

# Bare Knuckles: Fighting Deforestation In Sri Lanka

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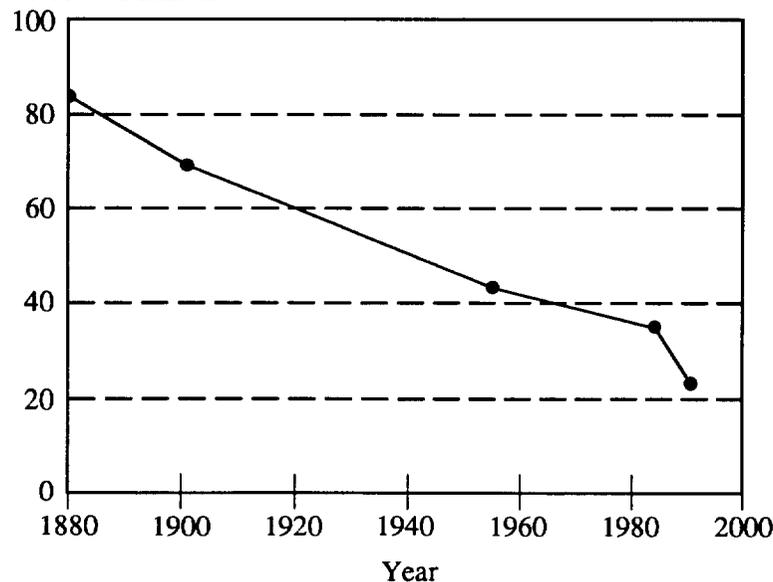
## Introduction

The Sri Lankan conservator of forests closed the report and let out a weary sigh.<sup>2</sup> Sri Lanka had been losing forest cover at a seemingly unstoppable rate for as long as he had been with the Forestry Department. Forests covered three-quarters of the country at the turn of the century; now, in the late 1980s, they covered less than one-quarter (Figure 1).<sup>3</sup> The country's rate of deforestation was the second highest in Asia, exceeded only by Nepal's.<sup>4</sup> The country's wet-zone forests, which originally covered the southwestern lowlands and central highlands, were disappearing especially rapidly. Forests covered scarcely a tenth of the wet zone in 1983 (Figure 2).<sup>5</sup> Those that remained were mainly small, increasingly isolated patches.

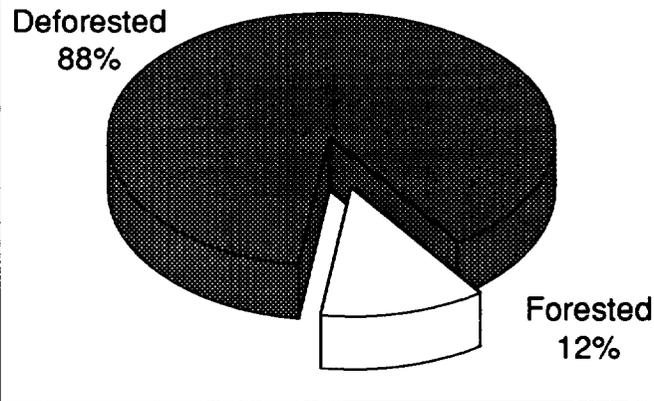
The country's rate of deforestation was the second highest in Asia.

**Figure 1**  
**Forest Cover in Sri Lanka**

Percent of land area



**Figure 2**  
**Wet-Zone Forest Cover, 1983**



The Knuckles Range in the central massif contained one of the few sizeable chunks of remaining wet-zone forest. The report, which was the outcome of a workshop to develop a conservation plan for Knuckles, contained the depressing news that agricultural encroachment was rapidly destroying forests at upper elevations. The scientists and environmentalists who prepared the report called on the department to take emergency measures. They recommended that the department declare all lands above the 3,500' contour a strict natural reserve, move the 1,000 families currently living in the proposed reserve to a buffer zone below the contour, and allow the encroached lands to regenerate to the montane forests that originally carpeted upper elevations in the Range.

The conservator caught a whiff of *deja vu*. Less than a decade earlier, in 1980, a group of wildlife biologists and local environmentalists had made a similar, but less drastic, proposal.<sup>6</sup> They had recommended that land above the 4,000' contour be declared a nature reserve, a less restrictive administrative unit than a strict natural reserve. The Department of Wildlife Conservation had accepted the proposal and duly surveyed the contour and marked it boldly on maps of the Knuckles Range. On the ground, however, both the Forestry Department's and the Wildlife Conservation Department's enforcement capabilities were thinly spread, a problem worsened by Knuckles' rugged terrain. Encroachment continued unabated.

Poor farmers had unhesitatingly crossed lines on maps before. Was moving the line to a lower elevation more likely to stop them? The conservator had the uneasy feeling that his department's two objectives — to protect the country's forests and to manage them for the welfare of Sri Lankans — were irreconcilable at Knuckles. Unlike the scientists and environmentalists, his official concerns encompassed not only plants and animals but people too. He was unwavering in his commitment to forest

protection, but even so he felt some sympathy for the peasant farmers who were simply trying to improve their families' lot in life. Could it be that the country was better off with some of Knuckles converted rather than all of it protected? Was it necessary to move the 5,000 people currently living in the proposed reserve, or was there some way to bring their desire for a better life into harmony with efforts to protect the remaining forest?

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## Roots of the Problem

The conservator had an inkling that history might provide clues to the answers to these and other questions that were troubling him. He opened his file cabinet and pulled out the folders containing reports on Knuckles prepared by his department and other government agencies during the last three decades.

The principal cause of forest encroachment was obvious enough: the high economic returns to cultivation of the perennial spice plant, cardamom (*Elettaria cardamomum*). Shifting cultivation and, more recently, potato farming occurred in Knuckles, but cardamom plantations affected the greatest area. Cardamom, known locally as the "Queen of the Spices," is native to Sri Lanka and other parts of the Indian subcontinent. Its cured (dried) fruit capsule is a distinctive ingredient in regional cooking. It also yields an aromatic oil used in drugs and perfumes. Sri Lanka produces about a tenth of world output.<sup>7</sup> It exports most of what it produces.

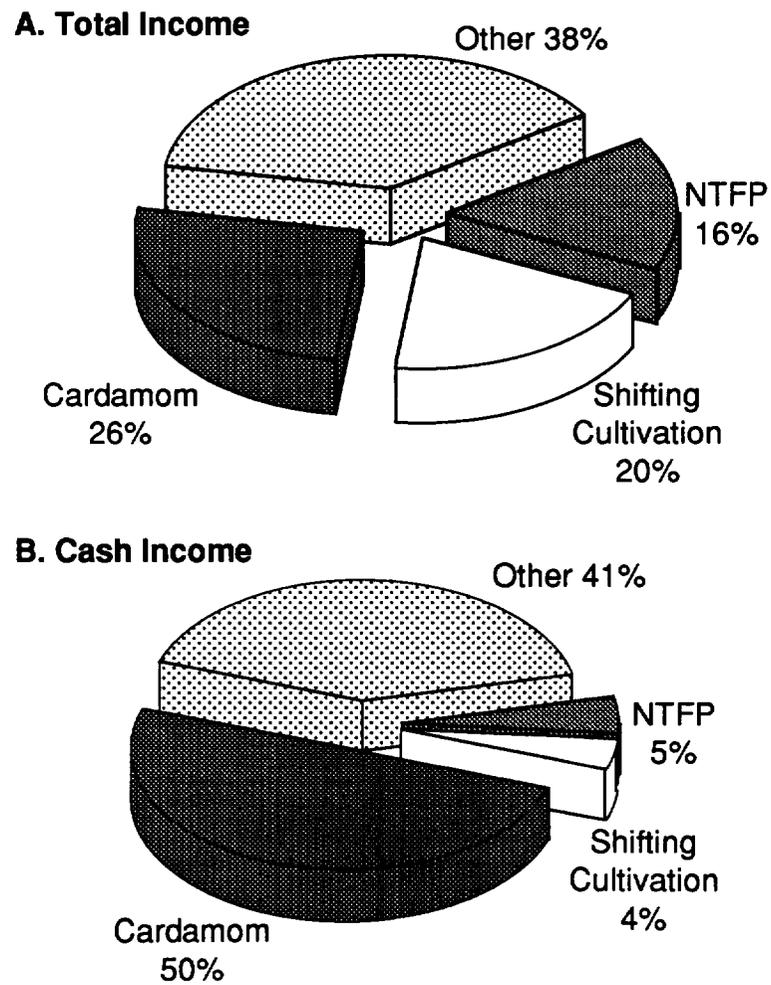
Cardamom is a bushy plant that reaches heights of about 2 meters. It grows only under shade, and it does best at cool and humid elevations. Although it grows naturally in Sri Lanka's forests, it has been cultivated for centuries. Farmers establish plantations by first removing about a quarter of the overstory of the natural forest,<sup>8</sup> to lessen the shade. Then they clear the understory and replace it with cardamom plants. They usually keep the forest floor clear of competing vegetation—"clean weeding"—to reduce competition for nutrients and to make it easier to harvest the capsules. Plantation yields depend on soils, climate, and quality of management. To maintain high yields, farmers must replant every 10 to 12 years.<sup>9</sup>

The submontane and montane forests at Knuckles offer ideal conditions for growing cardamom<sup>10</sup> and great, in the context of Sri Lanka, rewards to villagers who put in the hard work to establish plantations. The upper elevations where cardamom is grown are accessible only by walking several miles on narrow foot trails. Villages tend to be at lower elevations and consist of small clay or mud houses scattered among rice fields. There are 9 villages above the 3,500' contour and 39 below.<sup>11</sup> More than 30,000 people live either above the contour or within one mile below it.

The submontane and montane forests at Knuckles offer ideal conditions for growing cardamom.

The conservator came across a recent socioeconomic survey of three villages above the contour (Figure 3).<sup>12</sup> Two-thirds of the households grew cardamom. The total income of these households, including subsistence food production valued at market prices, was only two-thirds the national average, but it was 50 percent larger than the income of households that didn't grow cardamom. Their cash income was more than twice as high as that of households not growing cardamom. On a per-hectare basis, cardamom generated more than 10 times as much (total) income as non-timber forest products (NTFP) collected from the forest, and two-and-a-half times as much as shifting cultivation. The lucrativeness of cardamom explains why one farmer was "prepared to climb three big mountains and walk 10 miles one way into the forest per visit to his land."<sup>13</sup>

**Figure 3**  
**Sources of Household Income in Knuckles, 1992**



The conservator wondered whether it was fair to label these villagers "encroachers." Nearly a quarter of the encroached area in 1987 had been cultivated for more than 100 years, with another tenth having been cultivated for more than 50 years.<sup>14</sup> In pre-colonial Sri Lanka, the king had sole power to decide who should get land, how much, and for what purposes. There was no land titling system. The British introduced the Crown Land Ordinance of 1840 and the Waste Land Ordinance of 1897, which claimed for the government all untitled land. These ordinances made the government the largest landowner in the country and made most people officially landless.<sup>15</sup>

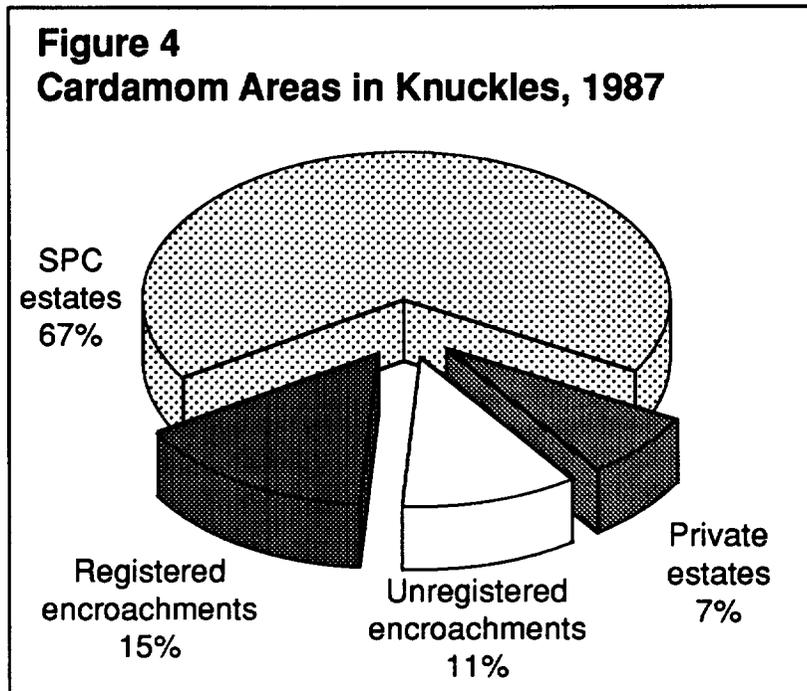
All land in Knuckles became either reserved forests or other state forests.<sup>16</sup> The government occasionally formalized encroached lands by granting temporary or permanent titles, but this process was extremely slow and cumbersome. It affected only a small part of the encroached land.

Although small-scale cardamom cultivation in Knuckles dates back more than 100 years, the big expansion in cultivated area began in the 1960s.<sup>17</sup> Then, as now, Sri Lanka was primarily a rural society. Only 20 percent of Sri Lankans lived in urban areas in 1965; by 1990, the figure had risen to only 21 percent.<sup>18</sup> Primary commodities, mainly agricultural products, accounted for 99 percent of the country's exports in 1965.<sup>19</sup> The government wanted to diversify agricultural exports away from the traditional mainstay, tea. Strong markets for spices convinced the government that spices, including cardamom, could provide more export earnings and contribute to alleviating the country's chronic current account deficit. The government instructed the Forestry Department to lease out land in Knuckles for cardamom cultivation.<sup>20</sup>

The government began promoting spice crops more aggressively in 1972, when it established the Department of Minor Export Crops (MEC). This department offered farmers incentives to grow a variety of exportable crops, including cardamom. The incentives included free planting materials, fertilizer subsidies, tax exemptions, and extension services.<sup>21</sup> The demand for land rose, and the government instructed the department to lease out additional areas of forest reserves. By 1987, half of the cardamom plantations in the country were in Knuckles.<sup>22</sup>

Encroachers were popularly viewed as the chief cause of forest conversion, but the conservator knew that this was misleading. Most current conversion was indeed caused by encroachment, but this was a relatively recent phenomenon. Two-thirds of the cardamom plantations in Knuckles in 1987 were operated by the State Plantation Corporation (SPC; Figure 4).<sup>23</sup> This was a public enterprise that administered private estates nationalized by Sri Lanka's pre-1977 government, as well as additional lands it developed.

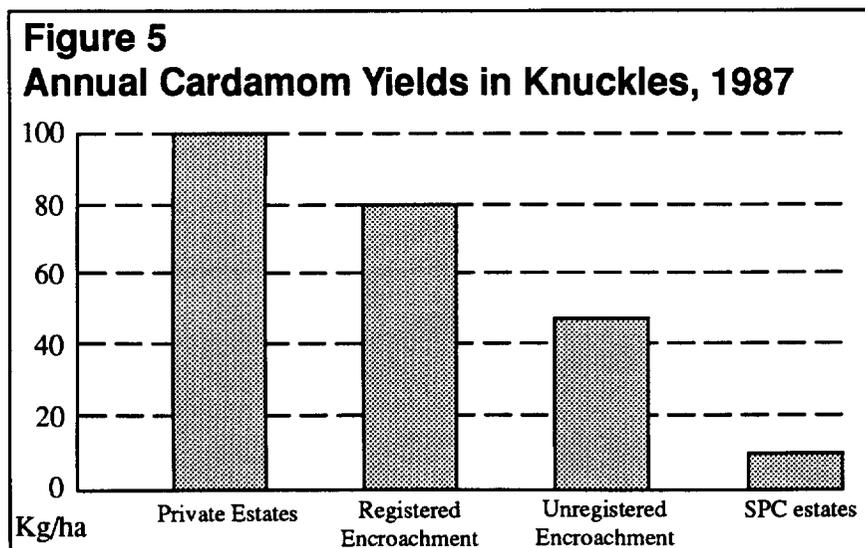
Encroachers possessed neither land title nor a Forestry Department license and therefore did not qualify for the Department of MEC's incentives. Nevertheless, in 1987 encroached lands represented a quarter of the cardamom plantations in Knuckles.<sup>24</sup> This, coupled with the fact that cardamom was first grown in Knuckles decades before the incentives were offered, made the



conservator wonder whether the government had not gone overboard in promoting cardamom. As long as they had land, did farmers need so many incentives to grow the crop?

Furthermore, the conservator was shocked to learn at the workshop that cardamom yields on SPC estates were only 11 kg/ha, a tenth the level on private estates (100 kg/ha; Figure 5).<sup>25</sup> Even more surprising, yields on SPC estates were lower than on encroached lands, which ranged from 50 to 80 kg/ha. Farmers without access to the government's generous incentives were more productive than the government estates, which had virtually unlimited access to the incentives!

Farmers without access to the government's incentives were more productive than the government estates.



A relationship between yields and land tenure appeared obvious: private estates, which enjoyed the most secure tenure, had the highest yields; "registered" encroachments, which lacked land title but were at least grudgingly (if somewhat precariously) recognized by the government, had the second highest yields; unregistered encroachments, which had not even a blush of legitimacy as far as the government was concerned, had the third highest yields; and SPC estates, which were publicly owned and operated, had the lowest yields. Might the differences have something to do with exposure to market forces and incentives to maintain plantations at high productivity?

Using the 1987 yields of 11kg/ha for SPC estates and 50 kg/ha for unregistered encroachments, the conservator calculated that if the 1,845 ha of SPC estates had never been developed, the country could still have produced their output of 20,295 kg of cardamom simply by allowing 406 ha of forest to be taken over by unregistered encroachers. This would have left a balance of 1,439 ha of undisturbed forest. The conservator noted that this was more than twice as large as the actual area encroached as of 1987. State-sponsored cardamom cultivation had not only converted more forest, but it had generated relatively less cardamom output in return.

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## Benefits of Protecting Knuckles, I: Biological Diversity

**I**t was fine to speculate about things the government might have done differently, but the facts of the matter were that substantial forest conversion had occurred at Knuckles, and that encroachment was continuing. There were recent reports that encroachment was now spreading above the 5,000' contour.<sup>26</sup> The report on his desk recommended halting further conversion above the 3,500' contour and relocating the farmers already there. Was uprooting thousands of people justified? The conservator took a sheet of paper and drew a line down the middle. He wrote "Benefits of protecting Knuckles" at the top of the left half, and "Costs of protecting Knuckles" on the right. He pondered the left column.

The scientists at the workshop had provided an ecological justification for establishing a fully protected area above the 3,500' contour. They explained how three aspects of cardamom cultivation have negative impacts on the forest's habitat and watershed values. First, the opening of the canopy and the clearing of the understory simplify the forest's structure, reducing the number of species<sup>27</sup> and reducing the forest's ability to protect watersheds. Rainfall hits the ground with greater erosivity, and there is less ground cover and natural debris to prevent soil erosion and to slow the rate of runoff after heavy monsoon rains.

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Second, predation of cardamom plants and fruits by wildlife leads farmers to hunt and kill wild pigs, sambhur deer, and leaf monkeys.<sup>28</sup> This depletes wildlife populations.

Third, the curing of the capsule requires the construction of wooden barns and the collection of fuelwood. Fuelwood collection leads to additional canopy opening and, if the rate of collection exceeds the rate of woody growth, additional deforestation. Fuelwood collection had led to "heavy depletion of the montane forest" in certain locales.<sup>29</sup> Cardamom production therefore affects a larger area of forest than just the area cultivated.

The Knuckles Range probably contains a more diverse set of forest types than any like-sized area elsewhere in Sri Lanka. Impressive rain forests in the lowlands contrast with pygmy forests on the peaks. Scientists at the workshop highlighted the fact that, hectare for hectare, Sri Lanka is the most biologically diverse country in Asia. Both its flora and its fauna are unique. A quarter of its flowering plants and a fifth of its ferns, and half of its reptiles and amphibians, are found nowhere else in the world (Table 1).<sup>30</sup> Most of the diversity is found in the wet-zone forests. Botanists and zoologists still do not have very good estimates of the number of species in Knuckles, but they expect that the forests contain many species waiting to be discovered<sup>31</sup> — if forest conversion does not cause them to go extinct first.

The conservator had heard about Knuckles' ecological richness many times before, but he also remembered attending a meeting between the former conservator and the Director of the Department of MEC.<sup>32</sup> The director literally laughed when the conservator suggested that the Department of MEC should curtail promotion of cardamom cultivation in Knuckles because it was endangering unique species. "How many rupees do wildlife contribute to our export earnings?" the director asked. "They fill hungry stomachs only if they're shot and eaten." The former conservator could not marshal a convincing argument against the director's simple economic logic. The present conservator had no desire to put himself in a similarly humiliating position.

Some scientists at the workshop, quoting a report which stated that global expenditure on nature-based tourism was growing at 20 percent per year,<sup>33</sup> had suggested that the biological diversity at Knuckles could provide a lure for international tourists and generate the hard-currency returns that his counterpart in the Department of MEC bragged about. Yet, the conservator found in the file a preliminary draft of a consultant's report on nature-based tourism in Sri Lanka, which did not include Knuckles in the list of sites with primary or secondary potential for ecotourism.<sup>34</sup> Access was difficult, and the attractions — mainly a pleasant climate and jungle walks — were subtle. Elephants, a sure-fire tourist draw, migrate to intermediate elevations at Knuckles during the dry season, but they do not climb above 3,500'.<sup>35</sup> Knuckles might have value as a tourist destination in the future, but when, and how great would that value be?

As measured by the number of Sri Lankans visiting the department's recreational forests, local interest in nature-based tourism was limited. The conservator, however, had noticed in the department's *Annual Reports* that the number was increasing steadily. Most of the visitors seemed to be well-educated, relatively young members of the urban middle class. Was not the number of such visitors sure to increase in the future, with population growth, urbanization (albeit at a slow pace), and rising incomes? Local use of natural areas, perhaps including Knuckles, might not generate foreign exchange, but did it not contribute to Sri Lankans' quality of life, and was that not important?

Some researchers from the University of Peradeniya had calculated that the value of the recreational experience enjoyed by local visitors to the Peradeniya Botanic Gardens was such that the visitors would be willing to pay, in the aggregate, about 10 million rupees a year for the right to visit the park.<sup>36</sup> (29 rupees = 1 US dollar in 1987.) Actual revenue collected from

Local use of natural areas might not generate foreign exchange, but did it not contribute to Sri Lankans' quality of life?

**Table 1**  
**Biological Diversity in Sri Lanka**

**Type of organism    # Species    % Endemic**

**I. Plants**

Algae	896	na
Fungi	1,920	na
Lichens	110	35
Mosses	575	na
Liverworts	190	na
Ferns	314	18
Gymnosperms	1	0
Angiosperms	3,100	27

**II. Animals**

Land snails	266	na
Spiders	400	na
Mosquitoes	131	13
Blister beetles	15	20
Fish	59	27
Amphibians	37	51
Reptiles	139	50
Birds (resident)	237	8
Mammals	86	14

entrance fees, which were set at a nominal level, was a fraction of this amount. Granted, the Peradeniya Botanic Gardens are right next to the major city of Kandy and make for an easier visit than hiking in Knuckles. Nevertheless, did not this research imply that the revenue generated by recreation can understate the value of recreation?

Other scientists referred to biodiversity's genetic resource values. Crop improvement specialists had identified over 2,800 wild varieties of rice in the country. Some varieties found at upper elevations showed a tolerance of low temperatures and other characteristics that might be useful if introduced to cultivated varieties grown in not only Sri Lanka but other countries as well.<sup>37</sup> Scientists also noted that Sri Lanka has over 500 local varieties and 10 wild species of pepper,<sup>38</sup> which again might provide useful raw material for breeders.

Knuckles' biodiversity seemed to have potential value as a source of improved crop plants, but, as in the case of ecotourism, the magnitude of this value was uncertain. Moreover, if the improved varieties were planted mainly outside of Sri Lanka, what benefit would the country reap from the use of its genetic resources? Who knows, maybe improved crops planted elsewhere would undermine some existing agricultural sector in Sri Lanka, just as the planting of rubber trees in Southeast Asia had undermined the natural rubber industry in Brazil. The Director of the Department of MEC wouldn't miss this point.

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## Benefits of Protecting Knuckles, II: Watershed Protection

The 3,500' contour was the approximate dividing line between submontane and montane forests in Knuckles.<sup>39</sup> The latter were particularly important for watershed protection. Lands above the contour were generally steeper and therefore more prone to soil erosion. Some ecologists also speculated that the loss of montane forests decreased overall water yields. Unlike forests at lower elevations, montane forests collect a significant amount of moisture from clouds. If the area of montane forest and the density of its canopy are reduced, there are fewer leaves and twigs to rake the passing clouds.

To the conservator, the importance of watershed protection in Knuckles was becoming increasingly obvious. Knuckles and other ranges in the central massif are largely responsible for the division of Sri Lanka into wet and dry zones.<sup>40</sup> The dry zone covers more than three-fourths of the country. During the southwestern monsoon (May-August), the plains east of the massif are in a rain shadow and therefore receive little precipitation. Rain does fall on the eastern slopes during the northeastern monsoon (October-

Water supplies in the dry zone depend critically on water originating in Knuckles and other ranges.

January), but the slopes are steep, and the rain runs off quickly rather than being gradually released during the succeeding dry months. Many rivers in the dry zone, including the largest river in Sri Lanka, the Mahaweli Ganga (= river in Sinhalese), have their headwaters in the central massif. Water supplies in the dry zone therefore depend critically on water originating in Knuckles and other ranges.

Soils in the dry zone are relatively fertile, but in the absence of irrigation the low rainfall depresses crop yields. Consequently, farmers in the dry zone have historically been particularly impoverished.<sup>41</sup> To overcome the water constraint and to help alleviate rural poverty, in the early 1970s the government initiated the Mahaweli Development Project. This project involved land development, a system of reservoirs on the Mahaweli Ganga to provide better control over water supplies, and a system of irrigation canals to deliver the water to farmers. It was planned to be implemented over a 30-year period.

The urgency of the rural poverty problem, coupled with the country's rising food consumption and the government's desire for food self-sufficiency, led the government to reformulate the project in 1977 as the Accelerated Mahaweli Development Project. The accelerated project was completed in 1988 at a cost of more than 8 billion rupees. It provides irrigation water to more than 120,000 ha of newly developed agricultural land and 35,000 ha of existing land.<sup>42</sup> More than one million people, most of whom were resettled from other areas, earn their living on these lands. They grow paddy in the wet season and maize, green gram (a legume), chilies, onions, okra, eggplants, and other crops in the dry season.

The project includes about one-fifth of the paddy land in the country.<sup>43</sup> Four of the five major reservoirs constructed under the project are outfitted with hydroelectric power plants. These plants provide one-third of the country's electricity and account for half of its installed hydroelectric power-generating capacity.

Knuckles is one of four major forested areas in the upper Mahaweli watershed (Map 1, p.19). Tributaries originating in Knuckles feed the Mahaweli at various points. Participants at the workshop presented substantial anecdotal evidence that conversion of Knuckles' submontane and montane forests was degrading the watershed and creating downstream problems. In only 13 years, 43 percent of the capacity of the Polgolla reservoir, one of the first reservoirs constructed under the Mahaweli project, had been silted up.<sup>44</sup> Similar problems were already evident in the more recently completed Victoria, Randenigala, and Kotmale reservoirs.<sup>45</sup> Decreased reservoir capacity reduced the storage capacity for irrigation water and reduced the lifetime of hydroelectric facilities. The Mahaweli project was expected to enable farmers to grow paddy in the dry season, but in practice not enough water was available.

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The effect would be to eliminate disproportionately the more efficient producers in the industry.

## Costs of Protecting Knuckles

The conservator had now filled the left column with qualitative descriptions of forest-related values at Knuckles. Thanks to the workshop report, he was able to put some hard numbers in the right column.

The report included an analysis of the impacts of the proposed reserve on the cardamom industry (Table 2). Slightly more than half the cardamom plantations in Knuckles — 1,415 ha — were above the 3,500' contour. At 1987 cardamom prices and plantation yields, the country stood to lose about 10 million rupees worth of cardamom exports if it shut down these plantations. He could imagine the Director of the Department of MEC indignantly pointing out that this was one-sixth of the country's export earnings from cardamom. He also reminded himself that cardamom cultivation had enabled local villagers to increase their household incomes substantially.

Looking more carefully at the figures, the conservator noticed that while the ban would affect only two-fifths of the SPC estates, it would result in the closure of half the private estates, three-fourths of the registered encroachments, and nine-tenths of the unregistered encroachments. Since non-SPC landholdings were five to ten times as productive as the SPC estates, the effect would be to eliminate disproportionately the more efficient producers in the industry. The conservator calculated that the average yield across all landholdings would fall from 32 kg/ha to 24 kg/ha. Agricultural economics was not his field, but this didn't seem to be a smart way to develop the country's cardamom industry.

Was there any way to reforest 1,415 ha without reducing the industry's average yield? SPC estates had the lowest yields. What if the 1,415 ha to be reforested were drawn entirely from the SPC estates? There were only 745 ha of SPC estates above the 3,500' contour, so another 670 ha would have to be drawn from below the contour. He calculated that if this were done, average industry yields would rise to 54 kg/ha, and the loss in export earnings would be less than 3 million rupees. The workshop report emphasized reforesting lands above the 3,500' contour, but was it worth losing 7 million additional rupees of cardamom exports to reforest 670 ha above the contour instead of below?

He got more excited as he made additional calculations. If the government allowed unregistered encroachers to take over the remaining 430 ha of SPC plantations below the 3,500' contour, and the encroachers boosted yields from 11 kg/ha to 50 kg/ha, there would be essentially no change in export earnings. The SPC and its 500-plus laborers<sup>46</sup> wouldn't like this, but then who thought the 5,000 villagers living above the contour would be happy being displaced? If the government went a step further and registered these lands, and if in response the yields jumped to 80 kg/ha, export earnings would actually rise. They would rise even more if the lands were privatized and yields jumped to 100 kg/ha. Maybe it was not necessary to trade-off cardamom production against forest protection! Maybe all that was necessary was to change the ownership status of existing lands.

**Table 2**  
**Impacts of Forest Protection on Cardamom Production in Knuckles**  
**(1987 prices)**

	SPC Estates	Registered Encroachment	Unregistered Encroachment	Private Estates
<b>I. Plantation areas (ha)</b>				
A. > 3,500'	745	300	270	100
B. 2,500'-3,500'	1,100	100	30	100
C. Total	1,845	400	300	200
<b>II. Cardamom output (kg)<sup>a</sup></b>				
A. > 3,500'	8,173	24,000	13,500	10,000
B. 2,500'-3,500'	12,067	8,000	1,500	10,000
C. Total	20,240	32,000	15,000	20,000
<b>III. Export earnings (1000 rupees)<sup>b</sup></b>				
A. > 3,500'	1,471	4,320	2,430	1,800
B. 2,500'-3,500'	2,172	1,440	270	1,800
C. Total	3,643	5,760	2,700	3,600

a. Assumes yields given in Figure 5.

b. Assumes cardamom price of 180 rupees/kg.  
 29 rupees = 1 US dollar in 1987.

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## How Much Forest to Protect, and How?

With a sinking feeling, the conservator realized two problems with his forest-restoration *cum* land-reallocation scheme. The first had to do with scale. There happened to be 1,845 ha of cardamom plantations above the 3,500' contour. How did he know that 1,845 ha was the ideal amount of encroached land to reforest, and how could he determine whether all the reforested area should be above the 3,500' contour, as the report recommended, or only part of it, as he had allowed in his calculations? He could easily work out the cost of any protection scheme in terms of forgone cardamom earnings. Could he somehow compare this cost to the uncertain benefits of biodiversity and watershed protection and thereby determine how much forest the department should protect?

The second problem had to do with implementation. On paper, he could devise schemes that minimized the loss of cardamom earnings for any given area of forest to be restored. But how could he ensure that the schemes would be implemented on the ground? For example, if the SPC gave up 1,415 ha of its land for reforestation, what would prevent unregistered encroachers from moving onto the land as soon as the SPC pulled out? If private owners and encroachers currently above the contour moved below the contour to take over 670 ha of SPC land, what would prevent a new batch of encroachers from moving onto the land they abandoned? Short of force, how could the department prevent encroachment? Wouldn't villagers continue invading forests to cultivate cardamom as long as it offered more income than other activities?

The workshop report recognized that farmers would be unwilling to relocate unless they were offered a livelihood at least as rewarding as growing cardamom: "it will be almost impossible to 'uproot' these cardamom growers and create a forest reserve unless equal or perhaps better alternatives are offered."<sup>47</sup> The report suggested that the department establish plantations of quick-growing timber species on overgrown tea land and other scrub land in a buffer zone below the 3,500' contour, and allow the resettled villagers to underplant with cardamom and other shade-tolerant crops. This agroforestry scheme sounded promising, but it was unproven and would require substantial investment. Finding the funds would be difficult: the government's budget deficit relative to the country's GDP was the fifth highest in the developing world.<sup>48</sup>

The conservator rued the fact that the country's economy hadn't industrialized more rapidly. If it had, perhaps villagers would have been drawn into cities and towns rather than being forced into the forest.

The conservator recalled a concept from the compulsory economics course he had reluctantly taken during his forestry graduate program. The reduced wildlife populations and silted-up reservoirs and irrigation canals were on-site and off-site *externalities* of cardamom cultivation. From the

point of view of people who benefited from biodiversity and watershed protection, cardamom growers didn't pay for the costs they imposed on others. From the point of view of the growers, they had no incentive to protect biodiversity or watersheds, because they received no financial reward if they did.

The way to deal with externalities, he recalled his professor saying, was to induce the party damaging the environment to *internalize* them. This was a glib statement; what did it mean in practice? What kind of policy would cause cardamom growers, whose thirst for a better life was unquenchable, to cultivate no more than the amount of land that provided the ideal balance between cultivation and protection?

The conservator sighed even more deeply than he had after finishing the report. He seemed to have come up with only more questions, and they seemed more difficult to answer. Who could help answer them?

What kind of policy would cause cardamom growers to cultivate no more land than the amount that provided the ideal balance between cultivation and protection?

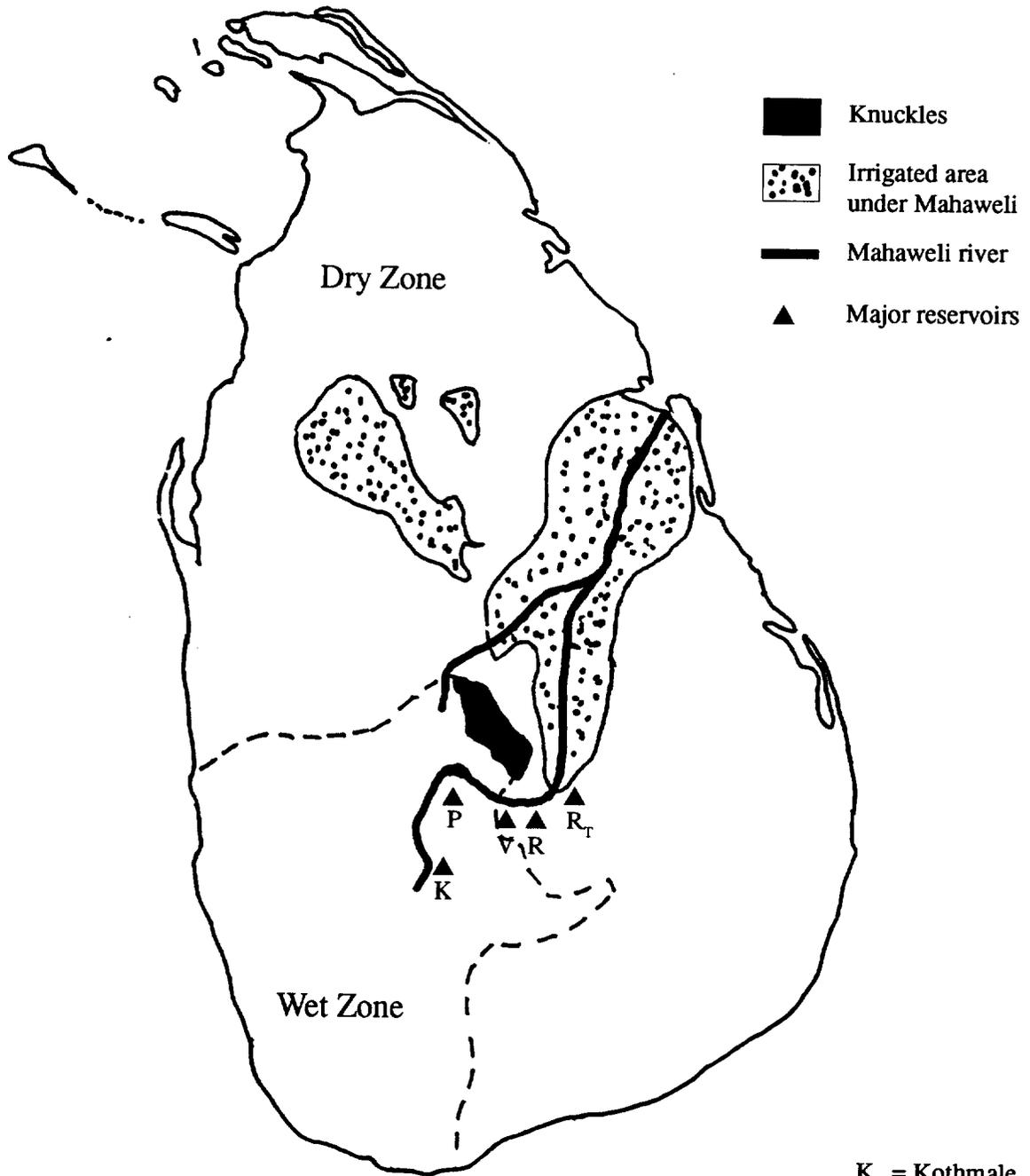
## Endnotes

- 1 Department of Agricultural Economics and Extension, University of Peradeniya, Sri Lanka, and Harvard Institute for International Development, respectively.
- 2 "The conservator" is used as a rhetorical device in this case. The actual conservator was not interviewed by the authors. Thoughts attributed to the conservator in this case are purely fictional.
- 3 NARESA (Natural Resources, Energy, and Science Authority of Sri Lanka), *Natural Resources of Sri Lanka: Conditions and Trends* (1991).
- 4 World Resources Institute, *World Resources 1992-93* (New York: Oxford University Press, 1992).
- 5 NARESA, *op. cit.*
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# Map 1



- K = Kothmale
- V = Victoria
- R = Randonigala
- R<sub>T</sub> = Rantambe
- P = Polgolla

A map of the location of the Knuckles range of forest and irrigated area under the accelerated Mahaweli Development Project.