

Improving the Sustainability of Wood Supplies in Tanzania in the 1990s

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Abstract

This paper presents research about the systems through which wood flows from resource areas to urban users in Dar es Salaam and Mwanza, Tanzania. The objective of the paper is to explain the nature of the wood systems and to identify their underlying institutional framework to provide the basis for policy suggestions to improve the sustainability of wood supplies to the two towns. A grounded theory methodology based on 306 open-ended interviews is used to develop descriptions and explanations of two wood systems that are presented as sub-sector maps. The consumption pattern of wood for both towns is presented and consumption estimates are presented for Dar es Salaam. The dispersed nature of the indigenous forests, limited finance for monitoring and a desire to retain the benefits of the wood systems' high employment creation produce, in the absence of forcible control, an ungovernable resource. This makes sustainable extraction of indigenous hardwoods unlikely unless effective local community participation in forest management can be established in the near-future. Sustainable extraction of softwood is achievable and would involve improving incentives to regional forestry staff by allowing a greater proportion of revenues they collect to stay in the Regions to finance re-planting and plantation management.

Keywords: Employment creation, forestry policy and regulation, hardwood, softwood, sustainability, Tanzania.

INTRODUCTION

This paper considers some of the challenges facing the construction sector in developing countries by virtue of construction being a major user of wood resources. It presents research about the wood markets and systems used to extract and provide wood to the towns of Dar es Salaam and Mwanza in Tanzania. The argument of the paper is that the sustainability of domestically produced wood resources is critical to construction and that improvements in sustainability of wood production can be achieved by improving the institutions that regulate wood production. An important extension to the argument, that institutional improvements must produce outcomes that reflect national priorities such as poverty alleviation and job creation, constrains the set of potential institutional adjustments available as will be seen in the case of hardwood. Research of this type is important to construction stakeholders as it facilitates informed participation by them in debate about timber and the forestry sector, a sector in which construction has a clear interest.

The research presented here¹ is set in the context of the need for sustainable management of natural resources in the face of rapid urbanisation and the attendant needs of shelter provision and affordable

building materials for expanding urban populations. Broader consequences of the decisions made about timber-based construction materials include the effects on the balance of payments (generally there should be pressure not to import timber and to export it) and the environmental impacts of extraction of trees on watershed management, the carbon cycle and bio-diversity associated with forest habitats.

The paper focuses on the challenges facing the industry collectively at the strategy and policy level. Actions that could be taken at the level of the firm (for example reducing the over-design of trusses or re-using timber formwork) are not addressed. Also excluded from debate here are issues to do with prolonging the life of timber by preservatives, etc.

Methodology

The general methodology adopted for the research is grounded theory. The idea is that theory (understood to consist of a plausible relationship among a set of concepts) evolves during research through interplay between data analysis (to identify patterns in the data and thence concepts and theory) and data collection [Strauss and Corbin, 1998]. The grounded approach was adopted as it was appropriate for the research subject and because a coherent body of knowledge or theories about the connections between wood resource production, exploitation and use in African countries could not be identified. This, and the dearth of relevant credible statistical data, meant that research was reliant on primary data collected from people working within the wood systems. Open-ended interviews were selected as the data collection technique as this method allows respondents to explain the world in the way they understand it rather than being prescribed the format of their response as happens when using questionnaires.

Fieldwork took place between 1997 and 1999. Interviewing commenced in the urban areas, with a stratified sample of wood retailers. These respondents identified their 'forward linkages' to users of wood and 'backward linkages' to suppliers. From this information, the main groups of users (furniture makers, housebuilders and building contractors) were identified and interviewed. Interviewing then moved to the supply areas and to the major staging posts within the source to urban chain. Here, the selection of who was interviewed was decided in a pragmatic way - those who were most likely to be able to provide an overview of the system (e.g. forest officials) and of their own business activity within the systems (e.g. pit-sawyers) were sought for interview. Interviews were conducted with a total of 306 respondents drawn from the main groups of actors involved in the provision, extraction, production, marketing and use of construction wood in Dar es Salaam and Mwanza. The breakdown of respondents is shown in Table 1.

The analytical and explanatory techniques of sub-sector analysis and commodity chains were found useful to the research. Explanations from the sub-sector approach are presented in this paper.

THE USERS OF WOOD IN DAR ES SALAAM & MWANZA

In both towns wood remains an essential commodity being used for fuel (for cooking, heating and light), for shelter production (poles, sawnwood), for fitting out buildings (joinery and furniture) and for utensils (bowls, grinding & mixing, and cutlery). Large amounts of wood is used in construction in temporary works (scaffolding, formwork, props) and in permanent uses (doors & door frames, window frames, joinery, roof construction, etc.). Wood-based industry, mainly furniture-making, is usually the largest employer and value-adder in the informal sector in African towns (see Tanzania Informal Sector Survey, 1991).

Housebuilding creates a major demand for wood. Traditional mud and pole construction requires a large number of poles (usually classified by diameter, preferred and non-preferred species, amount of seasoning and length) of different species for different elements of the structure. Mud and pole construction is declining in

Table 1: Interviewing Sample for Wood Production

Urban respondents	Dar es Salaam	Mwanza	Respondents in the forest	Hardwood producers	Softwood producers
Furniture makers	46	14	Transporters/dealers	14	7
Housebuilders	19	4	Sawmillers	7	19
Building contractors	4	4	Pit-sawyers	18	3
Retailers	101	17	Forest officers	11	13
			Private tree farmers	0	5
Total	170	39	Total	50	47

Source: Construction Wood Markets

Dar es Salaam and Mwanza concurrently with increases in price of preferred pole species and a decline in their availability. Nevertheless, houses using this construction are still built on the outskirts of the towns and materials are resources from adjacent forest areas. In town centres the construction of housing using industrially produced materials is now dominant. Sawn softwood is the preferred material for the roof structure and the cheapest pine is used for formwork to the ring beam. Houseowners prefer hardwood doors and door frames and window frames if they can afford them otherwise softwood is used. Higher income households spend more on their houses and consume more timber. In particular the amount of joinery in the house increases, the roof covering (and consequentially roof structure) changes and ceilings are introduced.

Non-housing construction uses hardwood for doors, door frames, window frames and joinery, and softwood is used for roof structures and temporary works. Smaller contractors prefer the cheaper hand-cut timber (and use more labour in fabrication) whereas larger firms tend to use machine-cut timber. Reinforced concrete construction uses large quantities of wooden formwork and poles as props. From the late 1990s new planning requirements for central Mwanza specify multi-storey buildings; this will produce an increase in pole demand.

On the largest buildings there is evidence of substitution away from wooden formwork and props to steel. It is unclear whether this is on grounds of speed, cost, or greater accuracy or whether new technology has come with expatriate contractors. Substitution to aluminium windows and doors has occurred in high cost buildings. This is explained by fashion, faster construction and the need for air-tightness in air-conditioned space.

Estimates of consumption of wood in Dar es Salaam²

Reliable directly estimated figures for wood consumption are unavailable. Thus, consumption has to be estimated indirectly from updated older figures, by analysis of fieldwork results and informed estimates. Table 2 shows the results of such calculations. The estimates shown triangulate with supply-side estimates.

The research concluded that most of the wood entering Dar es Salaam and Mwanza was for construction and furniture. Other miscellaneous uses include hardwood for the bodies of railway wagons and boat building and softwood for packing cases. The important connection between construction and the provision of wood to meet demand associated with construction evidenced here oblige construction stakeholders to take an interest in timber beyond self-interested concern about availability of future supplies to impacts of wood extraction on the environment and development more broadly. The next section considers the methods used to extract and deliver timber to construction and furniture making. From this some of the broader issues emerge.

THE SUPPLY-SIDE: HARDWOOD

In Tanzania hardwood timber comes from the natural forests and it is sawn by hand using the pitsawing³ method. At the moment the main sources are the miombo woodland in the Tabora and Rukwa Regions, pockets

Table 2: Estimated Wood Consumption, Dar es Salaam^a, 1998

Source	Poles Nr.	Softwood m ³	Hardwood m ³	Total sawn timber m ³
Household furniture ^b av.		24,000	24,000	48,000
House construction ^c md. min to max.	593,766 448,000 to 857,060	15,057 10,752 to 17,016	18,239 5,376 to 18,239	33,296 16,128 to 35,089
Pit latrines ^d av. min to max.			8,230 5,338 to 11,121	8,230 5,338 to 11,121
Large projects ^e av. min to max.	2,500,000 1,280,000 to 3,840,000	64,000 51,200 to 76,800		64,000 51,200 to 76,800
Total av. min to max.	3,093,766 1,728,000 to 4,697,060	103,057 61,952 to 93,816	50,469 34,714 to 53,360	153,526 120,666 to 171,010

Source: Construction Wood Markets

Notes:

av. - average; md. median case.

- Intermittent consumption by large firms and by government are excluded.
- Calculated from Household Budget Survey (1991/2) adjusted for population growth (at 4.8%) & inflation.
- Calculated from fieldwork data & population growth & median living space (4.5 m²/capita) figures.
- Superstructure construction materials not included; timber is usually cleaved & hewn (rather than sawn) mikurunge/mikongowele.
- Hardwood quantities omitted as are very variable depending on fit-out design.

of forest in Morogoro and Tanga Regions and the coastal forests in Kilwa and Lindi Regions. The first source supplies Mwanza and Dar es Salaam, the second and third supplies Dar es Salaam. In Tanzania the sourcing of hardwood shifts depending on the ease and cost of extraction. When easily extractable preferred species and sizes of trees are gone from one forest area extraction shifts to another area. This process is unregulated; our respondents did not describe any practices motivated by environmental protection or sustainable extraction. How extractors access information about the sites of prime prized species of trees for felling is an important and interesting question. Our respondents in the Tabora/Rukwa area reported an example in which the hunters and bee-keepers in rural communities collect the information while in the forest pursuing their primary occupations. This information passes to those in the community (often it seems associated with community leadership) who have good links with urban areas, including the urban timber markets, and business activity generally, including pit-sawing contractors. Urban orders for timber pass to those with urban-rural links who then organises production using a pit-sawing contractor or directly to the latter. The hunter or bee-keeper then acts as a guide to the contractors' work-force in return for a fee and presumably other agents also receive payment for information and facilitating the order. Besides shifting between areas extraction also shifts between species. Some of our respondents reported that mvule (*Chlorophora excelsa*) was once the species of preference whereas now mninga (*Pterocarpus angolensis*) is the most prized species. Current secondary species are mtundu (*Brachystegia spiciformis*) and mkoro/mkongo (*Azelia quanzensis*). Our research suggests that switching of species preferences is related to the price and scarcity of the species. There is some evidence of areas previously being logged for one species being logged for secondary species of increasing popularity.

The widespread use of pit-sawing (we found only two sawmills (at Ikwiriri) sawing hardwood) is interesting and requires explanation. Several factors appear to be relevant. First, the shift in areas of extraction has resulted in the old fixed sawmills being left stranded in areas without trees suitable for milling. Secondly, it seems that it is not viable to set up sawmills as a long-term business in areas currently being exploited because the resource is widely dispersed and is expected to be exhausted before the required rate of return on investment is produced. Other important reasons include the widespread

acceptance by the market of pit-sawn timber and the underlying economics and institutional arrangements that regulate the hardwood timber trade.

Regulation is supposed to work as follows. Those harvesting trees have to be registered with central government as a particular type of business and pay a flat fee. Once registered, a felling license (also from central government) has to be obtained before felling can commence. The amount paid for the felling license is variable depending on the volume (measured over bark) and species of tree to be felled. Agreement has to be reached with forest officers about the location of the felling. Once the trees have been felled a forestry official is required to hammer-mark the logs to certify felling is in terms of the license. Transporting logs requires a transit pass which is free on presentation of a valid felling license.

A number of problems arise in administering the regulations. First, many pit-sawyers (particularly those working independently) are cash-constrained and cannot afford the prescribed fees. Thus, they are unregistered and unlicensed. Some pit-sawing contractors are registered and sometimes take a license, but always exceed their allocated volumes. Second, the regulatory requirements are cumbersome and time consuming. Forest officers cannot administer them because of poor resourcing and the travel distances involved. When regulation is tightened in one channel agents react rapidly to reduce its impact by producing false documentation, "*playing around*" (as one dealer put it) to find the weakest link in enforcement, paying bribes, or switching channels so bigger volumes move down other channels. In general, those apprehended for illegal activity either do not know how to work the system or cannot afford the required bribe [see Monela and Solberg, 1998]. Unlicensed (and hence illegal) activity is widespread as is recognised by all those involved in the system, including forestry officials. Projects aimed at increasing revenue collection have had little success, collecting less than 10% of the estimated potential revenues [Danagro, 1997]. Thus, almost all hardwood is harvested illegally.

Figure 1 shows the hardwood system deduced from sub-sector analysis in diagrammatic or 'map' form. Overall, the diagram represents the variety of ways (social) agents extract, process, trade and distribute hardwood timber from source to use. Major activities or processes called 'functions' undertaken by agents are shown down the left of the diagram. Across the diagram are 'channels'⁴ which show the different ways agents organise production and distribution. The natural resource end (principally processing) is at the bottom of the diagram and its final sale into use (principally distribution) is at the top. Thus products flow from bottom to top. The boxes within channels represent agents - longer boxes represent more integrated agents who carry out more functions. Horizontal dashed lines within enterprises merely serve to separate functions. The vertical dashed lines show functions that are implicitly carried out by an integrated agent. The arrows between agents indicate the sale of timber. Dashed arrows represent forward contract sales, solid arrows indicate 'spot' sales. Thus, a channel in the diagram shows the number of agents involved in the transformation of the tree in the natural forest to final product delivered and retailed in town. The six channels drawn in Figure 1 are those which the evidence is most compelling. Arrows crossing between channels indicate 'switching' between channels and represent additional ways in which the wood could make its way to final use.

The main functions that agents at the resource end of the channels perform are pit-sawing (sawyers - working in pairs - identify, fell and saw the tree and sometimes carry the timber out of the forest), forest transport (transporters carry the timber out of the forest often using bicycles), pit-sawing contracting (contractors link pit-sawyers, forest transporters and the customers who buy the wood), and dealing (the buying and selling of timber). Sometimes villagers provide 'safe houses' where timber is stored to avoid detection before onward shipment. Pit-sawing contractors may also be dealers, or they may supply wood to dealers.

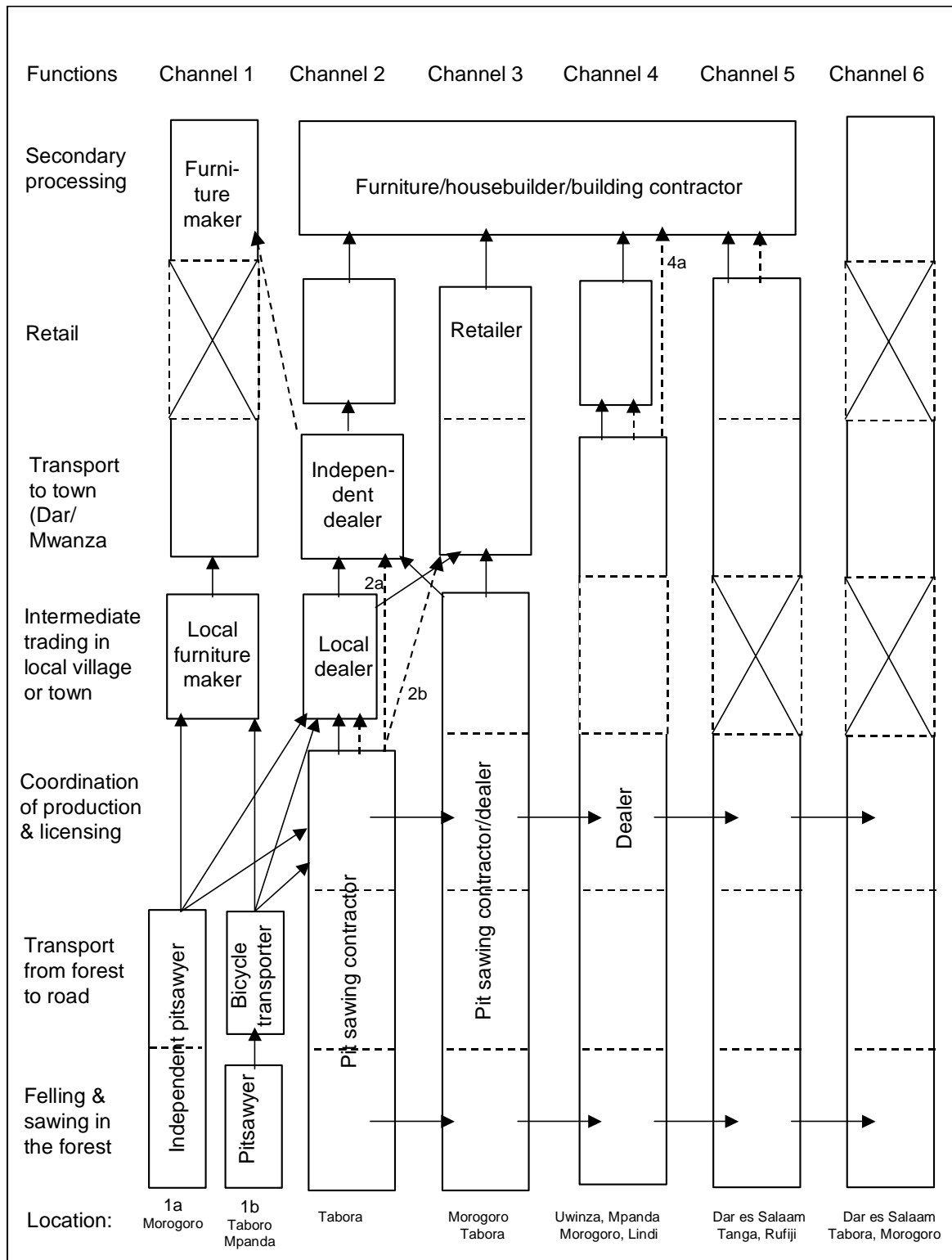


Figure 1: Sub-sector diagram for pit-sawn hardwood

Transport from the forest to urban areas is usually organised by the pit-sawing contractors or dealers as an outsourced function. The main participants at the distribution end of the channels are timber dealers, urban retailers, and secondary processors, principally furniture makers and builders. All these are usually based in urban areas.

The extent of integration of functions is the primary distinguishing feature of different channels. At one extreme each of the functions outlined above is done by one agent/business which then trades with the next business in the channel. Our research found that the value of each transaction in channel 1 (A and B) is small, and usually in cash, but the volume of trade using this channel is large. The other extreme is shown as channel 6 where all functions are within one business, i.e. the business is completely integrated. This would usually be an urban-based furniture maker or builder who uses the timber that he himself has cut from a forest area. Frequently used partially integrated channels (channels 2 and 3) involve a pit-sawing contractor hiring teams of pit-sawyers and labourers, providing them with saws and with food and medicines (which will be deducted from their wages) and sending them to the forest to cut timber. Most pit-sawing contractors cut timber to order (shown in channels 2a and 2b), and work on contract for known buyers (usually dealers from town) who advance cash. Pit-sawing contractors may also sometimes cut timber and sell on a 'spot' basis to dealers, in which case they finance the operation themselves. When pit-sawing contractors become involved there is a jump in the scale of production. Contractors usually organise a number of pit-sawyer pairs (average 6; reports of 200) and also arrange specialisation so that casual labourers perform ancillary tasks in support of pit-sawyers. In this way contractors mobilise resources to meet big orders.

In summary, many agents are involved in different functions within each of the production/distribution channels. Channels and their functions are spread geographically across country from widespread source areas to urban retail markets. There are multiple channels. The observed hardwood system reflects institutions that shape it in various ways; most obviously the low level of application of existing regulation (i.e. few fully registered and licensed businesses) allows informal activity (i.e. individually small scale production units, low capital, labour intense) to flourish. The sub-sector map provides qualitative evidence of a production system involving large amounts of labour. Labour is used across a wide range of skill levels from unskilled (e.g. unloading timber) to skilled (e.g. carving and shaping furniture) and across a range of types of labour (lumbering, pit-sawing, retailing, deal-brokering, etc.). The jobs span the rural, peri-urban and urban sectors and are more or less country-wide. Quantitative estimates for the pit-sawing part of the employment created can be deduced from information about pit-sawing productivity and the quantities of hardwood sold in the urban markets. Productivity of pit-sawyers sawing hardwood was found to be between 0.044 and 0.06 m³ per person per day with a maximum of 0.118 m³ per person per day. This corroborates findings by Kijoti and White (1981) who reported a figure of 0.047 m³ per person per day but is at variance with Monela and Solberg (1998) who report 0.01 m³ per person per day. Using our findings on productivity and the estimates for hardwood consumption in Dar es Salaam shown in Table 2 suggests that between 294,186 and 1,212,727 with an average of around 917,618 man-days of employment are created in pit-sawing alone. If ancillary pit-sawing workers (those digging pits, providing food, transporting planks out the forest) are added these figures probably double. These employment estimates are for the first (bottom) three functions only and exclude intermediate trading, transport into town and urban retailing. Thus, the hardwood system as configured in the late 1990s creates substantial off-farm, income-generating employment. With employment and income being recognised as central in poverty alleviation, the hardwood system should be seen as making a significant positive contribution to poverty alleviation.

THE SUPPLY-SIDE: SOFTWOOD

The main source of softwood in Tanzania are industrial plantations of pine and some cypress, most of which were established in the 1970s. The main plantation in the late 1990s was Sao Hill. Pine from this source, cypress from the northern plantations and pine from plantations near Mbeya and Njombe were found in Dar es Salaam in the late 1990s. Mwanza was previously supplied pine from Rubya plantation on Ukerewe island and now the bulk of its timber (pine) comes from Buhindi plantation 200 km to the west in Sengerema District.

Interviews with sawmillers, forest officers and forestry managers revealed poor management of plantations, i.e. lack of up to date information on resources, little pruning and thinning of trees, frequent forest fires, uneven age-class distribution of trees and limited replanting of trees. The result is that exploitation from the northern plantations has been unsustainable and many plantations have been exhausted. Some plantation

areas are now bare, others are under agriculture. Problems with unsustainable extraction in the northern plantations were exacerbated by aphid attack on monoculture cypress stands.

There has been a movement of sawmilling capacity from the northern plantations and Mbeya to Sao Hill and from Rubya plantation to Buhindi plantation. Older mills, unable to move or adapt, have closed. New entrants, mainly local businessmen with limited capital and using more flexible and simple technology such as mobile saws and pit-sawing have entered the market. Pitsawing softwood appears to be increasing. It was first reported in the 1980s and since 1994 it has been used for salvaging timber from fire-damaged stands in Sao Hill. A high proportion of the softwood that is used by the Dar es Salaam household market is pit-sawn. Pit-sawn softwood timber is also common in Mwanza.

The sub-sector analysis of pit-sawn softwood timber produces descriptions and explanations of the production system that are similar to pit-sawn hardwood and these are not presented here. The production system associated with machine-cut softwood is markedly different; its sub-sector map is shown as Figure 2. The greater simplicity of the map reflects the greater integration of the functions within the channels, different institutional arrangements and the absence of trading at any intermediate market. Four functions are identified: 'sawmilling' which includes logging, transporting the logs to the saw (if required) and sawing; 'transport' which refers to transport of the sawn timber to town for sale; 'retail' which is the distribution network in urban areas and finally, 'use' where a secondary processor, e.g. a carpenter, uses the timber.

Channel 1 describes a situation in which an agent acts as the link between producer and retailer and organises transport which is usually hired. Also found were cases from the northern plantations where sawmillers have sales representatives paid on a commission basis as a means of marketing their timber. In this case the agent is a true agent as he/she never takes ownership of the timber. Given this the agent never has to pay for the timber and hence does not require capital. This free-lance income-earning arrangement probably explains the growth in the number of agents in recent years. Channels 2 and 3 describe direct trading between the sawmill and retailer. Once established the ordering within these channels is often done over the telephone. Transport can be via retailers, sawmillers or hired transporter (channel 3a is used by large users of timber who buy at least a truck-load at a time). Channel 4 shows an integrated producer/retailer.

All four channels are used to get timber to Dar es Salaam. Timber sourced from Sao Hill uses channel 4 and 2 or 3 where producers are smaller. Channel 1 is common in trading from the northern plantations to Dar es Salaam as is channel 3a when the businesses involved are bigger. All sawmills interviewed in Rubya plantation had a retail outlet in Mwanza (i.e. channel 4). Some sawmillers also sold direct to large users (Channel 3a). Retailers use channel 1 or 2 when they buy from Bahindi plantation. Trading amongst retailers distributes timber round Mwanza town. The basic regulatory requirements of softwood extractors are the same as for hardwood: agents have to be registered and licensed with the license fee paid being proportional to the standing volume of trees extracted. In the northern 'Zofomo project' plantations (in Mt Meru, and west and north Kilimanjaro areas) additional fees are levied for road maintenance and silviculture. Other rules and regulations are the same as for hardwood.

A clearly demarcated and densely distributed tree resource make the collection of fees and harvesting of timber easier to control in plantations than in the natural forests. Even so, problems of management similar to those of the hardwood areas persist and cutting is generally unsustainable. Generally, the revenues collected typically amount to at most 45% of the revenue that should have been collected. Despite higher revenue collection, forest management and replanting in the softwood plantations is inadequate. Part of the problem is that the responsibility for replanting is split between central government, which keeps 70% of royalty revenues, and is supposed to provide funds for replanting and the regions which do the replanting. Forest officers in the regions point to the retention as a major cause of regional under-funding and some argue convincingly (e.g. in the Mwanza area in the late 1990s) that if they were able to retain a greater proportion of the fees replanting would occur and sustainability of extraction would improve. The additional fees levied in the Zofomo project are retained locally but seem not to have improved forest management in those plantations.

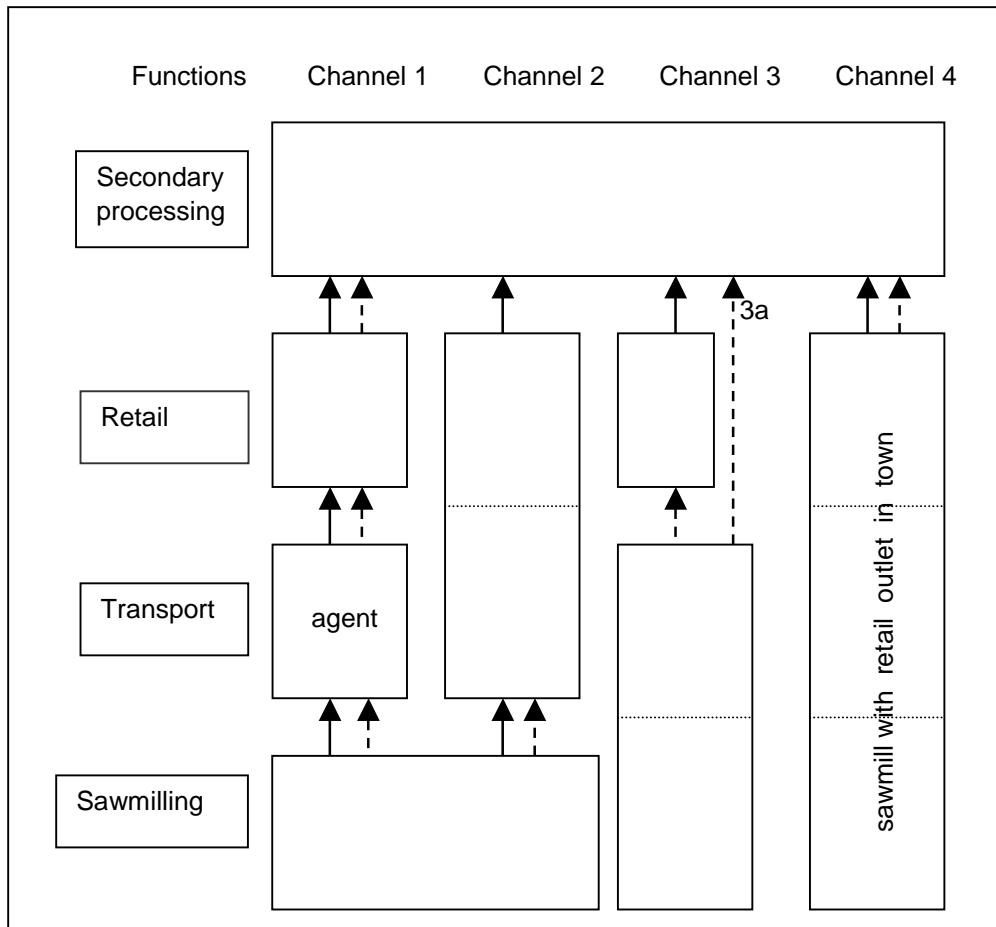


Figure 2: Sub-sector diagram for machine-sawn softwood

CONCLUSIONS

Wood remains a critical material in the construction of buildings in Tanzania. The range of uses of wood in temporary and permanent works expresses the versatility of the material and the economically sound desire to use domestically produced materials should ensure its continued importance as a construction material for the foreseeable future (assuming availability). With increasing household incomes and economic growth the demand for hardwood and softwood will increase with softwood taking most of the increase as hardwoods become more scarce and difficult to obtain over the longer run and their prices rise relative to softwood.

Hardwood

Forest regulation is poorly prepared to manage any increase in demand. Agents in the hardwood system will probably be able to organise to meet increases in demand over the short and medium term especially as the cost of transport decreases and the ease of access improves to the Kilwa/Lindi area with the opening of a new road link. This is supported by our interview evidence and analysis which shows that suppliers behave rationally in the short term and seek out the lowest cost sources and channels to urban markets.

We found evidence of communities in extraction areas having knowledge of the location of hardwood resources. In many areas of the world, communities contain implicit or indigenous knowledge that is built into institutions that provide the foundation for sustainable management of natural resources [see Ostrom, 1990]. As was reported earlier, our research did not find evidence of indigenous community management but it could be there. Perhaps some community members have knowledge about sustainable forest

management but issues of sustainability of extraction are over-ridden by the allure or necessity of immediate income associated with the commercial extraction of timber. Even if there is resource management by some communities (in local areas) we should not be surprised if overall, extraction of hardwood timber is unsustainable.

How to move towards sustainable extraction of hardwood needs consideration. Regulation by the state through the existing arrangements is ineffective. One reason for ineffectiveness is a lack of funding and investment in forest protection and personnel. Another is that the current system of regulation of timber extraction is best suited to a production system in which relatively few large capacity stationary sawmills are the backbone of production. Regulation of this type of system is relatively straightforward as production is easily traceable. However, the hardwood system currently operating in Tanzania is very different. The bulk of production is highly dispersed and monitoring is difficult in a regulatory system based on policing by professional foresters.

Given the shortage of funds it is unrealistic to expect an increase in the number of forest officers available to enforce regulation in the manner of old-style policing. Hence, an alternative system of regulation has to be developed. It has to acknowledge the dispersed nature of the resource, the views of local people and the lack of funds. These three requirements point to a solution involving some form of sharing the cost of regulation and management with communities resident in forest areas. Presumably communities would be willing to share the costs of regulation if they got benefits in return. In order to get the incentives right for communities the benefits would need to be related to the volume of regulated trade. Ideally (in incentive terms) communities would need to capture all the benefits of trade. In practical terms the latter would be achieved by the community being owner of the resource. Although the new Forest Policy and Forest Act makes provision management at the community level how this might work is unclear. Also, it remains unclear whether the sustainability of production of hardwood in Tanzania will be assured by the new system. For example unfettered ownership of forests by poverty stricken communities could result in rational decisions to exploit forests to extinction.

Any return (no matter how impractical given the above discussion) to an industrialised hardwood production system involving a few large capacity stationary sawmills should be fought with all possible vigour because of the devastating effect that this would have on employment. The multitude of small production units, although apparently chaotic, provides products that the bulk of the market want at prices they can afford while distributing income widely throughout rural, peri-urban and urban areas and across a wide variety of jobs. A more industrialised system might appear more organised and 'modern' but it will concentrate income in the hands of relatively few at specific locations.

Softwood

Extraction from all industrial plantations, with the exception of Sao Hill, has probably been unsustainable in the recent past. Even if the annual growth of the massive Sao Hill plantation is sufficient to compensate for over-cutting in all other plantations, common sense suggests that softwood production remains unsustainable for practical purposes. The goal should be to seek sustainability on, say, a regional scale so, for example, the area round Mwanza should be able to supply Mwanza's softwood needs on a sustainable basis.

By virtue of a dense and well defined plantation areas, regulation by policing by forest officers has, in the abstract, the potential for being effective and its real potential is demonstrated reasonably well by the experience of the relative success of softwood regulation. Increased autonomy, more devolved finance and accountability, and incentivised reward systems for regional forestry staff would increase their motivation and the performance of plantation management, particularly in replanting. It would seem that this would provide the foundation for sustainably produced softwood in Tanzania.

SUMMARY

Construction is a major user of wood resources and as such is a stakeholder in the forestry sector. In many developing countries in Africa forestry is in difficulty with wood resources being extracted in an unsustainable manner. The challenge to construction is to find ways in which it can usefully assist in setting wood production on a sustainable path. Construction can start by explaining its market demand and by being informed about the nature of timber production, its development benefits and by having pragmatic suggestions on how sustainability might be achieved.

ENDNOTES

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2. Similar but less detailed figures were produced for Mwanza but are omitted because of space constraints.
3. The production of pit-sawn timber involves cutting logs length-wise (usually into planks) by hand. A long, two-handled saw is worked vertically by two sawyers with one sawyer standing on the log which is lashed to a temporary platform and another standing beneath the log in a shallow pit dug into the earth underneath the platform.
4. Note that channels are defined by a particular arrangement of functions. Thus, one channel might occur at numerous different geographical places.

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