

Forestry and sustainable rural development in Delta State

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ABSTRACT

This paper presented a comprehensive case study of abundance, management, trade and consumption of wood in urban Ogwashi-Uku located in the Niger Delta region in Nigeria. This paper was written at a time when urbanization in Nigeria was thought to be causing an urban-rural crisis in which urban residents in Delta State relied on ever larger areas of rural woodland to supply their fuel needs, the author found that, contrary to expectation, deforestation did not decline with distance from town. Rather, traders harvested wood up to 450 km away, in uncontrolled areas. Closer to town farmers had clear tenure and rules governing tree use. Traditional authorities had dissolved but farmers had simply turned the top-down institution into a lateral one and retained the old principles of tree planting and protection. Indeed, offtake was stable and farmed areas supported stocks of wood double those of nearby reserves of natural woodland in Delta State.

The author went further to discuss the potential and constraints of a range of innovative incentive mechanisms for stimulating sustainable (natural) forest management and conservation in the Niger Delta Region.

WOOD FUEL IN DELTA, NIGERIA: THE URBAN-RURAL CONFLICT

The Delta Rural Energy Research Project was established to investigate the quantitative and organizational dimensions of wood fuel production, consumption and exchange, and the ecological implications of wood fuel resource management. This paper summarizes some of the

major and most interesting findings of the study. The area chosen for the study was the Delta region, in south western Nigeria, where a major urban metropolis is extending its firewood hinterland beyond the Delta Close-Settled Zone (where intensive agroforestry is practised) to woodlands at ever greater distances. The study investigated fuelwood consumption in urban Delta, the rural urban trade in firewood, the ecology of wood fuel, and the management of wood resources in the hinterland. The database for this study has been formed over a 20 year period, with household, commercial and traffic surveys carried out in the 1960s and again in the 1980s. This paper presents an account of the changes that have occurred in the wood fuel hinterland of Delta during the past two decades and in particular the demands of urban energy needs on rural areas.

THE RURAL-URBAN ENERGY CRISIS

The process of urbanization in the Third World involves very large numbers of people, many of whom retain rural habits in relation to energy use. This leads to the rural-urban energy crisis where large quantities of firewood are supplied from the rural areas. The energy alternatives for many of the urban population are restricted due to cost and inadequate infrastructure. Wood fuel is the main energy source in the urban areas of Delta and it is its supply which forms the focus of this paper.

According to the orthodox view (see Morgan, 1978; Moss and Morgan, 1981, 34-36), wood fuel is bulky and therefore transport costs form a large part of the total costs of production and marketing,

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limiting the distances from which it is brought to major urban markets to what its price will bear. Recalling von Thunen's classic theory of land use, Moss and Morgan propose a model of concentric zones to describe wood fuel hinterlands. Von Thunen, accepting the high costs of animal transport in early 19th century Europe, proposed that firewood should be produced close to the city market, assuming a homogeneous plain in an isolated economy. Where such conditions are approached, as perhaps at the town of Bara in the Sudan (Hammer, 1977, 1979), a model of concentric land use zones, in which firewood cutting moves outward through time, leaving a treeless tract behind, approximates reality. Such experiences have been elevated to the status of general law: 'There is the urban energy crisis. Treeless zones expand around cities that depend primarily on wood fuel, and fuel gets increasingly expensive' (Energy Research Group, 1986, 114). But its general applicability is questionable under modern conditions of transport and tenure. Wood fuel compared to other energy sources is still relatively inexpensive, although it incurs heavy transport costs in relation to its value. Urban growth may therefore be expected to intensify pressure on wood fuel resources in the peri-urban zone.

Between 1962 and the early 1980s the urban population of Delta increased from a quarter of a million to over a million, according to unofficial estimates. The increasing population has led a number of observers to predict the elimination of trees, in time, from the Delta Close-Settled Zone, the immediate hinterland of Metropolitan Delta. Indeed Eckholm et al. (1984, p 28) have stated that 'over the last 25 years commercial wood demands have led to severe deforestation and the collapse of a sustainable agricultural system... now farmland within a 40 km radius of the city (of Delta) has been largely stripped of trees'. These imaginings bear little relation to the well wooded reality of this area. Instead, the fuel hinterland of Delta has widened, taking advantage of improvements in the transport infrastructure, intensifying motor traffic and subsidized fuel costs.

The enlargement of the wood fuel hinterland of Delta, where distances of 300-450 km are

Commonplace for consignments of firewood, and wood carried as 'supercargo' on other vehicles may travel further, has opened up a vast area to the influence of its buoyant energy market. Few places in south western and eastern Nigeria are exempt from the woodcutter's axe, and administrative control, through licensing cutting and policing forest reserves is increasingly difficult. On the other hand, and contrary to expectations, wood fuel resources are managed under conditions of stable offtake in farmed parklands such as those of the Delta Close-Settled Zone.

The firewood hinterland of Delta is divided into two on the basis of the dominant forms of transport. First, is the local hinterland in which the dominant mode of transport was, until the 1970s, the donkey. This hinterland has historical continuity with the pre-colonial energy hinterland of Delta, and comprises the inner Close-Settled Zone. Beyond it is the distant hinterland, accessible only by motor transport, where farmers harvest wood from farmland, fallow or bush and sell the wood in small consignments along the roadside. This area is now heavily exploited by urban-based entrepreneurs who send trucks into the remote woodlands.

Surveys of traffic in wood fuel from the local hinterland, conducted in the 1960s and 1983, show that this traffic has declined dramatically during the last two decades. However, recorded imports from the distant hinterland have increased, with some consignments of wood coming from up to 600 km away. Large-scale operations are more profitable than small-scale wood transactions, and have attracted merchant capital to the distant hinterland. There has been a shift from the small-scale local supplier to the large-scale merchant supplier. This shift has also moved the geographical locus of the operation away from woodland close to the urban centre to distant areas of low population and extensive woodland.

The outward shift of Delta's wood fuel hinterland has both positive and negative implications. Positively, the stabilization of off take in the farmed parkland agro forestry system has removed any necessity for a zone of deforestation or desertification to follow urban growth. Negatively, pressure on natural woodland in the

distant hinterland is increasing without adequate conservationary safeguards.

THE URBAN FIREWOOD SUPPLY SYSTEM

To understand the deforestation problems of the rural area, it is necessary to understand the urban demand system for firewood. Urban firewood distribution is organized hierarchically. Most firewood arrives by truck at a central depot, before being split, bundled and distributed through a chain of local wood piles, smaller neighborhood piles and itinerant retailers. The organization and costs of local firewood pile operators and barrowmen show that the entire system falls into the urban informal sector. It is uncontrolled, but competitive and cost-efficient from the consumer's point of view, and effective in meeting the spatial and temporal distribution of demand.

A survey of households was carried out to assess the demand for firewood. The results of this survey indicated a mean monthly consumption of firewood of 332 kg; however, this figure disguises a wide variation between households of different economic and social status. Consumption of wood and demand also varies daily, weekly and between seasons. Significant intraseasonal variation is related to increased demand at special occasions and festivals. More wood is also used when kerosene or gas become scarce; the cost of gas and the long queues for kerosene force users to turn to the more readily available firewood.

Most urban firewood users buy firewood from retailers and a small number collect their own firewood. Purchases are made mostly within urban Delta, but a small proportion buy firewood outside. Users buy from the nearest woodpile retailer to them; from vendors using carts from door to door; or directly from central firewood depots. About a third of those who patronize vendors always do so, the rest occasionally, or when one happens to pass. Vendors are used because they provide a convenient source of firewood. However, price differences for firewood between the different suppliers also dictates the sale of firewood. The standard price of firewood in 1982-1983 was N 1.00 for a large bundle and about N 0.50 for a small

bundle. Lower prices were reported by some who bought in bulk or directly from rural producers.

Almost 90% of the respondents obtain their wood from within Metropolitan Delta. Only the educational institutions and a bakery send vehicles directly to buy wood from rural producers or middlemen. The wood supply market covers a mixture of sources which ensures that it cannot be controlled by a small group of distributors who can fix prices and profit from periods of scarcity.

The survey showed that recorded donkey traffic in wood fuel had fallen, by 1983, to 6% of its volume 14-18 years earlier: from 150 to a mere 8.5 tons/day during the peak flow season. However, other modes did not decline to the same extent. This with the increased use of motor cycles may perhaps be attributed to a scarcity of low cost rural transport resulting from the decimation of the donkey population during and after the Drought and oil spill of 1972-7. The shift to motor transport which occurred in the northern Nigerian countryside between the 1960s and the 1980s affected short distance as well as long distance traffic, and particularly relevant is the substitution of the motor 'pick-up' for the beast of burden. These vehicles now ply many rural tracks which were limited to walkers and cycles in the 1960s.

The wood fuel hinterland of Delta can be subdivided on organizational criteria into roadside and woodland sub sectors. The first consists of a linear market along the trunk highways, where passing motorists buy small consignments to carry as supercargo which may be delivered to urban consumers without passing through the urban distribution system. Wood is only one commodity dealt with along such highway interfaces between the urban and rural sectors, and may be prominent where a new road crosses well wooded and previously less accessible country. The woodland sub sector, on the other hand, is systematically exploited by entrepreneurs using trucks for large consignments, and the wood is delivered to urban distributors for splitting, bundling and resale. The distant hinterland is expanding as these commercial operators venture into less accessible areas. The profit margin available on large scale capitalized operations in the distant hinterland, compared with the smaller margins obtainable on

transactions involving one tree at a time in the Close-Settled zone, directs wood merchants away from the local hinterland. Their entry into the firewood trade of Delta has helped to transform its spatial pattern and the present price structure guarantees them a fast return on their investments.

THE FARMED PARKLAND OF THE DELTA CLOSE-SETTLED ZONE

The Delta Close-Settled Zone is a region of continuous farmland and dense rural population living both in dispersed farming compounds and in compact villages. The Zone has long been intimately related with the urban economy, though a distinction may be made between an inner zone, from which the city may be reached on foot in the course of a day, and an outer zone whose urban links depend mainly on motor transport. The further Delta region, beyond the Close-Settled Zone, where population densities are more variable and extensive areas of woodland may be found, is nevertheless dominated economically by Metropolitan Delta.

The second study area in the Outer Close-Settled Zone is less densely populated and less intensively cultivated, and contains a larger, though diminishing, proportion of fallow and shrubland, and also part of a protected forest reserve. On farmed parkland, evidence was found of a significant increase in tree density from 1972 to 1985. Timber volume on the farmed parkland areas is much higher than for the study area in the Inner Close-Settled Zone. Farmed parkland in the Outer Close-Settled Zone is the most productive management regime, and therefore the trend of conversion of shrubland into farmland is beneficial to wood production. The evidence for increasing tree densities on farmed parkland, even close to the urban area, during a period of recurrent drought stress, shows that the replanting and protection of farm trees is widespread and effective.

Much of the densely populated semi-arid zone is dominated by a 'farmed parkland' landscape. Cultivation is the dominant form of land use, and widely spaced trees of similar age and size are maintained by farmers for economic purposes. The Delta Close-Settled Zone is intensively cultivated

farmed parkland where soil fertility is maintained by the application of manure, and farm incomes are supplemented by the sale of a variety of tree products for medicinal, constructional and fuel purposes. Woody vegetation by virtue of the shade it casts, the nutrients contributed to the soil by leaves and fruits, and its effect as a windbreak, is an integral component of a traditional and essentially 'conservationist' farming system. In some areas, where soils are less fertile farmed parkland is replaced by shrub vegetation. Counts carried out on air photos dated 1972 and 1981, and ground surveys carried out in 1983-84, show that the density of trees on permanent farmland increased significantly (by 18%) during the survey period. The volume of timber, excluding the tree *Adansonia digitata* (which is not used for firewood), is 8.9 m³/ha, almost twice as large as volumes recorded in residual areas of shrubland. The species composition of farmed parkland is markedly diverse (39 species). In residual shrubland, by contrast, timber volume is low and the species few (5).

A survey of woodcutters was carried out in several villages in the inner Close-Settled Zone to map the supply of wood to both local and urban markets. Woodcutting is a part-time occupation adding significantly to the farming income of a minority of farmers. Wood is generally cut from other people's farms on payment of a fee. Fuel is obtained by cutting off branches or by felling whole trees; both living and dead trees are cut and felled. The price of wood appears to have some effect on whether branches or whole trees are cut, and whether trees with alternative uses are cut.

Owners of trees who wish to raise money by selling them for firewood evidently prefer to dispose of the trees or parts of them, to woodcutters rather than cut and sell the wood themselves. This is linked with the ownership of transport, for a woodcutter must either own an animal or vehicle to evacuate the wood. Although tree-cutting is a major source of income and employment for the farmers, tree-planting is also accepted as an important and integral part of the agro forestry system. Tree-cutters replant and protect seedlings which they obtain from forest department nurseries, or in other cases they protect volunteer seedlings by enclosing them in cages of cornstalks.

used as peripheral farm or shade trees, and villagers cite them to show how the range of trees available has increased. However, these trees are not substitutes for the important indigenous species and should be seen as complementary to these major species.

REAL OR PERCEIVED CRISIS?

The present study has shown that the model proposed by von Thunen is not applicable to the conditions in Delta. During the decade and a half separating the surveys of the 1960s from that of 1983, the shift from a local to a distant wood fuel hinterland, begun in 1965, was advanced much further. Since the local hinterland remains wooded, an explanation for the change is called for. Several factors have been at work. First, rising prices of firewood, together with subsidized petrol costs have made the increased distances acceptable to merchants. Second, resistance to woodcutting has stabilized offtake within the local hinterland. Such resistance can be explained in terms of the alternative use value of trees, local government restrictions on woodcutting, or a combination of both. It is remarkable in view of the severity of the Drought of 1972-74 in the Delta area and the need of many farms to cut and sell wood in order to survive. But even in such a crisis, owners of trees must weigh short-term benefits of cutting and selling against the long-term Value of a hedge against future contingencies - a perception of trees common in the Third World (Chambers and Leach, 1987). In such an integrated system of agro forestry, the value of trees for food, fodder, medicines, building materials, soil stabilization, fertilization and shade have to be considered. Third, the change of hinterland may represent a response to the species preference of the market.

The extent of price inflation, the construction and improvement of Federal and State highways crossing densely wooded and lightly populated areas of the country, the maintenance (until recently) of price subsidies on petroleum fuel, and the availability of merchant capital in the country have blown aside the constraint of distance as the only determinant of the spatial pattern of commercial firewood production. All these factors can be traced to the effects of the oil boom, which

came into its own in the 1970s, and therefore may not apply to the same extent in other countries. Nevertheless, trucks were supplying Delta from considerable distances as long ago as 1965. Since the tree stock in the local hinterland was then (and is now) as healthy as it had been more than a century before (Barth, 1857 Vol.2, 97-147), an explanation for the shift in hinterlands has to be found outside the special factors operating during Nigeria's oil boom.

This explanation is to be found in the 'producer resistance' put up by the agro forestry system of the Delta Close-Settled Zone. Under conditions of individual tenure, the alternative use value of the tree stock in the longer term, one of the corner stones of indigenous land use management, forbade its destruction in response to short term commercial opportunity even at times of drought and social distress. Tree-planting and felling on farms is highly regulated on an individual basis and has thus ensured that local and urban markets for firewood can be met without degradation of the wood stock.

No doubt this is not the whole story. The response of merchant capital has been critical. Delta's heavily capitalized road transport capability was a product of the groundnut boom, especially in the profitable 1960s when the overloaded railway system had to be supplemented by road. The same vehicles could as easily be used for carrying firewood, when returning empty from the coast, or during the slack seasons. It was well known that road transport brought a higher return than alternative opportunities. Innovative response to new markets had often in the past attracted Delta businessmen into buying rural commodities in bulk. Thus both the organization and the capital were prepared to move into firewood supply as soon as prices rose high enough to justify investment in its large scale production.

Notwithstanding these changes, a residual contribution to urban firewood supply must be expected to continue from the small sector, both in what we have called the local hinterland, and at greater distances. This is because of the importance of firewood production in many farm budgets, and the availability of surplus wood from farm trees and fallows. This output is transported by donkey, head loading or motor pick-up in small

In obtaining planting material, both formal (Federal, State or Local Government) extension forestry outlets, and informal information and plant exchange networks are used. Informal channels are credited with the first introduction of neem (about 25 years ago) and mahogany (about 15 years ago). Trees are planted, transplanted or simply protected as part of the everyday farming system maintenance. Tree planting needs to be put alongside the successful protection of volunteer seedlings of *Acacia albida* and other species to explain the successful maintenance of tree stocks in the inner Close-Settled Zone. The mix of species is the product of a balance between perceived needs and what the environment has to offer. Firewood needs represent only one of several demands made on farmed parkland trees, and the operators of the agroforestry system have to resolve conflict between such demands. Farmed parkland trees may be categorised as:

1. Main parkland trees which are intercropped with farm crops
2. Peripheral farm trees used as shade and boundary plants
3. Residential shade or fruit trees

Amongst the more commonly protected and planted trees is *Adansonia digitata* which is exploited exclusively for its non-fuel value; its bark is stripped; leaves picked and small branches cut. *Diospyros mespiliformis* and *Ziziphus mauritiana* are the only two species felled live, reported to be for utility wood, although the branches and twigs are used as fuel. Trees with lopped branches are most commonly *Acacia albida* and *Parkia biglobosa*.

There is a complex use of species for the varying wood product needs of the household. There are several different categories of biomass fuel used in the household: wood (ice) and its derivative charcoal (gawayi), and cornstalks (kara). These fuels are used for domestic cooking including the preparation of cooked food for sale and space heating. The main criteria used by the villagers for distinguishing between firewood categories are use and inherent properties.

Wood for the domestic cooking fire (wutar girki) is conceptually distinct from wood for the heating or log fire (wutar jindimi). The only

industrial activities with any significance for the consumption of biomass energy are blacksmithing and the production of wooden articles - stools, bowls etc. The whole system of tree-planting and protection has a long history of rules and traditions; there are formal rules governing the felling of trees (Barrot, 1972). These used to be effectively enforced at the district level by the District Head who used to encourage the villagers to preserve their tree heritage for posterity by replacement planting. It appears that the effectiveness of the system depended on the personality of the District Head as well as on the real authority he wielded; the most respected District Heads were the most successful at enforcing the rule.

Thus, until 1970 the Village Head's permission, or at least his knowledge, was required for the felling of farm trees anywhere in the village area; no fee was charged and no formal licence issued, but he was expected to ensure that a replacement seedling had been planted, or a volunteer identified as a replacement and put under effective protection from human or animal predators.

It is also evident that at present, although planting and protection are practiced widely, such activity is carried out neither in response to formal rules nor with any reference to the Village Head, who attributes this apparent collapse in the system to political changes. But as one respondent pointed out the system's undoing was its rigidity and its responsiveness to external, rather than local perceptions of environmental degradation: 'Sometimes, trees are felled to reduce shade on the farm - what sense is there in replacing such a tree with another one which will only produce more shade?'

As the foregoing demonstrates, the system has not been destroyed, but instead decentralized; it has not disappeared but merely transformed itself from a top-down structure into one organized laterally. Farmers may have stopped seeking the Village Head's permission to exploit their trees, but they have not lost interest in what happens to the Woodstock on their farms. However, a scarcity of indigenous species in the villages is forcing villagers to make do with the exotics produced by the nurseries. Trees such as neem and mahogany, which are regularly supplied by the nursery, are

consignments to local markets, the roadside or directly to Delta. In view of the productivity of tree stock on farmland, the conservationary practices of agro forestry, and the ecological risks of uncontrolled exploitation in woodlands by large-scale operators, such small-scale firewood production ought to be encouraged, provided that adequate safeguards continue to be observed.

In view of the visibility of farm trees around almost every old established settlement in Nigeria, and the well documented role played by the Delta Close-Settled Zone in meeting Delta's firewood needs (Trappes-Lomax, 1952; Mortimore & Wilson, 1965; Mortimore, 1972), it is extraordinary that the potential contribution of farmed parkland to commercial wood production is ignored or underrated in the forestry literature (but see Barrott, 1972). At best it tends to be relegated to meeting the needs of the local rural communities.

It is notable that the timber volume of farmed parkland may be more than double that of reserved natural woodland in the same locality. This also indicates that if scrubland and fallows are converted to farmed parkland, their wood productivity may be expected to increase by a large factor. These conclusions support an optimistic view of the potential contribution to urban, as well as rural, wood fuel needs that may be met from farmed parkland.

The indigenous firewood resource system of the Delta Close-Settled Zone supports the subsistence fuel needs of a dense rural population. This is achieved within the context of a rational and conservationary management regime, oriented to the objective of sustained yield.

A wood surplus is generated and marketed through a commercial sub sector whose operations are fully consistent with this objective. The firewood system operates within the overall framework of a high-intensity system of agro forestry in which multiple use objectives govern the planting, protection and management of individual trees. The diversity of species, and the high degree of substitution practiced amongst firewood's, guarantees the system's survival in the face of unexpected tree mortality or changes in consumer demand.

However, there are grounds for skepticism about the size of the contribution which the farmed parklands of the Close-Settled Zone may be expected to make to Metropolitan Delta's firewood needs, even if they are extended by the progressive conversion of fallows into permanent farmland in the less densely populated areas further from town. Between 1952 and 1983, the Inner Close-Settled Zone, or local hinterland, diminished in its contribution to urban firewood supply both relatively and absolutely (by 80%). Since this change does not appear to have been associated with any loss of trees, at least after 1972, it must be asked whereto the 'surplus' firewood was diverted. One answer to this question is that it was consumed by a growing rural population. The marketable surplus of wood may be expected to diminish with rising population density, given a constant rate of consumption. The labor intensification that permits the conversion of rotational woody fallows into a farmed parkland agro forestry system implies such an increase in the rural population and, therefore, in subsistence wood requirements.

To meet this projected demand, Moss and Morgan (1981, p155), on the basis of their data on annual wood increments, advocate the substitution of exotic for indigenous trees and their integration into agricultural systems in farm plantations and hedgerows. In the absence of incremental data for indigenous trees on farmed parkland, it is not possible to evaluate this proposal in terms of wood productivity. However, other factors should be considered: exotics are poor firewood trees and their propagation on farmland would do nothing to meet urban or rural demand for favored species. Exotics have few alternative uses and would occupy space and nutrients better given to multiple use indigenous trees. The exotic trees in this rainfall zone have no recorded beneficial effects on farm yields - such as *Acacia albida* has - and on the contrary, one of them, *Eucalyptus* spp., has a positively harmful effect on crops grown near it. Irrespective of the question of wood productivity therefore, the case for introducing exotics to the agro forestry system of the Delta Close-Settled Zone, as a response to the demand for wood fuel, is a weak one. Our conclusion is that this system should not be interfered with. Instead ways should be found of improving its productivity along traditional lines.

CONCLUSIONS

From this study it became apparent that several factors account for the preservation of trees in areas close to the urban centre. First, rising prices of firewood, together with subsidized petrol costs have made the increased distance acceptable to merchants. Second, resistance to woodcutting by the local farmers has stabilized offtake within the local hinterland. Such resistance can be explained in terms of the alternative use value of trees and local government restrictions on woodcutting. Third, consumer wood preferences, popular tree species are scarce in the local hinterland and thus demand has forced firewood cutters to move to distant areas where the species are available.

In view of the evidence of the importance given by woodcutters to sustained yield, it is out of place to diagnose an ecological crisis in the local wood fuel hinterland of Delta, even under present conditions of inflation and recurrent food shortages. The form of agro forestry practiced in this area is the most rational land use in the Delta Close-Settled Zone. However, in the distant hinterland an ecological crisis is in the making, unrestricted large-scale cutting of firewood will lead to massive environmental degradation. It is these areas that are in need of immediate management with restrictions imposed on wood cutting.

This long term study shows how urban demands for fuel wood have affected local resource management systems. The commonly accepted hypothesis of an urban firewood hinterland constrained by transport costs to a proximate and widening zone around urban centers, and subject to progressive deforestation, is inappropriate under northern Nigerian conditions. The burden of providing for urban demand has been effectively shifted from the Inner Close-Settled Zone to the further Delta region, but without deforestation of the near areas. The fuel hinterland of Delta has widened, with merchants taking advantage of improvements in the transport infrastructure, intensifying motor traffic and subsidized fuel costs. Farmers in areas close to the urban centre have retained and increased the tree cover on their farms with small scale production of wood fuel as a component of an intensive system of agro forestry.

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