other products, or sell opportunistically from home to neighbours.

At 8.2 hr/kg extraction time and N$2/tin (N$8/kg) local price the return to labour is N$0.98/hr – less than half the calculated opportunity cost of labour in the NCRs even if marketing effort and travel costs are excluded, but still better than no income at all. There was no price premium in urban markets in other parts of Namibia either.

Effects on the five forms of capital:
Natural capital – some of the nuts taken to other homesteads will germinate and contribute to the spread of marula trees
Social capital – the distribution of "free" nuts strengthens social ties
Human capital – a valuable traditional skill is practiced and perpetuated
Financial capital – a small income opportunity is created for people who have no alternative
Physical capital – no significant effects

4.4) Making *ondjove*

Ondjove is produced by pounding omahuku in the traditional wooden mortar and pestle used for grain processing (often after roasting the kernels lightly, and usually with some salt added). At a certain stage in the process (and telling exactly when this stage has been reached is a large part of the skill of efficiently making good ondjove) a small quantity of warm water is added to the paste and the pounding motion of the pestle is turned into a gentle rolling action, which forces the ondjove to the top of the nut paste, from where it is carefully poured off.

Of all the traditional production activities around marula, ondjove production is the most skilled and the most unpredictable. A relatively experienced oil extractor can usually – from good kernels – get about 200 ml of oil from 1 kg of kernels in one hour, but the yield can be substantially lower and/or the time substantially longer (down to no oil at all) if she is not very experienced. Yield is also affected by ambient temperature, the temperature and quantity of water added (relative to the characteristics of the omahuku being processed), timing and the action of the pestle. For this reason most ondjove producers have a strong preference for kernels they know.

4.5) Selling *ondjove*

In "modern traditional" Owambo cuisine ondjove is used more as a condiment than as a cooking oil. This is partly because of the easy and widespread availability of cheap sunflower and other industrially produced vegetable oils, and partly because ondjove is very rich – a little goes a long way.

Since the vast majority of the people in the NCRs are poor or very poor, with other, more pressing uses for such cash as they have, ondjove is usually only purchased in small quantities when it is urgently needed to entertain guests, or by those relatively few people who have paid jobs but no time to make their own ondjove. The product is therefore usually available in most informal markets in the NCRs, but never in large quantities. It is also sold packaged in small quantities – the customary container is a "nippy" (a small liquor bottle of either 200 or 250 ml). A nippy of ondjove cost N$15 in the NCRs and in other parts of Namibia. A nippy can sometimes be bought for N$10-12, but this exceptional (price inflexibility is a common feature of commercialised traditional products in the area).

Ondjove is traditionally a special or festive food, given to honoured guests as a token of esteem, and to the household only as a special treat. It is a common gift sent by rural people to their relatives in working in urban areas, partly because it is so highly appreciated, and partly because it is easy to transport. There are reasons to believe that the urban ondjove trade outside the NCRs is becoming more substantial, mainly because more of its traditional users nowadays have larger disposable incomes, and partly because the skill required to make it is in decline, as more and more young people turn away from their traditional ways. In the final analysis Namibia's population is just too small, and its income distribution too skewed, for there ever to be a large national market for a food oil, however delicious, that sells at N$60 to N$75/litre.

4.5.1) Scenario 8: Ondjove production for local and national markets

The extent of the local trade in ondjove has not been quantified, but observations in informal markets suggest that it is much less commercialised than omahuku, and insignificant compared with omaongo. It takes 1 kg of omahuku (worth at least N$8, and potentially N$17) and one hour of skilled labour to make ondjove worth at most N$15. The quantities produced are also so small that the marketing costs are relatively high.

Assuming that a woman who really knows how to make ondjove spends a whole a day on this chore, she can turn 8 kg of omahuku worth N$64 into 1.6 litre of ondjove worth N$120. If she could sell her production efficiently, she could theoretically make a daily income of N$56 – or 350% the minimum opportunity cost of labour as calculated above. However, if she has to spend two or three days and N$20 to N$40 marketing her production (as she might well have to) she effectively earns somewhere between N$12 and N$4 a day – and if she is skilled at ondjove production she is probably also skilled at other, more lucrative activities.

Effects on the five forms of capital:

Natural capital – no significant effects beyond a general appreciation of marula trees
Social capital – little effect
Human capital – a valuable traditional skill is practiced and perpetuated
Financial capital – a small income opportunity is created for people who have no alternative, but better-paid work is probably available
Physical capital – no significant effects

5) Cold-pressed Marula Oil Commercial Chain Analysis

There are several difficulties in carrying out a commercial chain analysis (CCA) on marula oil, and these include:

- The marula oil commercial chain for formal market products is extremely new and evolving, and as such represents a moving target;
- Some required information (such as volumes, schedules and processed product prices) is commercially sensitive and as such is not appropriate to document for public consumption.
- There are no directly comparable commercial chains with appropriately similar features, making comparisons and judgements about "winners and losers" questionable.

Therefore, marula oil not necessarily ideal for a CCA.

5.1) Background:

Marula oil has in recent years undergone a process of research and development and other investigations. This has resulted in a small niche market for cold pressed, RBD[5] marula oil as a cosmetic ingredient. The use of marula oil confers to personal care products moisturising features, protection against transepidermal water loss, and improvement in skin smoothness (Houghton, 1999) and uniqueness. Other functional features of marula oil are under research and development (CRIAA SA-DC, in preparation).

Marula oil in Namibia is produced in a partnership between Eudafano Women's Co-operative Ltd. (EWC), Katutura Artisans' Project (KAP) and CRIAA SA-DC. EWC are responsible for the production and management of the raw material (marula kernel), processing of kernel into oil is carried out by KAP, and CRIAA SA-DC provide management services to both EWC and KAP. These services include financial, logistical and management (including marketing). CRIAA SA-DC and KAP are contracted by EWC to provide these services, and marula oil from Namibia is exported in the name of EWC. This is an important intangible benefit that is difficult to quantify! In the development phases of the commercialisation of marula oil these service costs were provided by the public sector, and in the fully commercialised business operation of marula oil export all costs associated with such services would be recovered from revenue from sales. As the management capacity of EWC increases processing responsibilities and associated value-addition will be transferred from KAP to them[6].

EWC is a registered multipurpose service co-operative comprising 12 village associations throughout the marula-rich areas of northern Namibia. These 12 associations comprise some 3 500 women.

5.2) Discussion on some factors affecting the cost of marula oil:

Marula oil is expensive in comparison to most other speciality lipids used as ingredients in cosmetic products. The reasons for this are the high cost of production and the small scale of production and

[5] Refined, bleached and deodorised
[6] Other "privatisation" scenarios are under discussion and seem possible and desirable, but discussion hereof falls outside this scope of this report

sales against which to amortize these costs. The production costs are influenced by, *inter alia*, raw material costs, processing efficiency, processing costs and storage, quality control measures, management and financing. Presently crude marula oil is exported to a refiner in the UK. The cost and freight (C&F) charge for the crude oil in the UK must also include shipping and documentation charges.

It is not appropriate to supply pricing details in this report. However, the following percentage breakdown of a recent scenario and C&F price / kg can be provided as a guide.

Table 2:

Cost Item	% of C&F / UK
Total of raw materials[7]: including primary producer payment of N$17/kg, producer association logistics, association transport costs, EWC co-ordination and logistics, transport to Windhoek, handling and re-bagging	46.67
Processing and storage: all direct costs incurred by contract processor of crude marula oil	18.84
Quality control measures: external laboratory services, sampling, associated consumable, etc.	3.33
Export: documentation, packaging, loading and international freight charges	6.84
Financing: bank interest charges and other financial management requirements	3.68
Contingencies: covers various unforeseen costs	3.97
Management: raw material procurement, processing, storage, QC, freight, processing R&D provision, market liaison, promotion and development	16.67
TOTAL	100

Marula kernel decortication is labour-intensive and results in an expensive raw material. Primary producers in northern Namibia obtain N$17 / kg.

The system of collation of marula kernel from a large number of rural women in remote areas, transportation to Windhoek (some 750km), handling, etc., can lead to losses of raw material of around 5%.

Marula kernel, which is very oil rich (55-60%), is, paradoxically, difficult to extract. A low fibre content, and the oily nature of the raw material, creates significant difficulties in processing with screw-press technologies. The marula oil presently produced in Namibia is cold pressed using a hydraulic-powered batch press (developed at KAP and called the KAPMOND30T). This is a simple and robust technology, but is inefficient in terms of oil yield per kg of kernel[8], and in terms of rate of extraction (the number of kg of raw material produced over a period of time).

Cold pressed marula oil requires settling and filtration to remove suspended particles. This can lead to losses of 5 – 7.5 %, depending on various factors[9].

[7] Oil-bearing marula kernel
[8] Other more efficient technologies are under investigation
[9] Including ambient temperature and storage temperature

In order for marula oil to be used in most cosmetic formulation it is necessary to remove impurities and other undesirable components. Although crude marula oil has exceptional resistance to oxidative rancidity, it does suffer from hydrolytic rancidity – a feature shared with rice bran oil (Gringras, 2000). Hydrolytic rancidity is a degradation process whereby the oil (triglyceride) is attacked by lipase, or moulds, breaking it down into free fatty acids (measured at FFA[10]), diglycerides and monoglycerides. Removal of these breakdown products is necessary, and this is done by neutralisation of the free fatty acids, and other products in a standard refining procedure (De Greyt *et al*, 2000).

Removal of these components can result in significant losses that ultimately affect the cost of the oil as an ingredient for manufacture. The scale of these losses are affected by various factors such as:

- The level of free fatty acids, diglycerides and monoglycerides, and other impurities, in the crude oil;
- The skill and physical equipment of the refiner.

With sufficient attention to, and management of, parameters that affect hydrolysis in the marula kernel and crude marula oil, it is possible to produce crude marula oil on a commercial scale with an average free fatty acid level of less than 4.25%. At this level of hydrolysis, and assuming suitable skills and equipment of the refiner, refining losses should be less that 15%[11].

5.3) Processing and other steps between crude oil production and consumer product:

Table 3:

Processing step	Agent
Production of crude oil	KAP (for EWC)
Storage, settling and filtration	KAP (for EWC)
Quality checks	KAP / CRIAA SA-DC (for EWC)
Re-packing	KAP (for EWC)
Documentation and handling / containerisation	KAP / CRIAA SA-DC (for EWC)
Transport to refiner	CRIAA SA-DC (for EWC)
Quality checks	Refiner (for end client)
Refining (neutralisation, bleaching and deodorisation)	Refiner (for end client)
Packing and storage	Refiner (for end client)
Transport to manufacturer	Refiner (for end client)
Manufacture of consumer products	Contract manufacturer (for end client)
Distribution	End client
Retail	End client

There are several issues that can easily be hidden in a simplistic table like the one above. These relate to issues of influence and power in the chain, and who bears responsibility for quality and financing costs in the transition along each processing step. These are worth quick consideration, and include:

- The quality (in terms of FFA, in this example) is determined at various levels along the chain – right from primary producer level, through to the skills and physical equipment of the refiner. Quality affects yields, and therefore costs. Identifying roles and responsibilities, and developing workable and collaborative solutions, are difficult and time consuming.

[10] Free Fatty Acid = C X VP / M %, where V is the volume of the standard alkali used, P is the normality of the standard alkali, M is the mass of the test portion and C is one-tenth of the molecular weight of the appropriate fatty acid, such as oleic

[11] A rule-of-thumb measure for oils with a composition similar to marula is that losses should be within 3XFFA, for eg: an oil with FFA2 should be neutralised with losses of around 6%.

- More basic value can be captured by Namibian stakeholders if crude marula oil was refined in Namibia. However, careful consideration of the necessary physical equipment, process skills and associated assets and services would be needed. Even if this were technically and financially feasible, it may not be commercially prudent and would carry risks that may not be captured in typical feasibility studies.
- Whether the refiner is a "toll" / "contract" refiner, as opposed to a client for the crude oil, can affect the end cost to the manufacturer and hence the retailer. This can also influence the power / influence relationships along the chain. If the refiner is a toll or contract refiner the crude oil supplier is more likely to have recourse to the end client in case of dispute than if the refiner were the final purchaser of the oil and the end clients not been known to the crude oil supplier. There are many permutations herein and these deserve unpacking in the discussion of "winners and losers".
- At different stages of the process the responsibility for financing changes hands. Marula kernel and oil production is cash-intensive due to the high cost of the raw material and oil, and because of the slow rate of processing (which delays receipt of revenue once commitments to primary producers of raw material have been made).

5.4) Winners or losers?

There are many angles from which to approach this question (including a complete re-conceptualisation of the question!). In keeping with the spirit of this research question, though, we can briefly look at what might represent suitable routes to some form of an answer.

For the NGO community working around issues relating to the Convention on Biodiversity there has been a trend to look at "benefit sharing" arrangements, and at looking at the percentage of the retail value of the consumer product captured by the primary producer (Bell, 2000). Consideration of the small percentages in which ingredients like marula oil might be included in the formulation of cosmetic products (see Annex 1) will at a glance show that the percentage of the retail value of the consumer product likely to be captured by the primary producer is very small. However, this is unlikely to help researchers understand whether the primary producers, or their local enterprises, are winners or losers from any given commercialisation process.

If, however, we consider the practical benefits primary producers, and their local enterprises, could realistically derive from the commercialisation of their traditional resources, we come to a set of question that focus on seemingly prosaic questions. These could include:
- Do the primary producers, and their local enterprises, have access to relevant and independent technical and commercial advice?
- Is the supply chain configured in the most rational and commercially effective way?
- Does the customer pay for the consignments in a mutually agreed schedule?
- Is the paying price commercially sufficient?
- Do the primary producers, and their enterprises, have recognition by the end client, and can the primary producers, and their enterprises, be positively exposed to the consumer?
- Is there a meaningful commitment to purchase appropriate volumes of the product in the short, medium and longer term?
- Are the relevant players in the commercial chain committed to supporting commercially viable transfer of value-adding opportunity closer to the primary producer?
- Are there agreed and workable product / quality specifications, and is there appropriate tolerance by relevant parties to difficulties in meeting specifications?
- Is there realistic and flexible understanding by all stakeholders of the numerous difficulties involved in commercialising new products based on traditional resources?

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ANNEX 1

Examples of Cosmetic Formulations Showing Percentage Inclusion of Various Ingredients

Croda Oleochemicals – Collagen Boosting Lipstick C2191		
Ingredients	**Manufacturer / supplier**	**% by wt**
Procas H3 (PPG-3 Hydrogenated Castor Oil	Croda	49.0
Supermol S (Pentaerythrityl Stearate / Caprate / Caprylate / Adipate	Croda	14.0
White Beeswax (Cera Alba)	-	7.0
Candelilla Wax (Candelilla Cera)	Poth Hille	5.0
Crodamol ML (Myristyl Lactate)	Croda	4.0
Absorption Base CB1145 (Mineral Oil (and) Lanolin Alcohol (and) Oleyl Acohol)	Croda	4.0
Carnuaba Wax (Copernica Cerifera)	Poth Hille	3.0
Ozokerite Wax	Poth Hille	2.0
Crodamol SS (Cetyl Esters)	Croda	1.0
Maxi-lip (Octyl Palmite (and) Tribehenin (and) Sorbitan Isostearate (and) Palmitoyl Oligopeptide)	Sederma	1.0
Pigment:Timica Silk White (Mica (and) Titanium Dioxide)	Cornelius	6.4
Pigment: Ariabel Rubicon (C115850:1)	Warner Jenkins Europe	3.6

Source: *Formulation Directory and Exhibition Catalogue, Society of Cosmetic Scientists - Formulate, 5-6 December 2000*

Croda Universal Ltd. – Avocadin Cream C1776M2		
Ingredients	**Manufacturer / supplier**	**% by wt**
Avocadin (avocado oil unsaponifiables)	Novarom	5.00
Crodamol IPP (isopropyl palmitate)	Croda	7.50
Crodamol CAP (cetearyl octanoate)	Croda	2.00
Silicone 200/100 cS (dimethicone)	Dow Corning	0.50
Crodacol CS90EP (cetearyl alcohol)	Croda	2.50
Crosterene SA4310 (stearic acid)	Croda	0.50
Mineral oil (25 cS at 25°C)	-	5.00
Cithrol GMS N/E GE0803 (glyceryl stearate)	Croda	1.00
Cosmowax D (cetearyl alcohol & ceteareth 20)	Croda	2.10
Crillet 3 (Polysorbate 60)	Croda	2.50
Deionised water	-	to 100
Propylene glycol	-	2.00
Triethanolamine 99%	-	0.20
Perfume, preservative, colour	-	Sq

Source: Coupland, K. and Nichols, J.A. (no date) *Lipids – Their Use in Personal Care Products*