Wood utilisation in the Moya Region of Anjouan, Comoro Islands: volume, value and implications for biodiversity

ONG Dahari, final version August 2021

Wood utilisation in the Moya Region of Anjouan, Comoro Islands: volume, value and implications for biodiversity

Gill Shepherd, Misbahou Mohamed, Nastazia Mohamadi, Nadia Keldi, Hugh Doulton

In collaboration with Initiative Développement

Dahari, Mutsamudu, Anjouan, Comoro Islands

August 2021

Index

Charts

Executive Summary

The purpose of this study is to understand and as far as possible measure wood utilisation in the remaining most forested part of Anjouan around the Moya forest, and to assess the implications of that use on the prospects for biodiversity, now and in the future.

It is composed firstly of an analysis of fuelwood data collected by the NGO Initiative Développement (ID) in 2017 in the villages of Nindri, Kowe, Lingoni, Pomoni and Moya. In addition to a qualitative questionnaire conducted with 39 households, fuelwood and kerosene use were measured over four days in 25 households so that average per capita consumption figures could be arrived at.

Secondly the study reports on data collected by Initiative Développement during 2013-2015 to indicate the types and volumes of fuelwood used by the ylang-ylang distilleries in the region.

Thirdly it analyses the results of Dahari's own research, conducted mainly during 2019, into the felling of timber trees for small enterprises making furniture and doors, for house construction and for the making of the small outrigger canoes used by Comorian fishermen for daily inshore fishing.

Fourthly it reports on preliminary work undertaken on charcoal production and sale

Taken together, the four separate sets of data show how a hierarchy of wood-use decisions has developed which spares the most valuable trees for the production of the highest value goods, and substitutes many planted agroforestry trees for lower value employment in house construction. Woodfuel for ylang-ylang distillation comes almost entirely from agroforestry species found in farmers' fields and about three quarters of domestic fuelwood comes from the same source. Charcoal is produced from indigenous tree species still standing in farmers' fields, from the residues left after high-value hardwoods have been felled in the forest, and from mango trees.

Volumes of wood being removed from the Moya region are enormous. In the case of domestic fuelwood, it is calculated that about 13 tonnes a year is currently being used on the basis of the evidence collected by Initiative Développement. In the case of ylang-ylang distilleries, something like 3,300 tonnes a year are being consumed. The region's 36 woodcutters fell around 1200 trees a year for commercial purposes, selling the timber they cut and transforming it into planks and 'chevrons' (rafters) for furniture, house construction and the making of outrigger canoes. The value of the transformed timber, together with the value of outrigger canoes was calculated at about $400,000 per annum. This excludes the value added when planks and chevrons are made into furniture and doors and sold on again. It also excludes the prices or shadow prices of trees felled by householders themselves for their own private use or sale. We have not so far been able to quantify either of those components, but they clearly bring the overall value of the timber component of this study to well over half a million dollars a year.

Despite the very valuable protective role, overall, being played by agroforestry species, there is strong evidence that some of the most valuable indigenous and endemic tree species are disappearing fast.

Dahari's efforts to protect the remaining forest, to raise and replant indigenous species, and to enhance the numbers of agroforestry trees in farmers' fields, are of vital importance for the future of the island's biodiversity and the preservation of watersheds.

Wood utilisation in the Moya Region of Anjouan, Comoro Islands: volume, value and implications for biodiversity

1. Introduction

The purpose of this study is to understand and as far as possible measure wood utilisation in the remaining most forested part of Anjouan around then Moya forest, and to assess the implications of that use on the prospects for biodiversity, now and in the future.

It is composed firstly of an analysis of fuelwood data collected by the NGO ID (Initiative Développement) in 2017 in the villages of Nindri, Kowe, Lingoni, Pomoni and Moya. In addition to a qualitative questionnaire conducted with 39 households, fuelwood and kerosene use were measured over 4 days in 25 households so that average per capita consumption figures could be arrived at. Secondly the study reports on data collected by Initiative Développement during 2013-2015 to indicate the types of fuelwood and volumes of fuelwood used by the ylang-ylang distillation plants in the region. Thirdly it analyses the results of Dahari's own enquiry, conducted mainly during 2019, into the felling of timber trees for small enterprises making furniture and doors, for house construction and for the making of the small outrigger canoes used by Comorian fishermen for daily inshore fishing.

Conducting field interviews (Credit: Dahari)

Section 2 considers domestic fuelwood, Section 3 fuelwood for ylang-ylang distillation, and Section 4 the use of forest and other timbers for furniture, doors, house construction and outrigger canoes. Section 5 attempts to calculate volumes of wood removed for all these purposes, the monetary value of construction timber, and impacts on biodiversity.

2. Fuelwood use in Moya Region

2.1 Typical household sizes in the region

A total of 39 households were interviewed, located in Nindri (5), Kowet (8), Lingoni (6), Pomoni (5), and Moya itself (15). The villages and individual households were selected as part of an Anjouan-wide survey conducted by the NGO ID (Initiative, Développement) in 2017.

A series of qualitative questions about cooking and eating, fuelwood collection, favoured fuelwood tree species, types of firewood mainly collected, and typical locations for collection were asked.

In addition, in the case of 25 of the households, fuelwood and kerosene use were measured over 4 days, so that an average per capita consumption picture could be built up.

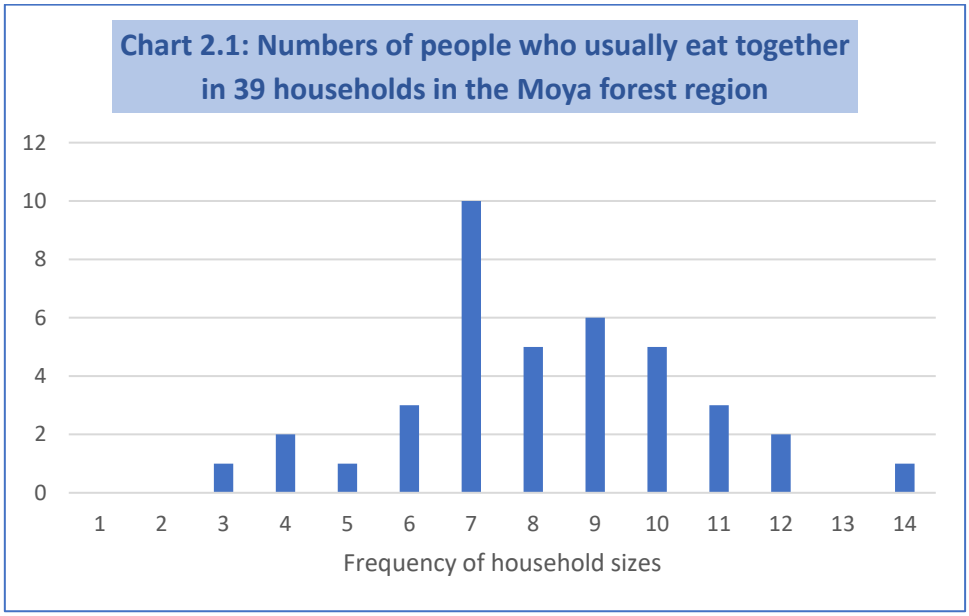


Chart 2.1 shows the distribution of household sizes. Small households are rare and households typically contain 7-10 persons, of whom 2 or 3 are adult and the rest children up to the age of 15. The largest household sampled contained 14 members who ate together.

The total number of individuals in the households sampled come to 319, so an average household size in this sample is large - 8.2.

2.2 Fuelwood consumption and cooking methods

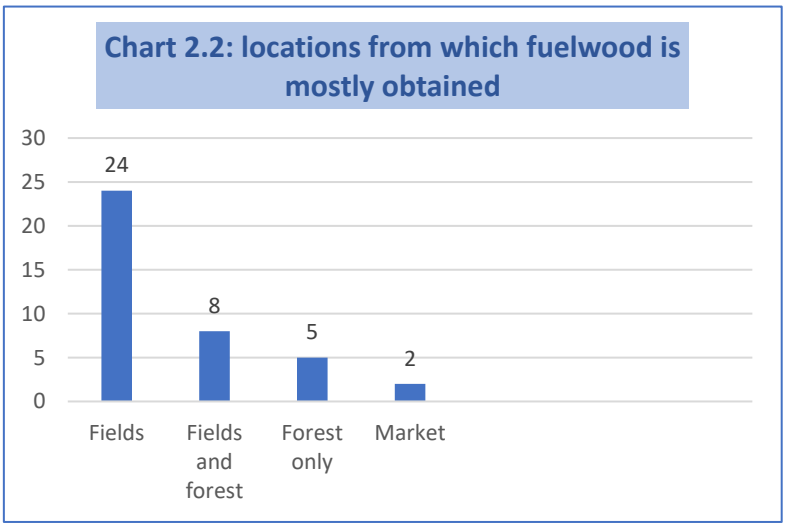
Two thirds of households exclusively used fuelwood for cooking while at least a third of households supplemented with kerosene. Eighty-two per cent of households said they used more wood during the rainy season than they did at drier times, and 41% also cited Ramadan, weddings and Maulidi (the celebration of the Prophet's birthday) as times when extra cooking called for extra fuelwood. Only one household claimed to cook simply on three stones when using fuelwood, and all other households, cooked on a 'fer a béton' fuelwood stove replaced every 6 to 12 months. Those who used kerosene, used a type of stove with a mantle or wick (mèche) which needed replacing after 3-6

months. They too increased their usage at times of celebration, when more extensive and complex cooking went on.

In this sample charcoal use was fairly rare, but six out of thirty-nine households said they sometimes used it, buying small bags that lasted only a day or two. LPG gas was never used and nor was dung.

2.3 Collecting fuelwood: location and time taken

Households were asked where they mostly obtained their fuelwood. Chart 2.2 shows that 62% (24) derived their fuelwood from their own or others' fields, 20% (8) gathered it from both fields and forest, 13% (5) gathered it solely from the forest and 5% (2) bought it in the market. Thus, about a third of households in this sample still extract at least some fuelwood from the forest. The remainder (bought in the market) of course comes from one of these two sources too.



Fuelwood collection is mostly undertaken by mothers and their children, though fathers also had a role in a third of households (12).

Chart 2.3: Those who collect fuelwood					
Mother + children	**Whole family**	**Husband and wife**	**Wife alone**	**Husband alone**	**child alone**
21	**7**	**3**	**3**	**2**	1

Respondents said that they spent from 3-5 hours a week on fuelwood collection, in anything from 1-5 trips. (Fuelwood collection is often a side-aspect of work in farmers' fields). When asked if collection times were slowly getting longer, everyone said that they were.

2.4 Preferred fuelwood species

Chart 2.4: Fuelwood species preferred and collected

Botanical name	Local name	1st choice	2nd choice	3rd choice	4th choice	5th choice	TOTALS
Mangifera indica	Manguier/Mmanga	16	10	2	2	1	**31**
Litsea glutinosa	Mbouchi or Mzavoka maro	8	10	5	3	1	**27**
Syzygium aromaticum	Mkarafou (cloves)	4	6	7	2	1	**20**
Cananga odorata	Ylang ylang	4	2	2	5	1	**14**
Pterocarpus indicus	Sandragon/msandrago/mbaruti		1	2	9		**12**
Cocos nucifera : coconut shells/coir	Mavindro		1	4	2	4	**11**
Nuxia pseudodentata	Moiha/Mwaha	3	3	4	1		**11**
Albizia saman	Msiro	1		4	2		**7**
Psidium Guajava	Mvwera (guava)		2	1		1	**4**
Artocarpus altilis	Fruit a pain/ breadfruit		1	1	1		**3**
Persea americana	Mzavoka (avocado)	1		1			**2**
Rheedia anjouanensis	Mkora		1	1			**2**
Cocos nucifera: dried portions of the tree	Cocotier seche					1	**1**
Cocos nucifera: small immature coconuts fallen from the tree	Coumbi				1		**1**
Eucalyptus robusta or E. staigeriana	Mkinini or MKalkis					1	**1**
Cocos nucifera: inflorescences of the coconut palm	Masangari					1	**1**
Senna floribunda	Mikalakatsa	1					**1**
Acacia auriculiformis	Mkassia			1			**1**
Weinmania comorensis	Mkindrikindri			1			**1**
Acacia farnesiana	Mougou				1		**1**
Cajanus cajan, (Pigeon pea)	Moutsouzi			1			**1**
Phyllanthus pervilleanus	Mroundra/Mouroundra ntsole					1	**1**
Unknown – maybe interview error ??	Mouhaba				1		**1**
Unknown – maybe interview error ??	Mvesa		1				**1**
Unknown – maybe interview error ??	pindre			1			**1**
		38	38	38	30	13	157

Among the first dozen species that crop up again and again in informants' top five species for fuelwood, are many trees which are already being grown for another purpose on farmer fields. Fruit trees such as mango, guava, breadfruit, and avocado are available for fuelwood when they lose a branch or come to the end of their lives, and the same is true of commercial tree-crops such as cloves and ylangylang. Coconut trees are an essential part of fuelwood supplies. Coconut shells and the coir surrounding them are an excellent fuel, and a few other non-timber parts of the coconut are used as well (coconut tree components highlighted in green in Chart 2.4). Some are imported exotics planted originally for fast growing fuelwood for ylang ylang distillation and the home. These include sandragon (Pterocarpus indicus), msiro (Albizia saman) and mkassia (Acacia auriculiformis). Very few indigenous trees appear among those species used for domestic firewood, though mwaha (Nuxia pseudodentata) is an exception. Informants were asked why they had chosen the species they mentioned, and they replied in all cases that it was because these species were (a) easy to obtain, and (b) burned well.

2.5 Characteristics of trees chosen for fuelwood

Given the fact that much fuelwood comes from farmers' fields, often with some tree crops within them, it is not surprising that quite a lot of fuelwood comes from larger trees. Wealthier households would probably be able to make more use of their own trees in this way, while poorer households would be more likely to collect their fuelwood from smaller trees.

Chart 2.5: Sizes of trees generally used for fuelwood

Tree size	no.	%
Often make use of larger trees for fuelwood, only sometimes using smaller ones	2	6%
Sometimes use larger trees for fuelwood and sometimes small	18	51%
Never cut fuelwood from large trees - only ever from small trees	15	43%

Eighty nine percent of respondents said that they only ever used dead wood for fuelwood (which in any case is attractive for having a much lower moisture content) while 11% did cut live wood at times (if no dead wood was available, presumably).

2.6 Fuelwood sources

Interviewees were easily able to name the locations (lieux-dits) in the forest or in the fields from where they usually collected fuelwood. (Chart 2.6).

It is note-worthy that in the case of 12 of the 39 households interviewed (31% of the total), collection was from the fields of others. This would be an interesting topic for further investigation. Are the fields made available to neighbours or dependent relatives without their own fuelwood resources by their better-resourced owners? Are they essentially abandoned fields, from which anyone may gather fuelwood? Or do those with few resources steal fuelwood?

Chart 2.6: Where do you get your fuelwood from?				
Inter-viewee no.	**Town/village**	**Forest 'lieux-dits' (named localities)**	**'Lieux-dits' (named localities) of own fields**	**'Lieux-dits' (named localities) of others' fields used to gather fuelwood**
	NINDRI			
226	Nindri		mahangani	
227	Nindri		mromagi macheléle	
228	Nindri	badrani mtouni	Corre	
229	Nindri		Hagnastsa	
230	Nindri	gogoni	ougoni	
	KOWE			
231	Kowe		hagnassa	m'rochaé
232	Kowe	nondroni		
233	Kowe		mbessine	
234	Kowe	mpaharone		
235	Kowe	satseni	gojajou	
236	Kowe	cojajou	setseni	
237	Kowe	satseni		
238	Kowe	cojajou		
	LINGONI			
239	lingoni	hamcolo	gnaboikouni	
240	lingoni		ougoni	hamazava et karafouni
241	lingoni		demedza	
242	lingoni	bandrajou	wezi	ougoni
243	lingoni		moihajou	
244	lingoni		hadzajou	
	POMONI			
245	Pomoni		mroboueni	
246	Pomoni		magoijou, m'robeni	
247	Pomoni		mrobeni, gnabo magibi	
248	Pomoni		magoijou	mrobeni
249	Pomoni		makoitrijou	
	MOYA			
250	Moya	ougouni, moya	makine	jibil
251	Moya		jibil	bandrahari
252	Moya		jibil	bandrahari
254	Moya		Bandrahari	
256	moya		bandrahari	hapaj
257	moya	ougouni moya	jibili	badrahari
258	moya	ougouni moya	bandrahari	makine
259	moya	mparoni moya	hapaj	hapaja
260	moya	magouni moya	bandrahari	jibil
261	moya	ougouni moya	jibili	
262	moya	ougouni moya	makine	
263	moya	ougouni moya	hapaj	
264	moya	magouni moya	makine	

2.7 Fuel consumption

Studies on fuelwood consumption rates in the Comoros are very rare, so although the current study was conducted with only a small number of households, the results are important. In 25 households drawn from several villages, fuelwood use and kerosene use was followed and measured over 4 days and a record was kept of the number of household members who ate together each day. As a result, per capita consumption rates have become available[1].

The Comoro Islands show very low fuelwood consumption by comparison with many other African countries: a function largely of low availability. The most recent data on consumption to be found prior to this survey dates from the 1990s. Chart 2.7 shows two estimates.

Chart 2.7: Fuelwood consumption in the Comoros, 1990s

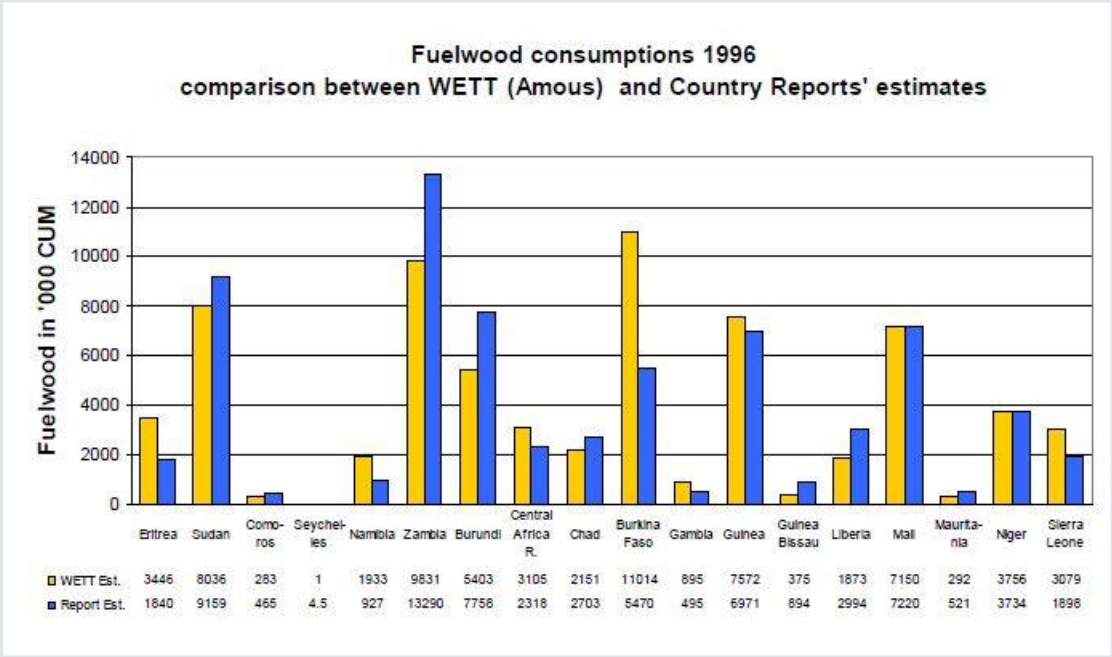


Chart from, 'Wood Energy Information in Africa' Rudi Drigo for FAO and EU, March 2001.
WETT figure is from 'The Role of Wood Energy in Africa' FAO 1999. TCDC figure is from 'Technical Cooperation among Developing Countries' (FAO Programme).

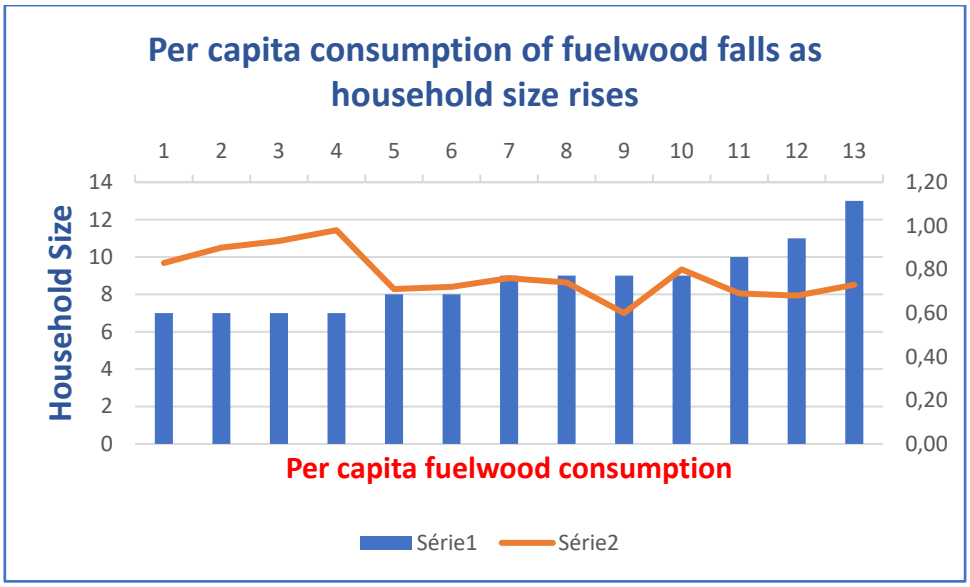
In the sample presented here, data are presented as a per capita daily consumption figure by weight, rather than an annual total figure in cubic metres. The households surveyed who cooked entirely on fuelwood and did not use kerosene for cooking have an average daily fuelwood consumption of 0.77kg per capita. Those who also used kerosene for cooking had a lower average daily fuelwood consumption rate of 0.64kg. Kerosene consumption rates in the sample varied

[1] Unfortunately, the data from three households, all in Moya, showed such high fuelwood consumption over the four days – much more than twice the average - that commercial activity (cooking food for sale), an unusual event such as a wedding, or enumerator error must have been involved. We have therefore excluded these households from the averages generated.

greatly and the average used per capita in the households for which we have data is 64ml. However, the mean is lower at 42ml and this seems a more likely typical figure.

It is well known from other fuelwood surveys elsewhere that large households consume relatively less fuel per head than small households because economies of scale come into play. The effect can be seen in the current sample, even though it is small. (Chart 2.8 excludes households using kerosene as well as fuelwood).

Chart 2.8: The effect of household size on fuelwood consumption



2.8 Providing a woodfuel use estimate for the Moya region

We know that about a third of households supplement fuelwood use with kerosene; that households use more wood in the rainy season than in drier months and that more fuelwood is used for celebrations. Given these variables, and the fact that we only have limited data to make estimates with, we have taken the higher per capita consumption figure of 0.77kg to cover for higher seasonal use and special occasion use. It probably provides conservative estimated results.

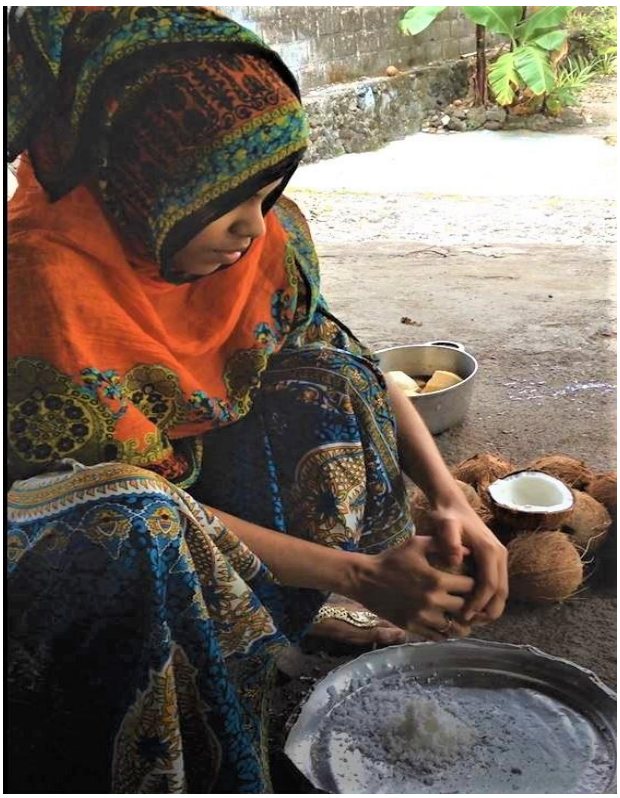
Chart 2.9 provides census figures for all the villages and towns around Moya forest. Here we present figures for 2017 (the year the survey reported on here was undertaken), 2019, and 2025.

Using them, it is possible to make calculations as follows. Daily per capita consumption is 0.77kg, so annual per capita consumption (x365) is 281kg. Using the census totals we can estimate that the total fuelwood tonnage for the area in 2017 was therefore a little over 12.6 tonnes.

The population growth rate in the Comoros per annum currently stands at 2.72% (on the basis of the growth rates seen in the census table). So, tonnage had already risen to 13.3 tonnes by 2019, and will rise to 15.5 tonnes by 2025.

Chart 2.9: Providing a woodfuel use estimate for the area around Moya forest				
NOM	**COMMUNE**	**2017**	**2019**	**2025**
Adda Daoueni	Mremani	9995	10545	12307
Kowe+Cosini	Moya	1641	1731	2021
Nindri	Moya	1425	1504	1755
Magnassini Nindri	Moya	1558	1643	1918
Maweni	Moya	764	806	941
Moya	Moya	12019	12680	14799
Pomoni	Moya	4319	4556	5318
Ngadzale	Domoni	8431	8895	10382
Outsa	Domoni	656	693	808
Ouzini	Domoni	1625	1715	2001
Salamani	Domoni	2439	2573	3003
		44871	**47341**	**55253**
Per capita daily fuelwood consumption is 0.77kg. Annual per capita consumption is 281.1kg		281.1	281.1	281.1
Total tonnage for all the settlements around the Moya Forest in selected years		**12,611,127**	**13,307,521**	**15,531,671**

It should be remembered that the main fuelwood species chosen indicate that only a very small fraction of this biomass is coming from the forest itself: the bulk of it comes from trees on farms.



Beginning to prepare lunch (Credit: Gill Shepherd)

3. Use of fuelwood for ylang distillation

3.1 Measuring wood use for ylang distillation

In 2013 and 2014 ID (Initiative Développement) conducted a survey of 41 owners of ylang oil distillation plants (alambics) in the area around Moya forest. ID reckons this was an 100% sample at the time of the survey. They weighed the quantity of ylang flowers being distilled and the quantity of wood used for that distillation[2]. Unfortunately, they did not record which alambics were of a new improved design using less fuelwood, and which were the traditional design.

Averaged across the two years and the 41 distilleries, a typical distillery would use 911kg of wood to distil 171kg of flowers. There is no data in the current survey on the number of times per year that any particular 'alambic' is used, so we cannot calculate total wood use for this purpose in these years. However, it is possible to say that total wood use for the firing of all alambics once each would come to 37.3 (37,351) tonnes.

ID also provides a table[3] in which 64 visits are made to alambics over the 2013-2014 period, to weigh the wood being used on a particular occasion, and to identify the species. It is impossible to link up the distilleries in the first table (where names and addresses of owners are given) with the visit codes in the second table, so it is impossible to deduce how frequently alambics are used.

However, an earlier unpublished Dahari report ('*Forest Resource Use Preliminary Results, 2013*) suggests that alambics are typically fired up about 15 times a month, for a maximum of 6 months a year[4]. If this is the case with the 41 distilleries surveyed here, each is used about 90 times a year. This level of use would demand 37.3 tonnes x 90 = 3,357 tonnes a year.

There is no way of knowing how closely this figure represents usage in the Moya region from the data we have available. But total tonnage of fuelwood for distilleries was clearly substantial in 2013/2014 and is no doubt not very different today.

3.2 The main agroforestry and forest species used for ylangylang oil distillation in the Moya forest area

Visits by the ID team to ylang distilleries were made on 64 occasions. On each of these visits the amount of fuelwood being used was measured, and the species being used were identified in almost all cases. Better still, the species components were all weighed, species by species. This provides invaluable data on the relative frequency of use of all species, and in particular makes it possible to separate the use of agroforestry species from forest species.

---

[2] They also made calculations about the amount of energy provided by the fuelwood, factoring in moisture content. These calculations may been seen in the document, '*Synthese Baseline-2013-2014_15_08_28_Version_Etude Dahari.xlsx*'

[3] '*BDD-Espèces-utilisées_Mai_2016.xls*'

[4] '*Rapport Des Savoirs Locaux sur les Arbres autour de la Foret de Moya a Anjouan/Union des Comores*' Emilie Smith Dumont, Subira Bonhomme, Nastazia Mouhamadi, Misbahou Mohammed
Janvier 2019, Darwin and FAO

Adding together the weights of all species found, on all the 64 visits made to ylang distilleries, we arrive at a total weight of 50,6-001.87kg. This is made up of 48,780.58kg (96.4%) drawn from agroforestry sources, and 1,821.29kg (3.6%) drawn from forest species.

Chart 3.1: Agroforestry trees/biomass sources used in ylangylang oil distillation by alambic owners in the Moya forest area			
Botanical names	**Local names in Shinzwani**	**kg**	**Per cent**
Mangifera indica	Mmanga	27194.1	55.8
Cananga odorata	ylang	3871.67	7.9
Casuarina equisetifolia	Mvindja/Filao	1943.92	4.1
Pterocarpus indicus	Sandragon/mbaruti	1935.77	4.0
Gliricidia sepium	Gliricidia	1681.51	3.4
Cocos nucifera	coconut leaf fronds	1571.13	3.2
Albizia saman	Msiro	1576.33	3.2
Artocarpus altilis	fruitapain	1408.6	2.9
Albizia lebbek	Mbaruti was shinzwani	1207.54	2.5
Eucalyptus	Mkinini or Mkalkis	1055.43	2.2
Syzygium aromaticum	Mkarafou	1038.39	2.1
Acacia sp.	Mkassia or Mougou	991.96	2.0
Psidium guajava	Mvwera	252.26	0.5
Ceiba pentandra	Mpambafou (kapok)	492.55	1.0
Artocarpus heterophyllus	Mfanasi	503.12	1.0
Tamarindus indica	Muhadjou	457.68	0.9
Cocos nucifera	Mavindro (Coir and shells)	436.81	0.9
Moringa oleifera	Mvunge	422.5	0.9
Cocos nucifera	coconut tree trunk	273.02	0.6
Terminalia catappa	Mnyamba/Badamier	212.62	0.4
Cordia myxa	Mrovou	113.39	0.2
Anacardium occidentale	Mbibo/cashew	37.62	0.1
Jatropha sp.	?	35	0.1
Persea americana /avocado	Mzavoca	67.66	0.1
TOTALS	**96.4%**	**48780.58**	**100.0**

Chart 3.1 shows that by far the most important woodfuel for alambics comes from the mango tree. Far behind come the ylangylang itself, Casuarina, Pterocarpus indica (Sandragon), Gliricidia, coconut leaf fronds and Albizia saman. After that small quantities of seventeen other species are found.

Chart 3.2 provides similar information for forest species, in much smaller quantities and from fewer species. Ficus lutea (mvuvu) is much the most common forest species employed, followed by one or more unidentified hardwoods. Nuxia pseudodentata (mwaha) and Calophyllum recedens (mfampevo) are also of importance. But quantities are minute compared with the quantities of agroforestry species employed.

Chart 3.2: Forest Trees used in ylangylang oil distillation by alambic owners in the Moya forest area			
Botanical names	**Comorian names**	**Kg**	**Per cent**
Ficus lutea	Mvuvu	758.03	41.6
Unidentified hardwoods	Unidentified hardwoods	299.88	16.5
Nuxia pseudodentata	Moiha/Mwaha	187.48	10.3
Calophyllum recedens	Mvapevo/Mfapevo	184.68	10.1
Albizia glaberrima	Mzilanze	103.1	5.7
Litsea glutinosa	Mzavuka maro	80.54	4.4
Unknown – interview error?	Mgnafoundre	63.98	3.5
Phyllanthus pervilleanaus	Mourundra ntsole	51.76	2.8
Unknown – interview error?	Mjadzia	41.18	2.3
Unknown – interview error?	Mzoumwiri	32.54	1.8
Ficus sycamorus?	Chihu (Mshuhi?)	18.12	1.0
TOTALS	**3.6%**	**1821.29**	**100.00**

3.3 Fuel sources for Moya's alambics

The extent to which Anjouan's original forest has already been replaced by a rich and varied agroforest is clearly shown, in a general way, in the fuel sources for ylangylang distilleries – 96.4% from fields and only 3.6% from the forest.

It is also noteworthy that the forest species listed are, unsurprisingly not the most highly valued forest species available. Those can be sold for higher prices for construction, doors, rafters and furniture and would not be wasted on fuelwood.

However, it is unfortunate that the ylang ylang study did not emulate the fuelwood study in listing fuel sources by main 'lieux-dits'. Without that information, ylang ylang fuelwood sources cannot readily be mapped.

Ylang-ylang in Anjouan (Credit: Klorane botanical.com)

4. Timber for construction, furniture and pirogues

The results from the 'Bois d'oeuvre' study are of great interest for the overall wood use study, since more timber for these purposes probably comes from natural forest sources than from farmer fields.

Dahari approached the study through interviews with tree owners selling trees, with woodcutters, with owners of carpentry and joinery workshops where timber is used for doors, furniture and house construction, and with the makers of outrigger canoes or pirogues.

Mtrondro, Khaya comorensis (Credit: Richard Davies[5])

4.1 Tree owners

A small sample of tree owners were interviewed in five villages: Adda, Outsa, Salamani Ouzini and Moya.

4.1.1 Contacts with owners of carpentry and joinery workshops

Tree owners were asked how they contacted potential purchasers of timber they wished to sell. Some had contacts with carpentry and joinery workshop owners in the larger towns of Domoni and Mutsamudu and dealt directly with them, visiting the workshops there from time to time. Some sold planks to workshop owners who visited their area. Some dealt with a village middle man who sold

[5] '*Guide des Plantes Ligneuses des Comores - arbres, arbustes et Lianes'. Richard Davies 1993.*

timber on their behalf; some sold planks in nearby villages and some (presumably low- volume sellers) were reliant on the contacts that the woodcutters they employed had with workshop proprietors.

4.1.2 Contacts with woodcutters

Some tree owners already had direct relationships with particular woodcutters whom they regularly contacted when they wanted to have a tree felled and sawn into planks, while some said they met woodcutters by chance in the forest or in the fields of others and got to know them in that way. Needs vary greatly in any case. One farmer reckoned that he had had 70 trees felled the previous year, while another mentioned felling 30 a year. The rest had between 1 and 6 trees felled a year.

Trees of course vary greatly in size and when farmers were asked how many planks (planches) they usually got from a tree, answers ranged between 20 and 100. The mean was about 50.

Planks are cut to a series of set lengths (such as 2 metres, 2metres 20cm and 3 metres) demanded presumably by the carpentry and joinery workshops they will mostly be sold to, and they are normally cut to a thickness of 3cm or 5cm. 'Chevrons' are also in demand – thicker lengths of timber – frequently 9cm x 9cm in cross-section – for use as rafters, centre-posts for wooden doors and so on. (Chevrons can be seen among other sorts of timber in the photograph on p23).

4.1.3 Areas from which timber comes in the case of this sample of tree owners

The tree owners interviewed in the five villages named the main 'lieux-dits' from which timber is currently coming as follows.

Chart 4.1: Main timber-cutting areas near 5 villages

Village	**Main zones (lieux-dits)**
Adda	Hagora
Outsa	Chavani Kambouni
Salamani	Ouhourani, Nkassi
Ouzini	Ndremani
Moya	Cherka

4.2 Woodcutters

4.2.1 Cutting intensity

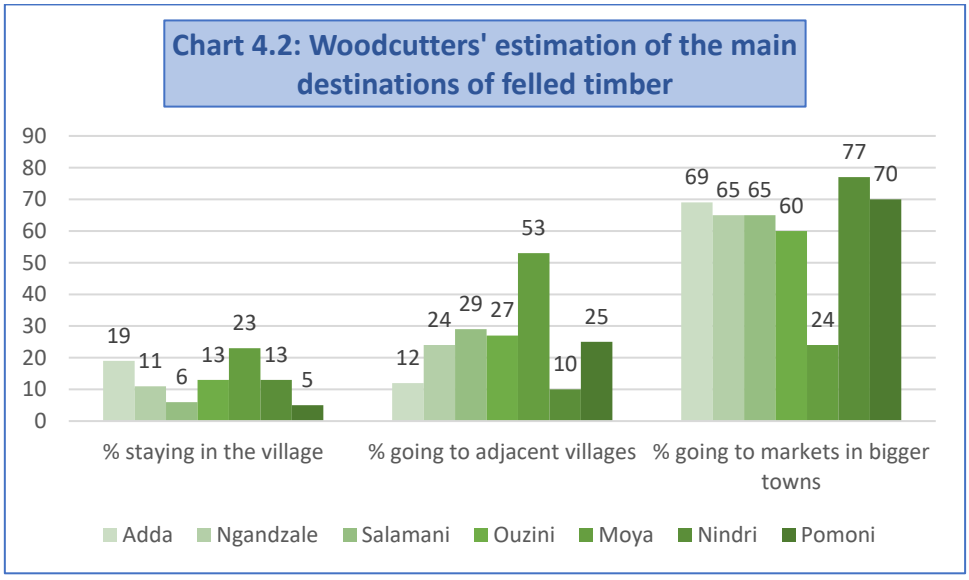
Twenty-eight woodcutters were interviewed in Adda, Ngandzale, Salamani, Ouzini, Moya, Nindri and Pomoni, all of whom but two used chainsaws. These represented 78% of all the woodcutters in these villages so it was possible to estimate for the remainder, village by village, and thus address the full (100%) impact of woodcutters and their clients on tree numbers in fields and forest. (Chart 4.2: Impact of 36 woodcutters in 7 villages on timber production and tree stocks).

As Chart 4.3 shows (next page), the cumulative impact of a relatively small number of woodcutters, working seemingly only part-time, is enormous. Though each woodcutter works on average with only 7-9 farmers a year in their fields, together they work annually with nearly 300 farmers eager to sell trees. In addition, woodcutters work in the forest, producing sawn timber from both locations. In all, the 36 woodcutters in these 7 villages fell an estimated 1168 trees annually, between them.

Trees are cut into planks (average per tree from answers given in interviews is 68 for on-farm trees[6] and 40 for forest trees). Chevrons were not included in the interviews from which Chart 4.3 was generated, but other interviews revealed that about 10 chevrons can be cut from a farm tree and 15 from a forest tree.

4.2.2 Destinations for the timber felled

The woodcutters' assessment of the destinations of the timber they felled presents a fairly predictable picture. Chart 4.2 shows that the bulk of the timber goes to larger towns where carpentry and joinery workshops exist and where there are good markets for the workshop products. At the same time some is used within the village where it was felled or in other adjacent villages. Only in Moya was 76% of timber kept for use in local villages and a mere 24% sent to larger markets.



[66] The larger number of planks cut from farm trees as opposed to forest trees may be because forest trees are suitable for some of the thicker, longer planks, while farm trees are sawn into thinner, shorter planks.

Chart 4.3: Impact of 36 woodcutters in 7 villages on timber production and tree stocks							
Village	Number of woodcutters in each village	What is the average no. of planks per tree cut in farmers' fields?	How many farmers did you work with over the past year?		What is the average no. of planks per tree cut in the forest?	How many trees a year do you fell, counting forest trees and field trees?	
		Average per woodcutter	Average per woodcutter	Totals	Average per woodcutter	Average per woodcutter	Total
Adda	9	**81**	**10**	**90**	**69**	**25**	**225**
Ngandzale	9	**65**	**7**	**63**	**52**	**35**	**315**
Salamani	5	**73**	**8**	**40**	**33**	**59**	**295**
Ouzini	3	**75**	**1**	**3**	**27**	**50**	**150**
Moya	3	**27**	**9**	**27**	**15**	**20**	**60**
Nindri	6	**73**	**10**	**60**	**32**	**17**	**103**
Pomoni	1	**20**	**15**	**15**	**0**	**20**	**20**
TOTALS	**36**	**68 planks per tree**	**Around 8**	**298 farmers**	**40 planks per tree**	**32 trees**	**1168 trees**

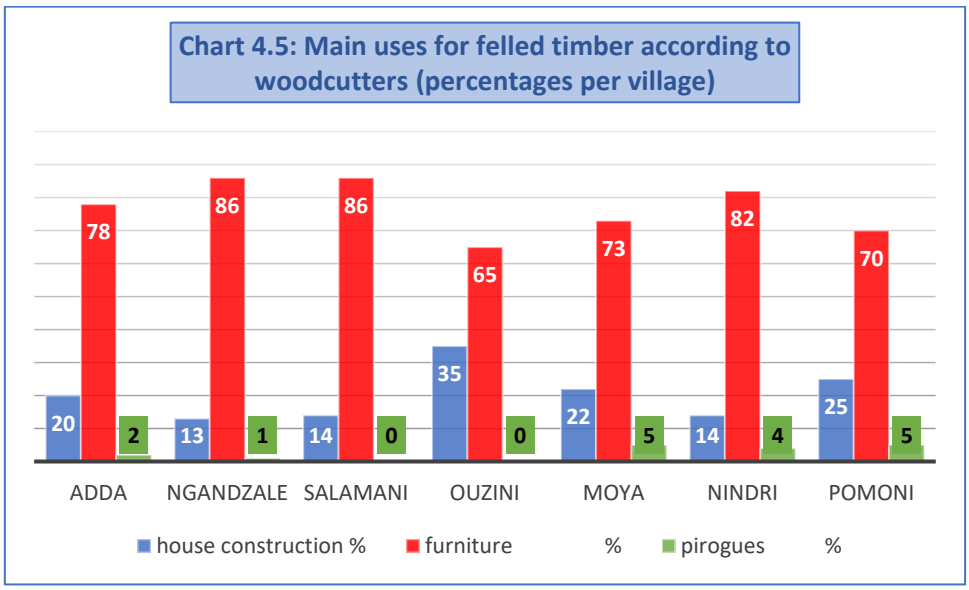
Woodcutters interviewed gave the names of the villages and towns which were the main destinations for sawn timber sent out of the village of origin. Domoni and Mutsamudu are by far the most important, followed by Mirontsi.

Chart 4.4: Main destinations for planks or chevrons transported out of the village of origin

Village of origin	Domoni	Mutsa-mudu	Mirontsi	Pomoni	Tsem-behu	Sala-mani	Ongoju	Mremani	Moya	Vouwani	Bandrani
Adda	5	6	1	1	1	1	1	1	1		
Ngandzale	5	1	1		1						
Salamani	1		2								
Ouzini	2	1	1			1					
Nindri		2		1						1	1
TOTALS	**13**	**10**	**5**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**

4.2.3 Main end purposes for which trees are felled, according to woodcutters

The 28 woodcutters interviewed were asked about the main uses to which the timber felled would be put. As middlemen between tree owners and purchasers of sawn timber in workshops, they are in a good position to know why timber is being felled and what its end purpose will be. Their answers are summarised in Chart 4.5.



The timber from the seven villages in the chart is turned far more frequently into furniture than into materials for house construction. Volumes of timber for the construction of small fishing boats - pirogues or 'ngalawa' – are small.

4.2.4 Tree species preferences

Charts 4.6 and 4.7 display wood cutters' species preferences when cutting trees from the forest and trees in the fields. Nearly all the forest trees are indigenous and some names are unknown or perhaps misheard by enumerators.

Far and away the most highly valued forest species (among those available) seen in Chart 4.6 are Mhonko (Rizhophora mucronate), Mkindrikindri or Murimundra (Weinmania comorensis), Mtrondro, Mpori, Mlandrema, Mnyombembe, or Mtakamaka (Khaya comorensis), Chivundze, or hadza (Phyllarthron comorense) and Mbanjeou, or Mfuantsi (Chrysophyllum gorungosanum). They are followed in popularity by Mrobwe (Ocotea comorensis) and Mpapa (Antholeista grandiflora). These are all forest hardwoods of great importance for furniture making and for house construction. Most of the rest of the mentions are second order forest species (with the exception of teak and betel nut), almost as good as the most popular species.

A vehicle transporting a mix of chevrons, planks and fuelwood (Credit: Dahari)

Chart 4.6: Tree species cut by woodcutters in the forest in order of importance to them and their clients								
Comorian names	**Scientific names**	**Adda**	**Ngandzale**	**Salamani**	**Ouzini**	**Moya**	**Nindri**	**TOTALS**
Mhonko	Rhizophora mucronata		4	3	11	1	1	20
Mkindrikindri, Murimundra	Weinmania comorensis	7	5	3	2	1	1	19
Mtrondro, Mpori, Mlandrema, Mnyombembe, Mtakamaka	Khaya comorensis	7	4	3	2	1	2	19
Chivundze, hadza	Phyllarthron comorense	11	3	2	2			18
Mbanjeou, Mfuantsi	Chrysophyllum	6	5	2	2		3	18
Mrobwe	Ocotea comorensis	5	3	2	2	2	3	17
Mpapa	Antholeista grandiflora	2	1	2	3		1	9
Mvuvu	Ficus lutea	1		1	1		3	6
Mbomo, mdjarou,	Tambourissa leptophylla		1				2	3
Mfapevo/ mfampevo	Calophyllum receduns		1	1				2
Komolasua	Strychnos mitis	2						2
Mtek	Gmelina arborea		2					2
Mtrouwagnougni	Calophyllum recedens	1				1		2
Murichikele	?		2					2
Mrambu	Piper betle		1					1
chihidziya	?				1			1
mzilandze	Albizia glaberrima						1	1
mgnamba	Terminalia catappa						1	1

Chart 4.7: Tree species cut by woodcutters in farmers' fields in order of importance to them and their clients									
Comorian names	**Scientific names**	**Adda**	**Ngandzale**	**Salamani**	**Ouzini**	**Moya**	**Nindri**	**Pomoni**	**TOTALS**
Mnadzi	Cocos nucifera	2	4	4	2	3	4		**19**
Mmanga	Mangifera indica	1	6	l	2		1	1	**12**
Mfanassi	Artocarpus heterophyllus	2	3		1		2	1	**9**
Mkinini, mkalkis	Eucalyptus robusta	4							**4**
Mvindja	Casuarina equisetifollia	4							**4**
Mpapa	Antholeista grandiflora	2	l	l					**4**
Chivundze, hadza	Phyllarthron comorense	3							**3**
Mbanjeou, Mfuantsi	Chrysophyllum gorungosanum	3							**3**
Mhonko	Rhizophora mucronata			3					**3**
Mkindrikindri, Murimundra	Weinmania comorensis	2	l						**3**
Mtrondro, Mpori, Mlandrema, Mnyombembe, Mtakamaka	Khaya comorensis	3							**3**
Mvuriapa	Artocarpus altilis var. non seminifera				1		1	1	**3**
Mbaruti	Pterocarpus indicus					1	1		**2**
Mrobwe	Ocotea comorensis	2							**2**
Msiro	Albizia saman		l				1		**2**
Mtek	Gmelina arborea		l						**1**
Mtrengemwe	Cussonia spectatata				1				**1**
Mzilandze, mjilanze	Albizia glaberrima		1						**1**

When woodcutters were asked what were the absolutely ideal species for doors, tables and other furniture their list (Chart 4.8) echoed many of the preferred species in Chart 4.6, but in a rather different order[7]. This perhaps indicates which species have now begun to be in decline.

Chart 4.8: Ideal species for doors and furniture were they available

Comorian names	Scientific names	TOTALS
Mrobwe	Ocotea comorensis	21
Mtrondro, Mpori, Mlandrema,	Khaya comorensis	19
Mbanjeou, Mfuantsi	Chrysophyllum gorungosanum	12
Mkindrikindri, Murimundra	Weinmania comorensis	8
Mvuvu	Ficus lutea	6
Mhonko	Rhizophora mucronata	4
Chivundze, hadza	Phyllarthron comorense	3
mnyamba	Terminalia catappa	3

Mhonko (Rhizophora mucronate) and Chivundze (Phyllarthron comorense) for instance receive few mentions in chart 4.8 as ideal species, but are very high up the list in Chart 4.6. This gap between what is ideal and what is actually available is summarized in Chart 4.9.

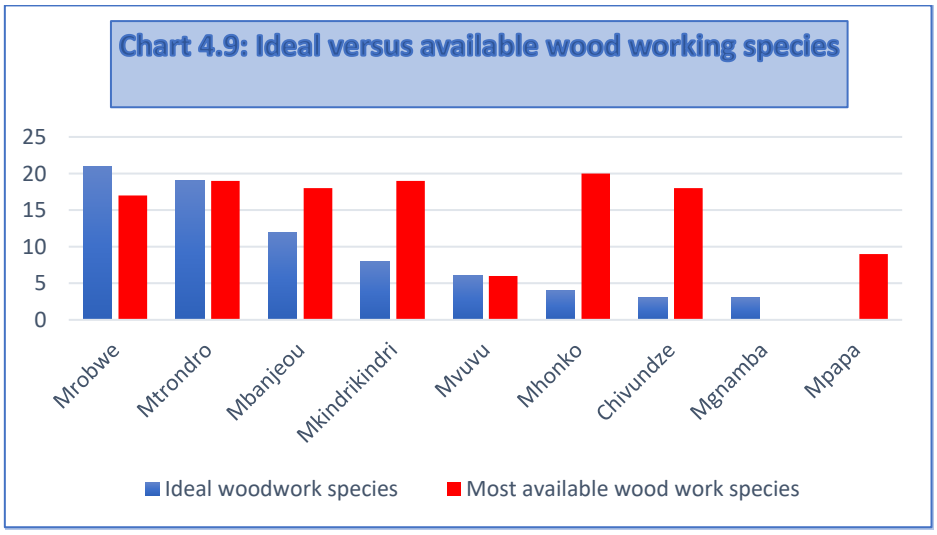


Chart 4.7 (Tree species cut by woodcutters in farmers' fields in order of importance) is of interest for attempts to follow through the decline of forest resources on Anjouan. It is important to note that, though they are not the most commonly mentioned species in the list, at least seven species (marked in green) are species also on the forest list, many of them indigenous hardwoods.

[7] Woodworkers also name the indigenous species Mrobwe (Ocotea comorensis) and Mtrondro (Khaya comorensis) as the top two ideal species for doors and furniture.

These remnant trees are becoming isolated in farmer's fields as fields are cleared up into the original forest. They probably cannot reproduce there, and gradually become an impediment to the farmer in due course. Sooner or later they are cut – either (as farmers themselves said when interviewed) because are threatening crops or have already fallen over, or because they represent a useful one-off source of income in times of need.

So, the most commonly mentioned trees on Chart 4.7 which are actually used for timber are of two kinds. On the one hand they are high value fruit trees such Mnadzi (Cocos nucifera), Mmanga (Mangifera indica), Mfanassi (Artocarpus heterophyllus, jackfruit) or Mvuriapa (Artocarpus altilis, breadfruit) which also have acceptable timber value. On the other hand, we find introduced light timber and fuelwood trees such as Mkinini, mkalkis (Eucalyptus robusta) or Mvindja (Casuarina equisetifolia).

4.2.5 Woodcutters' assessments of the best areas (lieux-dits) around Moya forest for timber

Twenty-eight woodcutters, from seven villages were asked where they thought the best areas for good quality timber were to be found. Villages mentioned on the left are the villages of origin of the woodcutters. It will be noticed that some of the same names crop up in lists for different villages of origin, so woodcutters clearly range far and wide to fell trees on occasion, even though they also fell trees in the fields of their own co-villagers.

Chart 4.10: Woodcutters' assessments of the best areas (lieux-dits) for timber

Village	Lieux-dits
Adda	Kangani, Mpomoni, Mongoriju, Ouzini (Hampouhou)
	Moya forest, Mpapani, Hagora, Salamani, Ouzini, Calgora
	and Mhouvejou (Mutsamudu), Mpapani, Bazmini and Antenijou
Ngandzale	Ouhourani (Ngandzale) Bazmini (Outsa) Tsembehou (Ntringui)
	Kambouni, Mpomoni, Ouzini, Moya, Mromachi, Koni
	In Ngandzale fields and in Dindri (Bandrajou vouwani)
	Lingoni (Digo), Bambao Mtrouni (towards Digo)
Salamani	Mongorijou and Lingoni, Adda, Mpomoni, Bambao Mtsanga
	Bambao Mtrouni, Moya, Kangani, Dziani
Ouzini	Ntrontroni, Kambouni, Mpindzani and Hakobambi
	Forests of Salamani and Ouzini
Moya	Mgnambajou, Mpoundre, Marani, Bandrahari
	Also near the village and in the Moya forest.
Nindri	Cheka and Dzindra, in Nindri fields, near Nindri village
Pomoni	Mpomoni fields

4.3 Owners of carpentry and joinery workshops

4.3.1 Sourcing timber

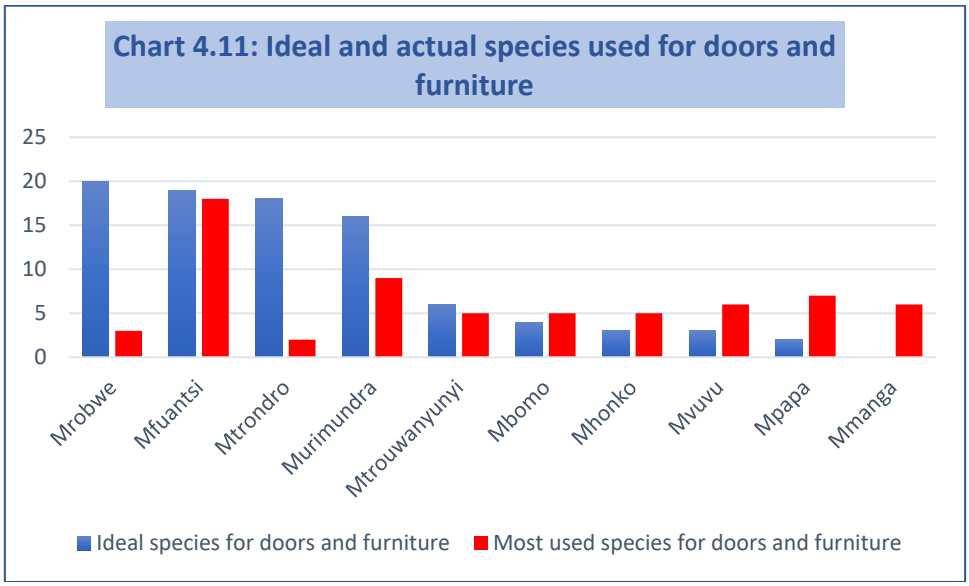
The workshop proprietors of Adda, Ngandzale, Moya, Domoni and Mirontsi are key users of the resources of Moya forest and the lands of adjacent farmers, maintaining relationships with all the main actors in the timber sector, in the region

They obtain most of the timber they need from woodcutters (52%) and wood sellers (24%) but also deal directly with tree owners on occasion (12%) and with the odd client who brings wood directly them for particular purposes.

Carpenters and joiners from Adda rely mostly on timber coming in from Adda itself, from Kangani, Hagora, Hampouhou and Hazira. Those from Ngandzale rely on local supplies and supplies from Salamani and Ouzini. In the case of Moya, workshop owners draw timber from Moya itself, and from Habeja, Cheka, Makini, and Ngandzale. Domoni carpenters and joiners get their supplies from Salamani, Ouzini, Adda and Ngandzale, while those in Mirontsi rely on Dindri, Pomoni and Bandrani. One workshop proprietor in Mirontsi even imports wood from Grande Comore.

4.3.2 Timber availability and timber choices – furniture and doors

The most important products of carpentry and joinery workshops are furniture and doors, and workshop owners have a strong sense of the most desirable timbers for these products



The top four species mentioned here in blue – Mrobwe (Ocotea comorensis), Mfuantsi (Chrysophyllum gorungosanum), Mtrondro (Khaya comorensis) and Murimundra (Weinmania comorensis) are all fine indigenous hardwoods which occur as the woodcutters' ideal top four as well.

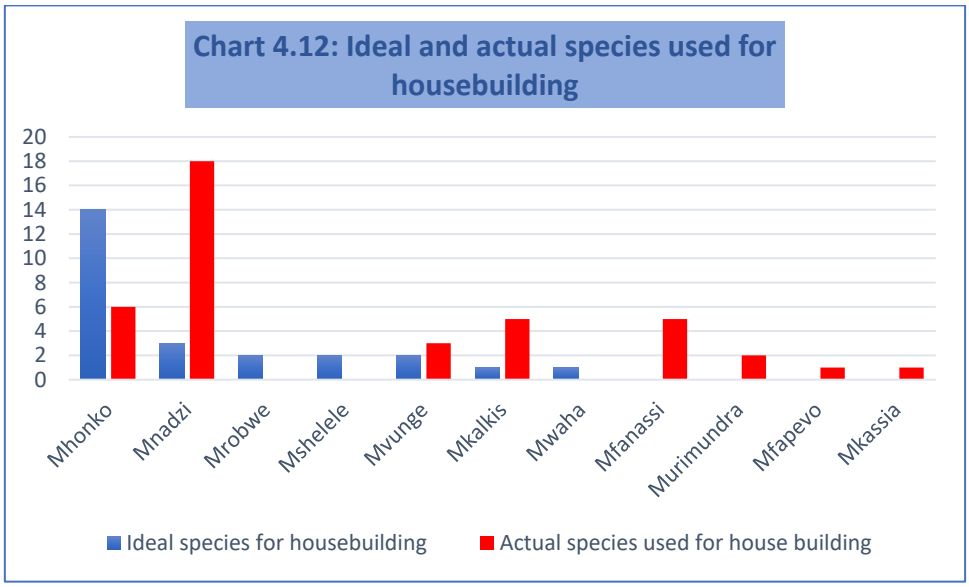
However, the red bars (actual species used) tell a different story. Two out of four of the top four species are becoming almost impossible to obtain for doors and furniture - Mrobwe and Mtrondro - and a third, Murimundra, cannot meet the demand upon it. Only Mfuantsi (a white wood) is still relatively available.

After that, doors and furniture are increasingly being made out of second order forest species. So we find an increasing importance for Mpapa (Antholeista grandiflora), Mvuvu (Ficus lutea), mbomo (Tambourissa leptophylla), Mhonko (Rhizophora mucronata) and Mtrouwanyunyi (Calophyllum recedens).

Even mango now makes it into the list of timbers used for high value products from door and furniture manufacturers.

4.3.3 Timber availability and timber choices – house construction

The other timber processed and sold through carpentry and joinery workshops is timber for houses and construction in general.



The 'ideal' timber for construction is mhonko (Rhizophora mucronate) which is lowly regarded for doors and furniture, and although wistful occasional mentions of mrobwe and mshelele occur here, it is very unlikely that these species would be available for construction purposes. Instead house construction relies on the use of coconut wood, (mnadzi), the jackfruit tree (mfanassi) and fast-growing exotic species such as Casuarina equisetifolia (mvinja) and Eucalyptus robusta (mkalkis). Some modest use would seem to be made of Weinmania comorensis(murimundra), Calophyllum recedens (mfampevo) and Acacia auriculiformis (mkassia).

So, timber for house construction occupies an interesting position in the hierarchy of tree uses, as Chart 4.12 shows. As far as the natural forest is concerned, it draws on less valuable – and more available - species than the precious woods used for furniture and doors. Some of the species used are agroforestry species and to that extent they are also needed for domestic fuelwood and for sale to ylangylang distilleries, so farmers must allocate their resources accordingly. There is also growing reliance on fast-growing tree species imported into the Comoros over the years.

4.3.4 The amounts of timber used by workshops monthly and annually

In the case of the twenty workshop proprietors interviewed, typical monthly consumption varied a good deal by village. Since the total number of workshops per village was known, it was possible to calculate total demand per month per village and thus total annual demand for the region.

Workshop owners made it clear that almost the entire volume of timber purchased by them went on furniture or doors. They suggested that 90-95% of the timber they bought was used for these purposes. Both chevrons and planks are used in door and furniture making, as well as in house construction[8].

Chart 4.13: Amounts of timber purchased by workshops monthly and annually

	Average monthly demand, from workshops surveyed		Total no of workshops per village	Total monthly demand		Total annual demand	
VILLAGES	chevrons	planks		chevrons	planks	chevrons	planks
Domoni	7	94	9	63	846	756	10152
Mirontsi	8	53	15	120	795	1440	9540
Adda	25	61	6	150	366	1800	4392
Ngandzale	7	58	5	35	290	420	3480
Moya	10	68	4	40	272	480	3264
TOTALS	57	334	39	408	2569	**4896**	**30828**

Given the large volumes of timber purchased for transformation, the data given to Dahari researchers about the finished products made from that timber and sold from workshops looks inaccurate, and it seems as if proprietors suddenly became shy about indicating just what their earnings might amount to every year.

The data collected on numbers of doors produced as shown in Chart 4.14 looks a little low, for instance, especially for Domoni and Mirontsi, in the light of reported output for Adda, Ngandzale and Moya.

Chart 4.14: Average annual production of doors, per workshop per village

Village	Average prices for doors				How many do you sell a year?
	single door		paired doors		
	kmf	dollars	kmf	dollars	
Domoni	91,000	203	175,000	390	19
Mirontsi	70,000	154	159,000	355	17
Adda	112,000	246	175,000	390	22
Ngandzale	125,000	275	175,000	390	26
Moya	125,000	275	175,000	390	15

[8] Both chevrons and planks vary in size, thickness and therefore price (see section 5).

The data collected on the numbers of pieces of furniture produced, as shown in Chart 4.15, looks ridiculously low for all villages except conceivably Adda.

Chart 4.15: Average annual production of furniture pieces, per workshop, per village

Village	Average prices for pieces of furniture				How many do you sell a year?
	kmf	dollars	kmf	dollars	
Domoni	100,000	223	400,000	890	1
Mirontsi	400,000	890	600,000	1338	2
Adda	400,000	890			13
Ngandzale	400,000	890			2
Moya	400,000	890			1

4.4 The production of outrigger canoes (pirogues)

4.4.1 Pirogues are made from a mixture of timbers

As the photograph shows, pirogues are fashioned from one large hollowed-out tree-trunk (the 'pirogue principale'), and from thinner lighter woods which make up the transverse poles of the outrigger/s (the miringo) and the balancers in the water (the zivera). The strengthening struts inside the pirogue are known as the nkassi. Most Comorian pirogues are actually single outrigger canoes rather than double as here.

Credit: Grete Howard

The tree species most commonly used for pirogues are as follows

Chart 4:16 Tree species most commonly used for the main body of the pirogue	
Most desired species	
Mtrondro	Khaya comorensis
Mzilanze	Albizia glaberrima
Mtrouwanyunyi	Calophyllum recedens
Mkindrikindri	Weinmania comorensis
Mnyamba	Terminalia catappa
Msiro	Albizia saman
Substitute species	
Mmanga	Mangifera indica (Mango)
Mfanassi	Artcarpus heterophyllus (Jackfruit)
Mvouriapa	Artocarpus altilis (breadfruit)

Chart 4:17 Tree species most commonly used for the miringo and the zivera forming the outriggers (small light timbers)	
Mkorwa	Calophyllum inophyllum (does not rot)
Mkanyani	Macaranga
Mpambafouma	Ceiba pentandra
Mbesi	Trema orientalis
Ylang ylang	Cananga odorata

Chart 4:18 Tree species most commonly used for the nkassi, the bracing struts inside the pirogue (small light timbers)	
Mbesi	Trema orientalis
Mkanyani	Macaranga
Mshuhi	Ficus sycamorus
Mkarafou	Syzigium aromaticum (clove wood)

Pirogue makers obtain the trees they need for construction as locally as they can, sometimes paying between 10,000 and 25,000 kmf (22-55 dollars) for a tree, for the main body of the pirogue. Sometimes, they are able to make a pirogue entirely from their own field trees, incurring no upfront costs and increasing the profit margin.

The prices charged for pirogues vary from 25,000-100,000 kmf (59-223 dollars), but then the size and complexity of pirogues vary and thus the time taken to make one. The mean would seem to be about 50,000 kmf. Of the pirogue makers interviewed, most made only one to four a year. Only one of those interviewed said he made 15 pirogues a year.

It is hard to assess the total impact on the Moya forest of pirogue-making. From pirogue-makers' own assessments and from the data in charts 4.5 (where woodcutters estimate 4-5% of timber felled going for pirogues) numbers of trees felled for this purpose are relatively low. If we apply the 5% figure to the last column in table 4.3, we get a figure of 50-55 trees a year for the main body of pirogues, which seems about right. The light timbers used to make the miringo, zivera and nkassi are not calculated for and could in any case be made out of trimmings from trees felled for other purposes.

The main body of a pirogue being fashioned from a msiro (Albizia saman) tree – one of the ideal species for the purpose. (Credit Richard Davies[9])

[9] '*Guide des Plantes Ligneuses des Comores - arbres, arbustes et Lianes'. Richard Davies 1993*.

5. Charcoal Demand and Supply

5.1 General trends in demand for charcoal

The trend for commercial use of charcoal in the years before Covid was sharply upwards, because there was an ever-increasing number of people grilling and selling kebab skewers and chicken wings. 'Every day one would notice a new little kiosk opening', one informant commented. Charcoal demand was steadily rising. However, because of Covid and the curfew, overall charcoal demand has diminished over the last year-and-a-half. Domestically, because group events were banned, large social family events almost came to an end. And commercially, because of the evening curfew, grilled kebabs and chicken wings could only be sold at lunchtime and not in the evenings.

There is also a trend for wealthier households to buy gas stoves for grilling at home, so from that point of view there is a decrease in charcoal sales independent of Covid 19.

5.1.1 Fluctuation in demand over the year

Before Covid-19, the high spot of the year for charcoal sales as far as households were concerned, was the month before Ramadan, Sha'aban, which is known as the picnic month. During this month people used to buy a lot of charcoal so as to be able to grill meat. Ramadan itself was also an important month for charcoal sales and after that festival days such as Eid and Miradji (the celebration of the Ascension of Mohammed into heaven) when people grill meat and make cakes. The muslim New Year's Day (the first day of Muharram) was also mentioned as an important day for charcoal consumption and one charcoal seller said he might in the past have sold 7 to 10 50 KG sacks just on that day. At the moment, people are just buying little paper bags of charcoal for these events. Otherwise In other parts of the year, charcoal use domestically is limited.

5.2 How charcoal sellers obtain supplies for the market

Of the five charcoal sellers interviewed, three bought their charcoal from any supplier they encountered. Two sellers made special arrangements with particular charcoal makers who supplied them each time they asked for it. One made telephone calls to his two suppliers when he was in need of charcoal and the other explained that his suppliers would come to find him in the market and would sell him charcoal on the spot, or would arrange to make it and bring it to him. These two might also buy from chance suppliers who turned up in the market if they were in need of supplies. Mutsamudu sellers generally obtained their supplies from Sima, Tanambao, Bandrani from between Mutsamudu and Ouani. Ouani sellers said that their charcoal came from Sima, Bazimini, Koki, Mirontsi, Bimbini, Mwamwa and Barakani and from between Mutsamudu and Ouani.

5.2.1 Frequency with which charcoal sellers renewed their supplies

A major buyer of charcoal said that he stocked up on supplies weekly or even more often if there were sellers offering a low price. Another major seller said that he bought substantial amounts of charcoal from his supplier so that he did not need to keep buying again and again over the month. He said that sometimes he spent as much as 250,000 KMF[10] (E500) in one go, which would be enough for two months. He had plenty of space in his house for storing charcoal. If he noticed stocks diminishing, he would call his supplier. Another said that before Covid-19 he would restock weekly because he might sell up to 10 25kg bags a day. But Covid-19 had reduced charcoal sales because

[10] 500 KMF = 1 Euro.

curfew regulations meant that there were no entrepreneurs selling kebabs in the evenings. So now he only stocked up twice a month. A third concurred that Covid-19 is reduced sales and reduced his restocking from four times a month to twice a month. Smaller scale sellers would tend to stock up once a month. They lacked the money to buy more frequently, since sales were going slowly and there are a few clients, and many sellers.

5.2.2 Buying from lorry drivers

Lorry drivers and charcoal makers would usually come first to ask if sellers wanted to buy. Only if they said yes would they bring the charcoal. Coming on the off chance, especially with the Covid-19 crisis, risks transporting charcoal but then not being able to sell it. Quite often lorry drivers do transport charcoal, but they do not own it: often the owners ride with the driver in the vehicle. The only exception to this general picture seems to be that some lorry drivers pick up charcoal on the Mutsamudu-Ouani road and drive it to the charcoal market in one of those two towns.

5.3 Prices in the market

Prices paid to buy charcoal from charcoal makers, and prices paid by the customers of charcoal sellers ought to show some difference. But the current data collected does not show this difference, so we assume that sellers misunderstood the question when giving the replies found in Table 1, and actually quoted the prices they obtained when they sold bags of charcoal. We need wholesale prices not retail prices.

Table 5.1: Current cost of a sack of charcoal

	Sack of '50 kg'[11]	Sack of '25 kg'[12]
1	4500-5000KMF	1500 KMF
2	5000 KMF	2500 MF
3	4500-5000KMF	doesn't buy
4	4000-5000 KMF	2000 KMF
5	3750-4500 KMF	1750-2250 KMF

Table 2 shows what sellers remember about the retail prices they obtained in the market over the last six years. Only one shows a price drop in 2021 as a result of Covid 19. All these sellers come from Mutsamudu and Ouani and there seems to be seems to be no difference in selling price between the two.

Table 5.2: Price variation over the last five years for '50kg' bags

	2016	2017	2018	2019	2020	2021
1	5000	4500	4500	5000	5000	5000
2	3500	4000	4000	5000	5000	5000
3	4000	4000	4500	4500	5000	4500
4	3500	4000	4000	5000	5000	5000
5	3000	3500	3500	3750	4000	4500

[11] A 50 Kg sack describes the sack used (probably a rice sack), not the weight of charcoal inside it. A 50 kg sack contains about 25kg of charcoal.

[12] A 25 Kg sack describes the sack used (probably a rice sack), not the weight of charcoal inside it. A 25 kg sack contains about 12.5kg of charcoal.

5.4 Charcoal making

The interviews conducted with charcoal makers did not take place in the locations where the charcoal sellers interviewed had obtained their charcoal from. So there is no direct description of chains all the way from producer to seller (See Table 3.) The two charcoal makers working on the coast sold to Domoni, Nioumakele and Dindri (not Mutsamudu and Ouani), while charcoal makers working in the hills in Ngandzale and Adda sold to local retail buyers or to intermediaries who took the charcoal to larger centres such as Domoni. Volumes made vary greatly (Table 4). And Table 5 shows how time-consuming charcoal making can be and perhaps for how little financial return[13].

5.4.1 Finding wood to turn into charcoal

Most charcoal burners obtained their wood through their own efforts. Some felled trees on their own land or bought a tree to cut from someone else. Some collaborated with people who were felling trees for timber and using chainsaws to make planks and chevrons. When they finished, charcoal burners would gather up what was left, sometimes obtaining it for free and sometimes paying the chainsaw owner for the residues. Sometimes, if a charcoal burner is offered a large tree to cut, he pays a chainsaw operator to do so and then splits the profit from the charcoal with the original tree owner. One small scale charcoal burner suggested that he mainly spotted fallen timber available to make charcoal with when he was out searching for fodder for his cattle.

Two thirds of the charcoal burners interviewed obtained at least some of the wood with which to make charcoal from their own fields: this would seem to be especially the case in hill areas where fields may still contain old forest trees which slowly die, or which increasingly get in the way of agriculture. The two charcoal makers living on the coast named Sandzeni and Bandrajou as the places where they mainly found trees to cut. Those living in Ngandzale named as their main sources of trees for charcoal the localities of Chitsahani, Janine, Dimani, Kanguani, Hadzoum and Djifouni. Around Adda, the main localities mentioned were Koudroi, Habeja, Mroguoguo, and Haguora.

5.4.2 Preferences for green or dry wood for charcoal

Small-scale producers often used dry wood, not because they chose to but because it had taken them time to gather sufficient fallen timber or logging residues to make charcoal. A couple of larger scale producers said that they actively preferred green wood because dry wood burns too fast. the remainder said that they mixed green and dry wood because both sorts were available and usable.

5.4.3 Prices at the location of production

Finally, the prices quoted for charcoal sales by charcoal producers (Table 6) are, surprisingly, as high as or even higher than those commanded by sellers in the main markets of Mutsamudu and Ouani.

[13] Of course, it is very likely that some charcoal burners are under-reporting the income they make from this activity because they know or suspect that they are making it illegally and without obtaining the necessary permits first. The interviewer conducted these interviews had a great deal of difficulty in persuading charcoal burners to talk to her, for this reason.

Table 5.3: Transportation and sales

Location of charcoal maker	Main location for sales and clients	Transportation	Percentage of charcoal sold in the market
Kowe (coast)	I organise sales myself at Domoni and Nioumakele markets	By bus	100% I send everything to market unless villagers here in Kowe let me know their needs in advance
Lingoni (coast)	I sell directly to a contact in Dindri	Take sacks to the edge of the road and put on the bus	100%. I send all my charcoal to Dindri, and I have someone there who takes charge of it
Ngandzale-1 (hills)	No regular clients. I bag up charcoal in the forest and bring it home to my house and sell from there	n/a	0%
Ngandzale-2 (hills)	I have 3 regular clients here in Ngandzale	n/a	0% I used to take charcoal to the market in Domoni by taxi. But now I have my clients here, and dealers buy from them to sell in the market.
Ngandzale-3 (hills)	I have one main client to whom I sell charcoal here in Ngandzale	n/a	0%
Ngandzale-4 (hills)	I have no regular clients – I sell to anybody who comes to buy	n/a	0% I just sell here in the village
Adda-1 (hills)	I bring the charcoal to the village and sell to anybody who wants to buy	n/a	0% it's not worth paying for transport for just 1-2 sacks
Adda-2 (hills)	I have no regular clients – I sell to anybody who wants to buy	n/a	0% People come to my house to buy
Adda-3 (hills)	No regular clients yet	Pay a taxi to transport the charcoal from 'Antenyjou' to my house in the village.	0% I plan to sell from my house
Adda-4 (hills)	I sell to anybody who wants to buy, and all of them come from Adda. Nobody comes to buy from other places.	n/a	0% I sell to people in the village

Table 5.4: Volumes made by various charcoal makers

Location of charcoal maker	No. of times a year	How much made each time	Annual total	Same quantity every year?	Comments on how/where the wood for charcoal is obtained
Kowe (coast)	10-15	40 x 12.5kg sacks	5000-7500 kg	No - depends on availability of wood and time	
Lingoni (coast)	1-2	5 x 25kg sacks	250kg	No - depends on availability of wood and time	
Ngandzale-1 (hills)	2	30 x 25kg sacks	1500kg	No - depends on availability of wood and time	Used to be a charcoal maker in Mayotte. Was expelled and so continued here – but earnings less good
Ngandzale-2 (hills)	2	15 x 25kg sacks	750 kg	No - depends on availability of wood	
Ngandzale-3 (hills)	1	50 x 12.5kg sacks	625 kg	It varies – I might go up 60 sacks but never more	
Ngandzale-4 (hills)	1	20 x 25kg sacks	500kg	I have never made less than 10 sacks	When I can find the wood to do it
Adda-1 (hills)	1	3 x 25kg sacks 6 x 12.5kg sacks	150kg	I have never reached 10 sacks because I don't cut trees, just use residues	I gather up residues after someone has cut a tree and made planks or chevrons. When I have enough, I make charcoal
Adda-2 (hills)	2	20 x 25kg sacks	1,000kg	I have never gone beyond 25 sacks	I only have an axe so that limits the volume I can make
Adda-3 (hills)	1	10 x 25kg 10 x 12.5 kg	375kg	Don't know – this is the first time I have made charcoal	A big tree in my field fell down. I called a charcoal maker to show me how to make charcoal. I have made it once and there is enough for a second time. I won't continue after that.
Adda-4 (hills)	2	40 x 25kg	2,000kg	Output varies depending on wood availability	

Table 5.5: Time spent charcoal making and income percentage coming from charcoal making

Location of charcoal maker	% of time spent on charcoal	Comments	% of income from charcoal	Comments
Kowe (coast)	Not much time	I don't try to make charcoal in the rainy season	High income in certain seasons	During the clove picking season there's lots of demand because lots of people make kebabs to sell by the side of the road.
Lingoni (coast)	Occasional only	I am mainly a farmer	I don't know	It makes some income
Ngandzale-1 (hills)	85%	No precise time. Can start in dry season and end in rainy season	Worse income than I made in Mayotte	I shall make it three more times to cover medical expenses and food while my wife gives birth, then I shall start market gardening if possible
Ngandzale-2 (hills)	90%	I accumulate wood for a month before burning	95%	Sole activity for several years.
Ngandzale-3 (hills)	80%	Mainly in the dry season	3%	Most of my income is from agriculture and cash crops. I am very tired of charcoal making.
Ngandzale-4 (hills)	80%	I make charcoal in the dry season	50%?	I used to distil ylang-ylang but no money now to buy flowers or run an alembic, So I make charcoal and raise animals.
Adda-1 (hills)	Maybe 70%	If I get the wood, I make charcoal in any season	2%	Main income is agriculture and livestock. Charcoal income is small but I don't like to see residues rotting on the ground
Adda-2 (hills)	80%	The dry season is best for making charcoal	5%	My main activity is agriculture. I do this through lack of alternatives. I have 7 children I have to feed, educate and buy clothes for and 20-25 sacks of charcoal raise the money for that.
Adda-3 (hills)	80%	(80% When making charcoal). But I also do agriculture and livestock raising. The dry season is best for making charcoal	?	I am new to charcoal-making. I don't think it will contribute as much to income as growing potatoes or raising livestock.
Adda-4 (hills)	About 70%	I have no precise season for making charcoal – if I have sufficient wood, I set to work.	3%	I do this because I lack alternatives. But it does not contribute much to my income.

Table 5.6: Prices by location of sale and by size of sack

INTERVIEWEE LOCATION	PLACE OF SALE AND SACK SIZE					
	Production site/ side of the road		Home village		Town	
	25 kg	12.5 kg	25 kg	12.5 kg	25 kg	12.5 kg
Kowe	6000	3000	6000	3000	6000	3000
Lingoni	3500-4000					
Ngandzale1 (sachet 500)			7000	4000		
Ngandzale2			6000	3000		
Ngandzale3 (sachet 500)			5000	2500		
Ngandzale			5000	2500		
Adda1 (sachet 500)			2500	2000		
Adda2			5000	2500		
Adda3			7000	3500		
Adda4 (sachet 500)	3500	1750				

5.5 Species used for charcoal

Table 5.7 Shows the tree species used most frequently for charcoal by the charcoal makers interviewed, while Table 5.8 details the species that would be used ideally if they were available. Table 5.9 summarises these two tables comparatively, and in visual form.

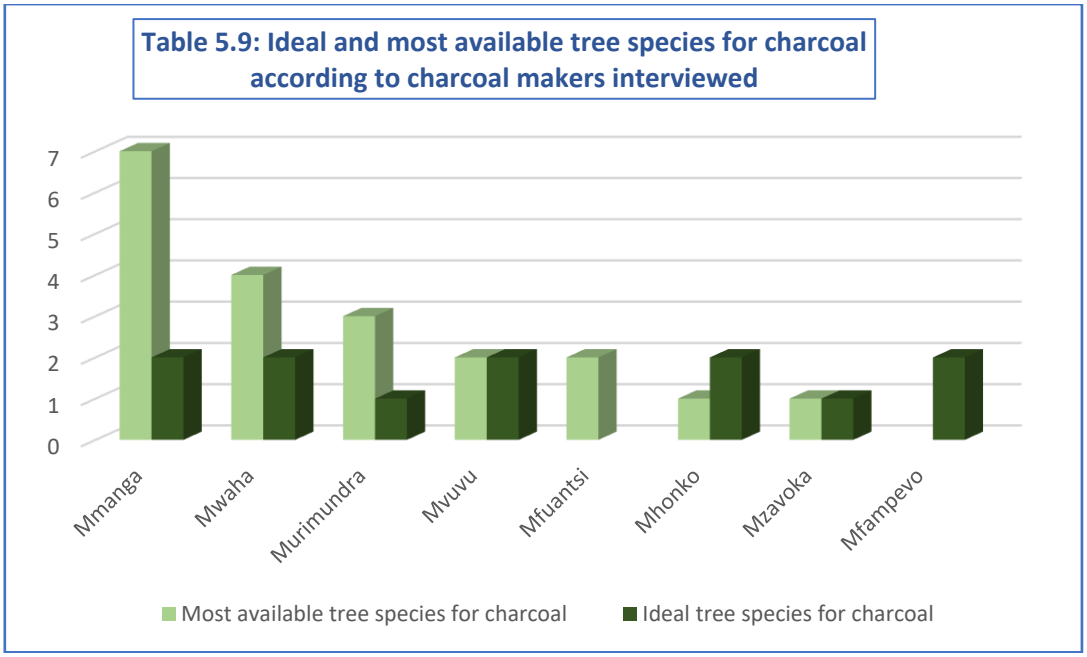
In terms of availability, Mmanga is extremely important for charcoal just as it is for doors and furniture, for the bodies of pirogues, for firing ylangylang alambics and for domestic fuel wood. Other species also have high value in other contexts: Murimundra is used for the bodies of pirogues and for housebuilding, and Mfuantsi, Mfuantsi, Mhonko and Mvuvu are widely used for doors and furniture. Mwaha has a competing value for housebuilding as well as for charcoal.
Other species such as Mzavoka are less valued and would really only be used otherwise for fuelwood and in ylangylang alambics.

Table 5.7: Species used most frequently by charcoal makers interviewed

Location of charcoal maker	Comments	Local name	Latin name
Kowe (coast)		Mwaha	Nuxia pseudodentata
		Mmanga	Mangifera indica
Lingoni (coast)		Mwaha	Nuxia pseudodentata
		Mouzafouka	Persea americana
		Mkarafou	Syzigium aromaticum
		Mmanga	Mangifera indica
Ngandzale-1 (hills)	some people also use the Mpapa, but I don't because where you find it you find water and it can protect water sources and streams. If I cut it we could all die of thirst here in the village.	Mmanga	Mangifera indica
		Mwaha	Nuxia pseudodentata
		Mwiri mundra	Weinmania comorensis
		Mkanyane	Macaranga
Ngandzale-2 (hills)	I just use mango. People often sell mango trees to us.	Mmanga	Mangifera indica
Ngandzale-3 (hills)		Sandragon	Pterocarpus indicus
		Mmanga	Mangifera indica
		Mwaha	Nuxia pseudodentata
		Mvouvou	Ficus lutea
Ngandzale-4 (hills)		Mmanga	Mangifera indica
Adda-1 (hills)	I collect up dry residues so I am not sure what they are	-	-
Adda-2 (hills)	I use the most common species round here	Mwiri Mundra	Weinmania comorensis
		Mhonko	Rhizophora mucronata
Adda-3 (hills)		Mvuvu	Ficus lutea
		Mfuantsi	Chysophyllum gorungosanum
Adda-4 (hills)	You can use any species except those with a soft trunk like pawpaw such as Msakua (Spondias cythera) or Mtregemwe (Cussonia spictata).	Mfuantsi	Chysophyllum gorungosanum
		Mwiri mundra	Weinmania comorensis
		Mpapa	Antholeista grandiflora
		Mmanga	Mangifera indica
		Msiro	Albizzia saman

Table 5.8: Species regarded as ideal by charcoal makers interviewed

Location of charcoal maker	Comments	Local name	Latin name
Kowe (coast)		Mtsongoma	Psidium cattleianum
		MBushi	Litsea glutinosa
Lingoni (coast)		Mwaha	Nuxia pseudodentata
		Mouzafouka	Persea americana
Ngandzale-1 (hills)	This wood is very hard – would need a chain saw	mfapevo	Calophyllum recedens
Ngandzale-2 (hills)	There is really no more forest – even charcoal makers are discouraged by the lack of these species.	Mhonko	Rhizophora mucronata
		Shivoudze	Phyllarthron comorense
Ngandzale-3 (hills)	These are the best species because they are really hard and burn well	Mvuvu	Ficus lutea
		Mwaha	Nuxia pseudodentata
		Mwiri Mudra	Weinmania comorensis
Ngandzale-4 (hills)	People used to prefer charcoal from species like Mwaha and Mwirimudra but now that these species are no longer available, they do appreciate mango. I always use mango, partly because I stay close to the village to make my charcoal	Mmanga	Mangifera indica
Adda-1 (hills)	Mango is much valued for charcoal because it burns very well	Mmanga	Mangifera indica
Adda-2 (hills)	There is one species above all which is valued for charcoal and that is the Mhonko. It is a hard dry wood which produces good charcoal burning slowly and well	Mhonko	Rhizophora mucronata
Adda-3 (hills)	The most highly valued species for charcoal is the Mvuvu. These trees are big and old and the wood is hard so the charcoal burns slowly and very well	Mvuvu	Ficus lutea
Adda-4 (hills)	There is a particular species which is highly valued for charcoal and it is the Mfapevu. It burns very well.	mfapevo	Calophyllum recedens



5.6 : Provisional conclusions

Because we do not yet have data on charcoal volumes it is impossible to guess how far charcoal production puts pressure on available tree and forest resources in the Moya area.

Domestically, charcoal is important only on special occasions over the course of the Islamic year when grilled meat is a desired addition to the menu. Wealthier households are already switching to the use of stoves using LPG gas. Commercially, the constant growth of kiosks and small shops selling brochettes for busy workers was noted by several informants. Covid 19 has temporarily limited this growth because of the curfews imposed every evening (so that brochettes are currently only sold at lunchtime), but the potential for much higher charcoal use in this sector will eventually make itself felt once the population is mainly vaccinated and the pandemic wanes.

Charcoal production in Anjouan is not a very developed activity. It seems that some people practise in in their spare time, but - at least in this part of Anjouan - it is not a full time activity but is rather practised alongside other agricultural activities. The limited data we have so far suggests that the annual quantities of charcoal produced from Moya's trees and forests are far exceeded by the quantities collected for firewood and for firing up alambics.

In terms of impact on biodiversity, or on Anjouan's tree-cover, we do not have enough data to be able to say anything definitive. The species most appreciated are of course hardwoods, and the main charcoal sources for these are either old indigenous trees coming to the end of their lives in farmers' fields, or charcoal made from left-overs after a forest tree is felled and sawn up for planks or chevrons by a professional with a chain saw. Introduced species are less valued, with the exception of mango.

5.6.1: eventual next steps

So far, however, our supply-side data are very limited indeed, and a demand-side survey of roadside restaurants and kiosks selling grilled meat will eventually give us a much clearer picture of the volumes of charcoal likely to be being produced.

6: Results

The amount of biomass being taken out every year from the Moya region's forest and fields is difficult to assess, but is high. It is striking how much financial benefit it is providing as well. This section of the report first attempts to quantify those two factors, drawing on the data laid out in Sections 2, 3, 4 and 5, and then turns to probable impacts on biodiversity.

6.1 Annual Biomass removals from Moya region's forest and fields

6.1.1 Fuelwood

Section 2.8 provides a woodfuel use estimate for the Moya region using a figure for per capita consumption of fuelwood 0f 0.77kg calculated through weighing fuelwood piles for four consecutive days in a sample of households and finding out how many people ate at mealtimes each day. Using census figures for all the villages and towns around Moya forest, the report presents figures for 2017 (the year the survey reported on was undertaken), 2019, and 2025. The total fuelwood tonnage for the area in 2017 was about 12.6 tonnes, rising to 13.3 tonnes in 2019 and projected to rise to 15.5 tonnes by 2025.

6.1.2 Wood used for the distillation of ylangylang

Section 3 presents data on woodfuel use in the alambics around Moya forest. The measurements taken indicate how much wood is used each time one of the 41 alambics is fired up. Total wood use for the firing of all alambics once each would come to 37.3 (37,351) tonnes.

Earlier Dahari work suggests that alambics are typically fired up 15 times a month, for six month of the year. If this is the case here, then each of the 41 alambics is used about 90 times a year. This level of use would demand 37.3 tonnes x 90 – a truly colossal 3,357 tonnes a year.

Sources of the great volumes of fuelwood used for ylangylang distillation must be from accessible sources near to roads ('*Forest Resource Use Preliminary Results', 2013*) and the current survey indicates that 96.4% comes from trees in fields and only 3.6% from the forest.

6.1.3 Timber removals for construction, furniture and pirogues

An 100% sample of woodcutters in the villages of Adda, Ngandzale, Salamani, Ouzini, Moya, Nindri, and Pomoni showed that, between them, they estimated that they felled around 1168 trees per year (Chart 4.3).

According to them, this timber goes to eleven towns and villages where there are workshops for furniture, construction and doors. By far the most important of these are Domoni and Mutsamudu, followed by Mirontsi. After them in importance come Salamani, Pomoni and Tsembehu.

Woodcutters asserted that timber for furniture accounted for an average of 78% of all the timber they sold, while timber for construction accounted for an average of 18%. The remainder goes for pirogues (about 4%) (Chart 4.5).

In terms of trees, this means 911 trees felled for transformation and sale to carpentry and joinery workshops, 210 trees felled for house construction purposes and 47 trees felled for making the main body of pirogues.

Workshop owners made it clear that almost the entire volume of timber purchased by them went on furniture or doors. They suggested that 90-95% of the timber they bought was used for these purposes, both planks and chevrons. Domoni and Mirontsi were in aggregate the largest purchasers of timber for transformation into doors and furniture, with Adda, Ngandzale and Moya using only half or a third as much.

In the case of the twenty workshop proprietors interviewed, typical monthly consumption varied a good deal by village. However, since the total number of workshops per village was known, it was possible to calculate total demand per month per village and thus total annual demand for the region. (Chart 4.13).

The annual total for the Moya region as a whole calculated from figures here was 4,896 chevrons and 30,828 planks.

Of the 911 trees we assume are sawn and sold to workshops, we can hypothesize that if one tree produces 13 chevrons (an average[14] of the chevrons typically sawn from farm trees and the number typically sawn from forest trees) then 377 trees are used for chevrons (using the figure of 4896 for total numbers of chevrons per year from Chart 4.13). From the remaining 534 trees, 30,828 planks (Chart 4.13) can be sawn at an average rate of 58 per tree[15].

6.1.4 Tree Removals for charcoal making

We do not yet have the data to complete this section.

6.2 Prices and value of manufactured products

This section presents the information on prices obtained during interviews. It will be seen that planks come in a series of fixed sizes:

1.5m x 5cm
2m x 3cm
2m x 5cm
2m20 x 3cm
2m20 x 5cm
3m x 5cm
Tree owners may also pay a price for the felling of a whole tree rather than paying by the board.

The price tree owners get for their planks often has to include the price paid to a woodcutter for the creation of that board, so what woodcutters get per board may be lower than the farmers' price. But in other cases, the price is the same, board size for board size. (Charts 5.2.1 and 5.2.2). Perhaps the woodcutter in that case effectively pays the farmer for the board and sells it on for him to workshop proprietors.

Prices paid by workshop proprietors for planks of different lengths and thicknesses are clearly higher than prices paid earlier in the chain, and it is also very evident that purchase prices are higher in big centres like Domoni and Mirontsi than they are in Adda, for instance. A board 2m x 3cm is typically

[14] About 10 chevrons can be cut from a farm tree and 15 from a forest tree.
[15] Average numbers of planks from trees are 68 for on-farm trees and 40 for forest trees (Chart 4.3)

sold by a tree owner for 2000- 2500 kmf ($5-6). But a workshop owner in a smaller centre will pay 3500-4000 kmf for it ($8-9) while one in a large centre like Domoni or Mirontsi will pay 6000-7000kmf ($13-16). So middle men such as woodcutters and transporters are making a profit per board of between $3 and $8.

Chart 6.1: Examples of prices obtained by tree owners per board (various sizes) or per tree

Village	1.5m x 5cm		2m x 3cm		2m x 5cm		2m20 x 5cm		3m x 5cm		Trees	
	kmf	$	kmf	$	kmf	$	kmf	$	Kmf	$	kmf	$
Adda	3000	7	2500	6	4000	9	6000	13			15000	34
Adda											25000	56
Outsa	1500		2000	5								
Salamani					5000	11			7000	16		
Ouzini					5000	11						
Moya					5000	11						

Chart 6.2: Prices paid to woodcutters for felling trees and cutting planks

Village	2m x 3cm		2m x 5cm		Village	Whole Trees	
	kmf	$	kmf	$		kmf	$
Adda	2000	5	4000	9	Adda	15000-25000	34-56
Adda	2000	5	4000	9	Moya	10000	22
Adda	2000	5	4000	9	Moya	15000	34
Adda	1500	3			Nindri	10000	22
Adda	2000	5			Pomoni	10000	22
Adda	500	1					
Adda	1000	2					
Adda	1500	3					
Ngandzale	2000	5					
Ngandzale	2000	5					
Ngandzale	2000	5					
Ngandzale	2000	5					
Ngandzale	2000	5					
Salamani	2000	5					
Salamani	2000	5					
Salamani	2000	5					
Salamani			3500	7.8			
Ouzini	2000	5					
Ouzini			3500	7.8			
Moya	1500	3					
Nindri	1000	2					
Nindri	1000	2					
Nindri	1000	2					

Chart 6.3: Prices paid by workshop proprietors for planks of different lengths and thicknesses									
	2m x 3cm		2m x 5cm			2m20 x 3cm		2m20 x 5cm	
Village	kmf	$	kmf	$	village	kmf	$	kmf	$
Adda	4000	9	10000	22	Ngandzale	4500	10	4500	10
Adda	4000	9	7500	17	Ngandzale	4500	10	4500	10
Adda	3500	8			Moya	3500	8	5500	12
Adda	3500	8	4500	10	Moya	3500	8	5500	12
Ngandzale	3500	8	4500	10	Moya	3500	8	5500	12
Domoni	6000-7000	13-16	10000	22	Moya	3500	8	5500	12
Domoni	5000-7000	11-16	10,000	22					
Domoni	6000-7000	13-16	10000	22					
Domoni	5000-7000	11-16	10000	22					
Domoni	6000-7000	13-16	10000	22					
Mirontsi	6000-7000	13-16	10000	22					
Mirontsi	6000-7000	13-16	10000	22					
Mirontsi	6000-7000	13-16	10000	22					

Workshops buy chevrons (2m. long and 9cm x 9cm in width and depth) for 3000-4000 kmf ($7-$9) and though board prices vary in size and by places where they are purchased, an average could be set at 4000 kmf ($9). Planks for construction tend to be made from lower value wood and a lower price for them has been chosen here. Using data from section 5.1.3 the following calculation can be made:

Chart 6.4: Annual value of timber for construction, furniture and pirogues				
Wood product	Value per unit	number of units	Value in kmf	Value in dollars
Chevrons	3500	4896	17,136,000	39,168
planks for furniture workshops	4000	30828	123,312,000	277,452
planks for construction	3500	12180	36,540,000	85,260
whole trees for dug-out pirogues	13000	47	611000	1363
TOTALS			**Kmf 177,599,000**	**$403,243**

So, at a conservative estimate the annual value of timber, construction and pirogues in this part of Anjouan approaches half a million dollars a year. And this excludes the value added by carpentry and joinery workshops turning planks and chevrons into furniture and doors, information which proved very difficult to collect from interviewees in the end.

The value of the transformed timber, together with the value of outrigger canoes was calculated at $403,243 per annum. This excludes the value added when planks and chevrons are made into furniture and doors and sold on again. It also excludes the prices or shadow prices of trees felled by householders themselves for their own private use or sale. We were not able to quantify either of those components, but they clearly bring the overall value of the timber component of this study to well over half a million dollars.

6.3 Implications for biodiversity and the future

6.3.1 Forest trees

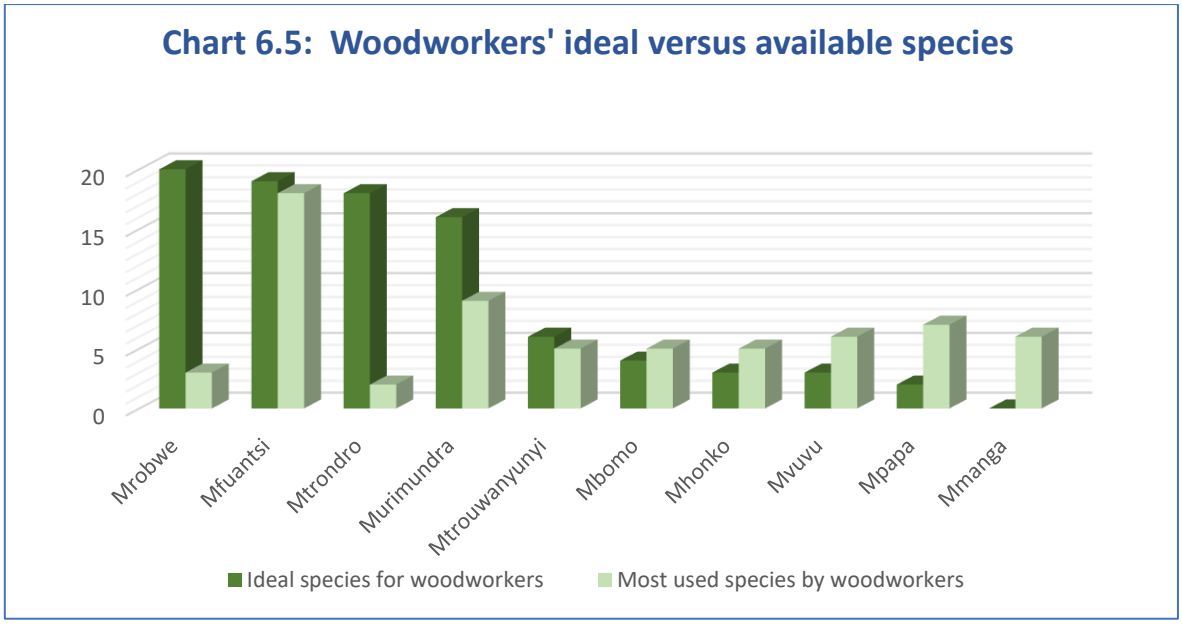
There has clearly been a tremendous loss of tree biodiversity – and thus of the animal, bird and other biodiversity dependent on forest - in the Moya forest area over the years. This began in the days of the colonial Sociétés (commercial agriculture and logging companies) who exploited timber in the Comoros for much of the 20th century. The Société de Bambao[16], for instance, in existence from 1893 – 1975, ran almost a monopolistic 'state within a state' in the Comoros and was very active in Anjouan. The attrition continues, and forest cover in the islands as a whole reputedly fell from 12,000ha to 3,000 ha between 1990 and 2010 (UN FAO).

Livingstone bats in the Moya forest. Their preferred tree species is Mrobwe - Ocotea comorensis - a species which is rapidly disappearing (Credit: Bronwen Daniel, Dahari)

Within the confines of the data collected and reported on here, it is possible to see that demand for hardwood species for doors and furniture is already threatening some of Anjouan's best indigenous hardwoods, and that second-order substitutions are already making inroads into other species.

The top four species mentioned in Chart 5.2.4 in the 'ideal species' dark green line - Mrobwe (Ocotea comorensis), Mfuantsi (Chrysophyllum gorungosanum), Mtrondro (Khaya comorensis) and Murimundra (Weinmania comorensis), are all excellent indigenous hardwoods. Mrobwe and Murimundra are endemic species as well.

[16] Mouhssini Hassani El-Barwane *'La Societe coloniale de Bambao Comores (1893-1975)' 2015.* Editions KomEdit,Moroni Comoros.



The pale green bars show that Mrobwe (Ocotea comorensis) and Mtrondro (Khaya comorensis) are rapidly disappearing, and interviewers heard of one or two other species that had already been all but completely logged out such as Mtsinguizou and Mgarnati (indigenous hardwoods, unidentified botanically). The pale green bars suggest that Murimundra (Weinmania comorensis) will be the next in line to disappear. Mfuantsi (a white wood) is still relatively available.

As these species disappear, others are coming under threat such as Mtrouwanyunyi (Calophyllum recedens), Mbomo (Tambourissa leptophylla), Mhonko (Rhizophora mucronata), Mvuvu (Ficus lutea) and Mpapa (Antholeista grandiflora). These too are all indigenous species.

Data from the survey of woodcutters (charts 4.8 and 4.9) shows that their top four preferred species for felling and sale are unsurprisingly the same as those of wood workers. Their preferred second order species include Mvuvu (Ficus lutea) and Mhonko ((Rhizophora mucronata) but then diverge towards Chivunze (Phyllarthron comorense) and Mnyamba (Terminalia catappa) - all similarly indigenous. Mhonko (Rhizophora mucronate) and Chivundze (Phyllarthron comorense) receive few mentions as ideal species, but are rated highly by woodcutters for still being available in good quantities.

Chart 4.7 (Tree species cut by woodcutters in farmers' fields in order of importance) is also of interest for attempts to follow through the decline of forest resources in the Moya region of Anjouan. It is noteworthy at least seven species (marked in green on the chart) are species also on the forest list, many of them indigenous hardwoods. These valuable remnant trees are becoming isolated in farmer's fields as fields are cleared up into the original forest. They probably cannot reproduce there, and gradually become an impediment to the farmer. Sooner or later they are cut – either (as farmers themselves said when interviewed) because they are threatening crops or have already fallen over, or because they represent a useful one-off source of income in times of need.

Mentions included Mpapa (Antholeista grandiflora), Chivundze (Phyllarthron comorense), Mfuantsi, (Phyllarthron comorense), Mhonko (Rhizhophora mucronata) and even Murimundra (Weinmania comorensis), Mtrondro (Khaya comorensis) and Mrobwe (Ocotea comorensis) though in small numbers.

The trees chosen for house construction materials are of lower commercial value than trees for doors and furniture. As far as forest trees are concerned, Mhonko (Rhizophora mucronata) seems to be the species of choice, failing Mrobwe (Ocotea comorensis) which is now almost too rare to be considered for this end use. Modest use is made of Mshelele (Brachylaena ramiflora) and Mwaha (Nuxia pseudodentata) which is more widely used as a fuelwood tree.

Finally, the preferred forest species for hollowing out the main body of pirogues are of interest. Mtrondro (Khaya comorensis), Murimundra (Weinmania comorensis) and Mnyamba (Terminalia catappa) are desired if available, followed by Mtrouwanyunyi (Calophyllum recedens). But Msiro (Albizia saman), an introduced species, is increasingly substituting for these hardwoods.

6.3.2 Agroforestry trees

As earlier sections show, a hierarchy of tree species exists, following a hierarchy of uses. The only non-forest tree that is really acceptable for doors and furniture is the mango: its hard, durable wood gives it a value which few other introduced trees can meet.

Timber for house construction occupies an interesting position in this hierarchy. It draws in part on less valuable - and more available – forest species. Increasingly, however house construction relies on the use of coconut wood, (mnadzi), the jackfruit tree (mfanassi) and fast-growing exotics such as Casuarina equisetifolia (mvinja) and Eucalyptus robusta (mkalkis).

Below house construction again comes wood fuel for ylang-ylang distilleries (96.4% from farm species and only 3.6% from the forest). And finally, domestic fuelwood, made up of similar proportions of on and off-farm species.

The great extent to which many of Anjouan's lower slopes have been turned into agroforests because of the intensity with which fruit trees and commercial tree species such as ylang-ylang and cloves are grown on them has actually protected the forests on the upper slopes to some extent, though clearly not enough, since population growth has been high.

7.0 Conclusion

The major challenge now for the agencies which, like Dahari, work with local communities on Anjouan is to intensify both the protection and enrichment of the forest on the upper slopes, and simultaneously to intensify agroforestry and tree planting for all purposes in the farms on the lower slopes. Dahari has already made very good progress on both of these endeavours.

Annex 1: Trees species mentioned in the report

Comorian names	Scientific names	Status	Fuelwood	Charcoal	Ylangylang	Timber from farm	Timber from forest	Timber for pirogue bodies
Chihidziya	?	?					*	
Chivundze, / Shivoudze/hadza	Phyllarthron comorense	Indigenous		*		**	****	
Cocotier seche	Cocos nucifera (dried parts of tree	Introduced	*		***			
Coumbi	Cocos nucifera immature nuts	Introduced	*					
Gliricidia	Gliricidia sepium	Introduced			***			
Komolasua	Strychnos mitis	Indigenous					**	
Masangari	Cocos nucifera Inflorescence	Introduced	*					
Mavindro	Cocos nucifera (shell, coir)	Introduced	***		*			
Mbanjeou, Mfuantsi	Chrysophyllum gorungosanum	Indigenous		**		**	****	
Mbaruti/Msandrago	Pterocarpus indicus	Introduced	***	*	***	*		
Mbaruti wa shinzwani	Albizia lebbeck	Introduced			**			
Mbesi	Trema orientalis	Introduced						
Mbibo	Anacardium occidentale	Introduced			*			
Mbomo, mdjarou,	Tambourissa leptophylla	Indigenous					**	
MBushi/Mzavoka maro	Litsea glutinosa	Introduced	****	*	**			
Mfanassi	Artocarpus heterophyllus	Introduced			*	****		**
Mfapevo/ mfampevo/ Mtrouwanyunyi	Calophyllum recedens	Indigenous		**	***		**	****
Mjadzia	?	?			*			
Mhonko	Rhizophora mucronata	Indigenous		***		**	***	
Mikalakatsa	Senna floribunda	Introduced	*					
Mkanyane	Macaranga	Indigenous		*				
Mkarafou,	Syzygium aromaticum	Introduced	****	*	**			
Mkassia (moudjitabou),	Acacia auriculiformis	Introduced	*		**			

Comorian names	Scientific names	Status	Fuelwood	Charcoal	Ylangylang	Timber from farm	Timber from forest	Timber for pirogue bodies
Mkindrikindri, Murimundra	Weinmania comorensis	Endemic	*	***		**	****	****
Mkinini, mkalkis	Eucalyptus robusta	Introduced	*		**	***		
MKora	Rheedia anjouanensis	Indigenous	**					
Mmanga	Mangifera indica	Introduced	****	*****	****	****		**
Mnadzi	Cocos nucifera	Introduced				****		
Mnyamba	Terminalia catappa	?Indigenous?			*		*	****
Mnyafundre	?	?			**			
Mougou	Acacia farnesiana	Introduced	*					
Mouhamba	Securinega virosa	Indigenous	*					
Moutzouzi	Cajanus cajan pigeon pea stalks	Introduced	*					
Mpamba fuma	Ceiba pentandra	Introduced?			*			
Mpapa	Antholeista grandiflora	Indigenous		*		***	***	
Mrobwe	Ocotea comorensis	Endemic				*	****	
Mrovu	Cordia myxa	Indigenous			*			
Mshelele	Brachylaena ramiflora	Indigenous					*	
Mshihi dziya, Mshuhi mambe	Ficus sycomorus	Indigenous			*			
Msiro	Albizia saman	Introduced	**	*	***	*		****
Mtek	Gmelina arborea	Introduced				*	**	
Mtrengemwe	Cussonia spictata	Indigenous				*		
Mtrondro, Mpori, Mlandrema, Mnyombembe, Mtakamaka	Khaya comorensis	Indigenous				**	****	****
Mtsongoma	Psidium cattleianum	Introduced		*				
Muhadjou	Tamarindus indica	Introduced						
Murundra ntsole,	Phyllanthus pervilleanus	Indigenous	*		*			
Murichikele	?	?					**	

Comorian names	Scientific names	Status	Fuelwood	Charcoal	Ylangylang	Timber from farm	Timber from forest	Timber for pirogue bodies
Mvesa	?	?	*					
Mvindja	Casuarina equisetifollia	Introduced			***	***		
Mvunge	Moringa oleifera	Introduced			*			
Mvuriapa	Artocarpus altilis	Introduced	**		**	**		**
Mvuvu	Ficus lutea	Indigenous		***	****		***	
Mvwera	Psidium guajava	Introduced	**		*			
Mwaha/Moiha	Nuxia pseudodentata	Indigenous	***	****	***		*	
Mzavoka/Muzafouka	Persea americana	Introduced	**	*	*			
Mzilanze / mjilanze	Albizia glaberrima	Indigenous			**	*	*	****
Mzumwiri	?	?			*			
Pindre	?	?	*					
Rambu	Piper betle	Introduced					*	
Ylang ylang	Cananga odorata	Introduced	***		***			

	Unidentified or mis-recorded species	***	Highly valued in the category